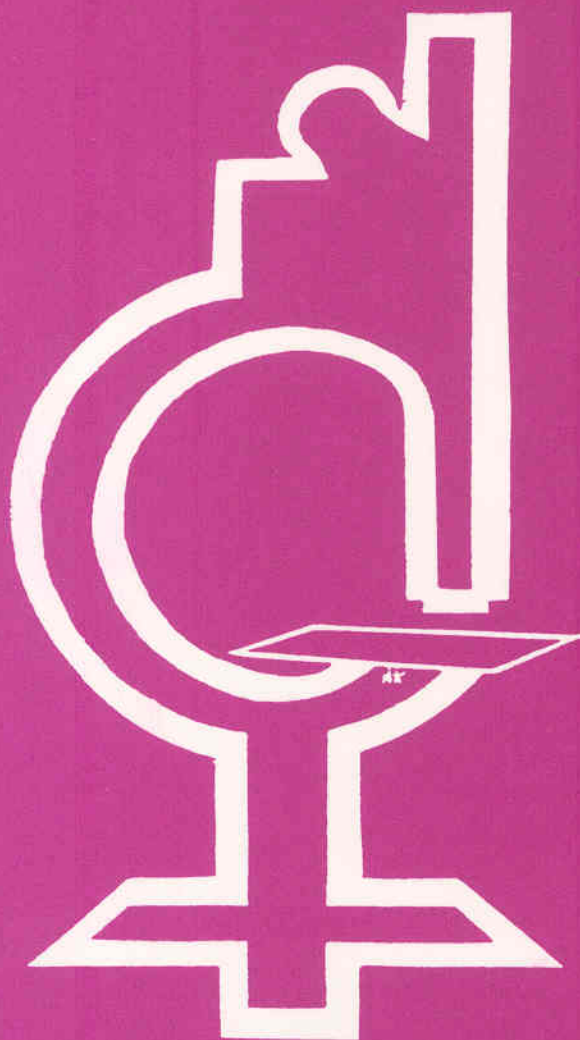


WOMEN IN SCIENCE AND TECHNOLOGY

A Selected and Annotated
Bibliography



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Introduction

This bibliography was compiled through a grant provided by the Women and Development Studies Unit of The University of the West Indies, St. Augustine, Trinidad and Tobago. The objective was to bring together in one place, an extensive listing of research material relating to women in science and technology and to create a database using Micro CDS/ISIS to store and retrieve this information.

Sources

The compilation of this bibliography draws heavily on the information sources, catalogs, databases held or are accessible at Mullins Library, University of Arkansas, Fayetteville. The works cited are not necessarily held at this library.

Scope

The bibliography includes all types of publications e.g. monographs, chapters in books, journal articles, conference papers, reports, seminar/workshop documents and dissertations. The references listed are mostly english language publications or are available in english up to the date October 1993.

Arrangement

The bibliography is divided into two parts :

- (1) A **Main Section** where individually numbered entries are arranged under broad subject divisions.
- (2) **Subject** and **Author** indexes. The former consists of natural language subject terms arranged in alphabetical order. The latter provides names of personal or institutional authors. The number given after each entry in both indexes refers to the sequential numbers in the Main Section of the bibliography.

General

001 Adams, R.M. 1989. **Nowhere are the shortcomings of our educational system more critical than in the area of science and technology.** *Smithsonian*. Vol.20, July, p.8.

Blacks, Hispanics, and women, all of whom will play a greater role in the nation's future labor force, remain at significantly lower levels of proficiency. Unless scientific and technological literacy is given more attention, public understanding will not be able to keep pace with new technologies.

002 African Training and Research Centre for Women. 1983. **The role of women in the utilization of science and technology for development: an ECA contribution to the African Regional Meeting on United Nations Conference on Science and Technology for Development, Cairo, 24-29 July 1978.** Addis Ababa, The Centre. ii, 62p.

003 Archer, J. and Freedman, S. 1989. **Gender-stereotypic perceptions of academic disciplines.** *British Journal of Educational Psychology*. Vol.59, No.3, p.306-313.

Sixty college students, aged 16-20 years, rated 10 academic disciplines consisting of the following dimensions: difficult-easy, interesting-boring, useless-useful, masculine-feminine, simple-complicated, and science-arts. Each dimension was rated on 7 points. Engineering, physical sciences, and mathematics were rated as significantly masculine whereas english, biology, psychology, french, and sociology were rated as significantly feminine. Sex of the rater caused no effect. Only in the case of biology was academic background a significant influence.

004 Archer, J. and Macrae, M. 1991. **Gender-perceptions of school subjects among 10-11 year olds.** *British Journal of Educational Psychology*. Vol.61, No.1, p.99-103.

Thirty girls and thirty boys between the ages of 11-12 years rated 17 school subjects along seven point dimensions, including masculine-feminine. Physics, craft, design, and technology, and information technology were rated as significantly masculine; typing, home economics, personal and social education, and RE were rated as significantly feminine. In contrast to previous studies, chemistry, mathematics, biology, and languages were rated as neither masculine nor feminine. Stepwise regressions using mean ratings for each school subject were calculated for boys and girls separately. For boys, "interesting-boring" predicted a large proportion of the variance on masculine-feminine; for girls, "difficult-easy" predicted a considerable proportion of the variance, as it did for the combined sample.

005 Benjamin, M. 1991. **Science and sensibility: gender and scientific enquiry 1780-1945.** Cambridge, MA, Blackwell publishers. 240p.

In this analysis, three areas are linked: women as practitioners of science, gender representation within science and tension between science and feminism.

006 Bettelmeim, B. 1965. **The commitment required of a woman entering a scientific profession in present-day American society.** IN *Women and the scientific professions, the M.I.T. symposium on American women in science and engineering.* p.3-19. Edited by J.A.Mattfeld and C.G.Van Aken. Cambridge, MA, The M.I.T. Press

Discusses the professional woman in general. In particular, the difficulties she faces, of what she may reasonably expect of society and society of her, and of those changes we need to effect in our present world to do justice to both women's aspirations as a human being and her aspirations as a woman.

007 Bloch, E. 1989. **The strategic importance of education for competitiveness.** *EUDCOM Review*. Vol. 24, No. 1, p.18-23.

Discusses worldwide economic competitiveness and the need for increased numbers of science and engineering students to keep up with advancing technologies that influence economic strategies. Highlights include the relationship between research and graduate education; academic research funding; graduate, undergraduate, precollege education; and opportunities for women and minorities.

008 Bolger, N. and Kellaghan, T. 1990. **Method of measurement and gender differences in scholastic achievement.** *Journal of Educational Measurement*. Vol.27, No.2, p.165-174.

Examined gender differences in scholastic achievement as a function of method of measurement by comparing the performance of 739 boys and 758 girls all aged 15 yrs in Irish schools on multiple-choice and free-response tests of mathematics, Irish, and English achievement. Males performed significantly better than females on multiple-choice tests compared with their performance on free-response examinations. The hypothesis that the gender difference would be larger for the languages and smaller for math because of the superior verbal skills attributed to females was not confirmed.

009 Brooks, C. I. and Mercincavage, J. E. 1991. **Grades for men and women in college courses taught by women.** *Teaching of Psychology*. Vol.18, No.1, p.47-48.

Grades were compared for 346 men and 388 women in accounting, foreign language, and mathematics courses taught by women. Average grades for women were significantly higher than those for men in accounting and math courses.

010 Bulcock, J.W., Whitt, M.E. and Beebe, M.J. 1991. **Gender differences, student well-being and high school achievement.** *Alberta Journal of Educational Research*. Vol.37, No.3, p.209-224.

Focused on gender differences in student achievement in Newfoundland, where girls are performing better than boys in all school subjects except physics. Support for a biological and a culturally based theory is reviewed, and arguments in favor of both are rejected. Instead, a demographic or cohort size hypothesis was proposed that generated three hypotheses: when relative incomes are low, (1) gender effects on the quality of school life will favor girls, (2) gender effects on student well-being will be mediated by the quality of school life and will favor girls, and (3) gender effects on school achievement will be mediated by the quality of school life and will, again, favor girls. In a study of 182 female and 135 male 10th graders, support for the demographic model of gender differences was equivocal. Results indicate that student perceptions of their school lives influenced both their well-being and their achievement in literacy and numeracy.

011 Callahan, C.M. 1991. **An update on gifted females. Special Issue: Update: Undeserved gifted.** *Journal for the Education of the Gifted*. Vol.14, No.3, p.284-311.

Specific performance data on aptitude and achievement tests are presented in contrast to data on grades. Career plans and aspirations are discussed in light of attitudes toward mathematics and science, beliefs and behaviors of parents and teachers, and past performance.

012 Callaway, H. 1981. **Women's perspectives: research as revision.** *Convergence: an International Journal of Adult Education*. Vol. 14, No. 4, p.34-43.

The author's purpose is to trace the development of research on women by women in order to show the values motivating this work and the resulting new approaches to methodology, theory, and expression. Provides a critique of the model of the female in existing scientific disciplines.

013 Carpenter, P.W. and Hayden, M. 1987. **Girls' academic achievements: single-sex versus coeducational schools in Australia.** *Sociology of Education*. Vol.60, No.3, p.156-167.

Analyzed the effects of parents' occupational status, teachers' encouragement for further study, and high school curriculum on 1,039 Australian girls' academic achievement in girls' and coeducational schools in 2 states during the students' senior year. Multiple regression analysis indicated that mother's education was the most important independent predictor of the type of school attended. Attendance at a girls' school was a significant predictor of exposure to key social influences, enrollment in a science course, and academic achievement in only one state. Findings support attempts in Australia to provide single-sex classrooms for science and mathematics courses. A model of girls' academic achievement is also discussed.

014 Cobb, J.P. 1979. **Filters for women in science.** IN *Expanding the role of women in the sciences*. p.236-248. Edited by A.M.Briscoe and S.M.Pfafflin. New York, NY, The New York Academy of Sciences. (Annals of the New York Academy of Sciences, vol. 323)

Describes six filters of science that are present in the life of young scientist. These are socialization in the school years; elementary school experience and its socialization effects; junior high experience, the high school years which result in a decline of interest in mathematics and therefore enrollment in mathematics course; external campus and peer pressure, and graduate school.

015 Cobb, J.P. 1984. **Planning strategies for women in scientific professions.** IN *Women in scientific and engineering professions*. p.75-85. Edited by V.B.Haas and C.C.Perrucci. Ann Arbor, MI, The University of Michigan Press.

There are several important measures of successful change for women in scientific professions. These include (1) when the proportion of women in a field is no longer an issue; (2) when parents no longer perceive of their little girl's interest in math as unusual or odd; (3) when the salaries of women in science and technology are equal to the salaries of men; (4) when there are as many women as men working in science-based industries, in science branches in governments, or in science departments of public and private institutions with bachelor's, master's or doctoral degrees in such fields as industrial, mechanical, civil, chemical, or electrical engineering, geology, computer science, textile, plastics, ceramic engineering, mining, petroleum or electro-optics engineering; or (5) when women are moving easily around the country in management positions as metallurgists, geophysicists, environmental scientists, botanist, radiologists, hydrologist, organic chemist, physical chemists, accounting and marketing specialist.

016 Contrucci, J. and Fischer, B. 1990. **Women in a technological world: an interdisciplinary core course at Emmanuel College in Boston.** *Bulletin of Science, Technology and Society*. Vol.10, No.4, p.191-195.

A course focused on how women are globally connected through experiences with technology is described. Topics include computers, world hunger, reproductive strategies, and solid waste disposal. The impact of the class on students and the faculty is also reviewed.

017 Cooper, S.E. and Robinson, D.A. 1989. **Childhood play activities of women and men entering engineering and science careers.** *School Counselor*. Vol.36, No.5, p.338-342.

Compared the self-reported childhood games, toys, and activities of 214 male and 51 female college freshmen entering the male-dominated engineering and technical science fields, using the Social Background Questionnaire Item Checklist developed by E. Metzler-Brennan et al. Results provide preliminary support for the idea that masculine and androgynous childhood activities may play a role in the development of skills necessary for achievement in mathematics and physical sciences, which are salient in male-dominated professions such as engineering and science.

018 Czujko, R. and Bernstein, D. 1989. **Who takes science? A report on student coursework in high school science and mathematics.** New York, N.Y., USA: American Institute of Physics. Education and Employment Statistics Division. 73p.

The scientific literacy of the average citizen is primarily the result of formal education in science. Such education is very important in an increasingly technological society such as the United States. To get a feel for students' understanding and appreciation of science, it is important to examine their mastery of basic skill levels as well as their exposure to more advanced concepts. The goal of this report is to provide some of the data necessary to evaluate how well the secondary school system is meeting these goals. The focus of this initial report is on coursework in science and mathematics as one measure of the successes and shortcomings of the education system. The bulk of the analyses described in this document was carried out on the base year data from the High School and Beyond Study. Related data from other sources are discussed to fill out the picture provided by these analyses. National trends; regional diversity; physics and chemistry; race and ethnic background; the gender gap in mathematics and science; and post-secondary school plans are highlighted in this report.

019 Desantis, J. P. and Youniss, J. 1991. **Family contributions to adolescents' attitudes toward new technology.** *Journal of Adolescent Research*. Vol.6, No.4, p.410-422.

Eight hundred and fifty-two ninth to twelfth graders rated their favorableness toward new technology. When there were significant differences, males and older adolescents tended to be more favorable toward technological issues than females or younger adolescents. In study one, 158 mothers of adolescents said whether they had made efforts to help their adolescents develop technological skills. Adolescents' attitudes toward technology were sensitive to mothers' education and whether or not mothers helped their adolescents to develop technological skills. Mothers' helping made a difference in youths whose mothers had less education; those youths whose mothers helped showed a more favorable attitude than those whose mothers did not help. Adolescents whose mothers had a college education were favorable toward technology whether or not their mothers helped.

020 Edwards, A., Laporte, S.B. and Livingston, A. 1991. **Cultural diversity in today's corporation.** *Working Woman*. Vol.16, No.1, p. 45-61.

Cultural diversity needs to be recognized, understood, valued, and managed. The workplace in the US is changing in gender, color, nationality, and cultural points of view. By 2000, women will make up about 47 percent of workers, and minorities and immigrants will hold 26 percent of all jobs, up from 22 percent in 1990. If US business is to recover lost productivity, regain its competitive edge, and move into the 21st century with a renewed sense of preeminence, it will have to effectively attract and manage the diverse talent that will characterize its new workforce.

021 Ellermann, N.C. and Johnston, J.A. 1988. **Perceived life roles and locus of control differences of women pursuing nontraditional and traditional academic majors.** *Journal of College Student Development*. Vol.29, No.2, p.142-146.

Examined whether 33 female undergraduate seniors in traditional academic majors, special education, nursing, and home economics differed from 38 female seniors in nontraditional majors (pre-medicine, engineering, and business) in their perceptions of future life roles and in their locus of control orientation. Results from an inventory on perceptions of present and future role involvement and from a scale designed to measure locus of control revealed differences between the 2 groups in perceptions of life roles, particularly regarding the home and family. While both groups were highly committed to their careers, students in the nontraditional disciplines were significantly less committed to a home and family. There was no difference between groups in locus of control.

022 Ellis, P. 1991. **The need for female participation in technical and vocational education in the Caribbean.** *Journal of Cooperative Education*. Vol.26, No.3, p.77-81.

Although more females than males participate in education in the Caribbean, few choose vocational-technical, math, science, or technology programs. Barriers such as sex role perceptions, socialization, stereotypes, and lack of female role models perpetuate the gender divisions in education and training.

023 Enhart, J.K. and Meehan, S. 1989. **Financial aid: a partial list of resources for women.** Washington, D.C., USA: Association of American Colleges. Project on the Status and Education of Women. 5th ed. 22p.

The publication offers women ideas about how to select and pay for higher education, lists resources, and describes the variety of schools and programs available. It also lists about 70 other guides to financial aid resources.

024 Fee, E. 1981. **Is feminism a threat to scientific objectivity?** *Journal of College Science Teaching*. Vol. 11, No. 2, p.84-92.

Addresses the issue of possible conflict of interest between women's values and the values of science, including such topics as the liberal ideology of science, questioning science as a source of authority, scientific objectivity, and possibilities of a feminist science.

025 Fox, M.F. and Firebaugh, G. 1992. **Confidence in science: the gender gap.** *Social Science Quarterly*. Vol.73, No.1, p.101-113.

A study investigates the confidence in science between 1973-89 and, specifically, the variation in confidence by gender. Findings indicate no overall trend up or down in confidence in science, but a definite gender gap, with women expressing less confidence in science.

026 Freckman, D.W. 1989. **The scientist shortage and the gender gap.** *Bioscience*. Vol.39, No.4, p.523-527.

In policy circles, the issue of women in science has evolved from the problem of ensuring equity to concern about the coming overall shortage of US scientists and the need to bolster the dwindling ranks with women and minorities, groups currently under-represented. Yet despite the predictions, little has been done to increase the number of women in the education pipeline in time to meet the expected crunch. The many recent reports identify solutions for the predicted scientist shortage in 2000 and the current under-representation of women in science. One focus is to help women finish graduate school, find employment, and achieve tenure in academia. Mentoring programs at all levels should be implemented, according to the reports. Women scientists, educators, and the public could aggressively request money for programs to increase the numbers of women in science.

027 Fuller, C.H. 1989. **Undergraduate origins of women and men 1970-1982 graduates who received doctorates between 1970-1986.** Great Lakes Colleges Association, Ann Arbor, Michigan. 274p. (ED 312982)

Data from a study of the undergraduate origins of Ph.D.s are presented. Baccalaureate origins of doctorate recipients were analyzed for total and proportional productivity for each of the U.S. institutions whose graduates between 1970 and 1982 had earned at least one doctorate between 1970 and 1986. Analysis shows that leading baccalaureate sources, based on proportional productivity, include private and public institutions, each of the major Carnegie Commission classes, and a wide range of selectivity levels; women's colleges, as a group, are more productive than co-educational institutions in the humanities and in the science fields (except engineering); and those co-educational institutions that are significant sources of doctorates earned by women include several of the formerly all-male institutions.

028 Fusselman, K. 1986. **Technology and women's employment: the office of today and tomorrow.** *Secretary*. Vol.46, No.9, p.10-11.

Reports on a study that projects that technology will not cause clerical staff displacement during the next 10 years, but it may produce difficulties for persons looking for new jobs who have no experience with technology. Includes panel recommendations.

029 Gonzalez, N.L. 1984. **Professional women in developing nations: The United States and the third world compared.** IN *Women in scientific and engineering professions*. p.19-42. Edited by V.B.Haas and C.C.Perrucci. Ann Arbor, MI, The University of Michigan Press.

Traces the evolution of professionalism among women. Uses indices of professionalism to compare previous patterns of professionalism with what exists today. The author concentrates on employment, education and political participation as general areas of concern believing that women's professional status is intimately bound up with all three which are themselves causally interrelated. Highlights the changing position of women in developing nations.

030 Gordon, G.G., DiTomaso, N. and Farris, G.F. 1991. **Managing diversity in R&D groups.** *Research Technology Management*. Vol.34, No.1, p.18-23.

A recent study in which interviews were conducted with 100 scientists and engineers from 5 industrial research institute member companies addressed the problems and opportunities created by the increasingly diverse workforce in research and development. Issues highlighted by the study included: (1) New groups (women, minorities, and foreign-born employees) are not as attuned to the rules of corporate behavior as traditional employees (native-born white males); (2) The competence of blacks is still questioned frequently; (3) Management attitudes have the greatest effect on the treatment and attitudes of the new groups; (4) Stereotypic responses are still heard from a number of managers. Possible solutions to the problems that were found unique to are exacerbated by the existence of a diverse workforce included: top management support of diversity and the benefits it can bring; better orientation of new employees; the sensitizing of the company to the customs, values, and business practices of various ethnic groups; and the recruitment and retaining of women.

031 Gordon, H.A. 1990. **Who majors in science? College graduates in science, engineering or mathematics from the high school class of 1980.** Survey report June 1990. Washington, D.C., USA: National Center for Education Statistics. 32p. (NCES-90-658; ED 324197)

Examines the major fields of study of a representative sample of high school seniors from the 1980 High School and Beyond Senior Cohort Survey who had graduated from college by 1986 and compares those who majored in engineering, mathematics, or the natural and physical sciences with those in other fields. Among the significant findings are: (1) the proportion of males was higher than the proportion of females; (2) there were no significant differences in the proportions in majors among Whites, Blacks or Hispanics; (3) students with higher grades in high school, students who reported more time spent on homework, or students who had high achievement test scores graduated more frequently with a major in science, engineering, or mathematics; (4) those who studied more mathematics in high school graduated more frequently with a major in science, engineering, or mathematics; (5) the number of students who moved out of the sciences in college was larger than the number who moved in; (6) females who had higher grades and took calculus in college were less likely than males with similar backgrounds to graduate with a major in science, engineering, or mathematics; and (7) more male college graduates stated in high school that they intended to major in science, engineering, or mathematics than female college graduates.

032 Hackett, E. J., Mirvis, P. H. and Sales, A. L. 1991. **Women's and men's expectations about the effects of new technology at work.** *Group and Organization Studies*, Vol.16, No.1, p.60-85.

Compared the views of 654 men and women, 52 percent men, employed in hourly production jobs regarding the effects of an innovation on their working conditions, their organization, and the rewards they receive. Gender differences were found on an array of expectations likely to influence the innovation process, including knowledge of and general attitude toward new technology, job security, safety, learning opportunities, training and technical assistance, and rewards. In general, women's expectations about the likely effects of new technology were more pessimistic than men's. Gender differences persisted when education, age, seniority, and relevant characteristics of an employee's current job were controlled.

033 Hammonds, E.M. 1991. **Sage publishes special issue on black women in science.** *Science*, Vol. 253, (August 23), p.919.

This is a special issue of SAGE: a scholarly journal on black women. Includes profiles of black women scientists and overview the participation of black women in mathematics, the biological sciences and engineering and technology. Most of the women profiled are "firsts" either the first black women to obtain the doctorate in their field or the first to hold research and teaching positions in their field. All displayed a strong commitment to science and were grateful for the opportunities that were opened to them. Many experienced great stress and isolation due to racism and isolation.

034 Harding, J. 1982. **Girls and science and technology (GASAT).** *School Science Review*, Vol. 63, No. 224, p.570-571.

Discusses an international conference which focused on the problem of Girls and Science and Technology. Summarizes efforts by different countries to increase the numbers of women in science and technology, and lists recommendations from the conference.

035 Harding, J.,(ed.). 1986. **Perspectives on gender and science.** Bristol, PA, Taylor & Francis, Inc. 222p.

This volume contains the papers presented in the program on women in science. The first six papers provide evidence of how it is, or has been, with women in science. Recurrent themes are those of social pressures and personal prejudice limiting women's access to science and further constraining the achievement of those who qualify to practice. The remaining five papers take a more theoretical perspective of what is seen as the alienation of most women from science and technology through gender-related constructs of personal identity and of the nature of science.

036 Harding, J., Hilderbrand, G. and Klainin, S. 1988. **Recent international concerns in gender and science/technology.** Special issue: Education and national development: emerging realities. *Educational review*, Vol.40, No.2, p.185-193.

Reviews escalation of concerns in gender and science/technology by reference to a bibliometric study of literature published in the field and to the International Girls and Science and Technology (GASAT) conferences. A brief survey of topics addressed at the 1987 GASAT conference is included, and case studies in Thailand and in Australia are presented.

037 Harris, D.M. 1990. **Science attitudes, locus-of-control, career commitment and experiences of academically talented high school females.** Thesis (Ph.D.), University of Florida. 228p.

A pretest-post-test design was employed. Four instruments were used to measure the variables: The Test of Science-Related Attitudes (TOSRA), Science Attitudes Survey (SAS), Locus of Control in Science (LOCIS), and Science Impact Questionnaire (SIQ). A questionnaire to measure prior science-related experiences was developed by the researcher. Three instruments and the questionnaire were administered to ninety-eight participants, 47

females and 51 males, at the beginning and end of an intensive science experience. The experience questionnaire was given at the beginning of the treatment. The Science Attitude Survey was administered as a post-test only measure. The results indicated that males and females were significantly different before the treatment only in their expressed attitudes as measured by the TOSRA. Treatment effects were found on the TOSRA with scores declining except for females' view of scientists as normal which increased. Males and females responded differently to commitment to a science career (SIQ) after the treatment; males arrived and remained more committed to a science career than females. Significant differences by gender were found on three scales of the SAS given as a post-test only. The females were more positive than males on attitude toward women in science, competition in science with the opposite gender, and feeling about success in science. Concludes that males and females continue to report different views of and commitment to science. Positive changes did not occur as a result of the treatment except for females' view scientists as normal people. The SAS appeared more sensitive to females' positive science attitudes than the TOSRA.

038 Harvey, J. and Goldstein, S. 1985. **Sex differences in science and mathematics for more able pupils.** *Gifted Education International*, Vol.3, No.2, p.133-136.

Administered science attainment, attitude, science interest, and a spatial test to 244 able boys and girls from a mixed comprehensive school in the UK to determine gender differences. Significant differences, with boys performing better than girls were found in the following measurements: mechanical reasoning, evaluation of data, mathematics attainment, attitude toward school science, mathematics, and spatial reasoning. It is suggested that no sex-difference effects are apparent until optional choices are made in the 3rd year when girls generally opt out of physical science.

039 Haws, P.K.S. 1984. **Women in non-traditional careers in the fields of science and mathematics: Distinguishing characteristics.** Thesis (Ph.D.), The University of Mississippi. 147p.

The sample for this study included 69 traditional freshmen, 28 non-traditional freshmen, 39 traditional seniors, and 36 non-traditional seniors from a large university in the Southwest. Scholastic Aptitude Test scores, a researcher-designed Attribution Questionnaire, the Attitude Toward Women's Scale, the Sixteen Personality Factor Questionnaire (16 PF) and Super's Work Values Inventory were used to assess differences among groups. Factorial Analysis of Variance was used to assess mean differences on all resulting scores. Analysis of Variance for Repeated Measures was used to assess differences in attributions across hypothetical situations. Statistical programs were selected to handle unequal n's. Analysis of data revealed statistically significant differences between women in the non-traditional group and women in the traditional group on SAT math scores, on three of the attribution variables, on three personality variables, and on four occupational variables. Statistically significant differences were found between freshmen and senior women on attitudes toward women's roles, two personality variables, and one occupational variable.

040 Hopkins, E.A.H. 1979. **A certain restlessness.** IN *Expanding the role of women in the sciences*, p.173-178. Edited by A.M.Briscoe and S.M.Pafflin. New York, NY, The New York Academy of Sciences. (Annals of the New York Academy of Sciences, vol. 323)

States that when considering to expand the role of women in the sciences, one should look not just at enlarging the number of women in conventional roles but also at expanding the scope of things women do professionally that can be considered as within the province of science. There are numbers of places other than in laboratories and classroom where science impacts society. Discusses how society can direct more young women into those parts of science not at first considered a part of science. Focusses

on physical scientists and chemists.

041 Horn, L. 1990. **Trends in high school math and science course taking: effects of gender and ethnicity.** Paper presented at the annual meeting of the American Educational Research Association, Boston, MA, April 16-20, 1990. 32p. (ED 319593)

Provides a descriptive summary of the changing trends in high school course taking in mathematics and science for students who graduated between 1969 and 1987. Focuses specifically on gender and racial/ethnic group differences. Compares the average number of credits completed in mathematics and science classes for public school students based on high school transcripts collected in four national surveys. These surveys included the Educational Testing Service Study of Academic Prediction and Growth (1969); The National Longitudinal Survey of Labor Force Experience: Youth Cohort (1975-1978 and 1979-1982); High School and Beyond (1982); and the National Assessment of Educational Progress Transcript Study (1987). Twenty-eight figures display the statistical data.

042 Hornig, L.S. 1979. **Scientific sexism.** IN *Expanding the role of women in the sciences.* p.125-133. Edited by A.M.Briscoe and S.M.Pfafflin. New York, NY, The New York Academy of Sciences. (Annals of the New York Academy of Sciences, vol. 323)

Raises questions about the nature of science and the structural framework within which it is practiced. The issue discussed is not only whether and to what extent sex discrimination exists in science but also whether the conceptual and institutional settings of modern science are so constructed that they will almost certainly be discriminatory. States that the proposition that needs to be considered is whether some relatively simple adjustments in how scientific training and professional arrangements are organized and viewed, might not make these disciplines both more attractive and more rewarding for women.

043 Hornig, L.S. 1984. **Professional women in transition.** IN *Women in scientific and engineering professions.* p.43-58. Edited by V.B.Haas and C.C.Perrucci. Ann Arbor, MI, The University of Michigan Press.

The modern feminist movement is less than two decades old, yet the transformations that have occurred in that short span in the aspirations and expectations of women are enormous, as they have already altered the fabric of our society in irreversible ways. Women have become publicly active participants in that society during these years: to prepare themselves for careers and professional roles they have flocked into colleges, universities, graduate, and professional schools in unprecedented and still growing numbers. In that process, not only has society changed its assumptions about women's place, but so have women themselves. Yet, because success in the professions requires many years of training and experience, many of the effects of this expansion of horizons are still in their early stages; professional women are moving toward equality but they have not attained it yet. An assessment of the issues in this transition of women to full professional status is provided by two early reviews of the status of women in the professions published in 1964: an issue of *Daedalus* called *The Woman in America*, and the proceedings of a conference held at the Massachusetts Institute of Technology under the title *Women and the Scientific Professions*.

044 Hornig, L.S. 1987. **Women graduate students: a literature review and synthesis.** IN *Women: their under-representation and career differentials in science and engineering.* Proceedings of a workshop, Washington, D.C., October 9, 1986. p.103-122. Edited by Linda S. Dix. Washington, D.C., USA: National Academy of Sciences. Office of Scientific and Engineering Personnel. (ED 285752)

Women remain under-represented relative to men in most science and engineering fields while having caught up or surpassed them in behavioral sciences and in some humanities and education

fields. This under-representation is a growing cause for concern in view of declining interest on the part of men in the traditionally male-dominated areas at a time of heightened awareness of erosion in our international position with respect to both national security and economic competitiveness. The public interest requires actions to remedy these developing problems by the more effective inclusion of women and minorities. Objective measures of ability and performance make it amply clear that women suffer no deficits in these dimensions and that explanations for lower participation and lower success rates in completing graduate study must be sought elsewhere. Two major areas of interest for further research and possible intervention programs emerge. One of these is the issue of financial support, and the other is the possible effect of improved educational environments, especially with regard to more equitable treatment by faculty, and of equalization of ultimate rewards in recognition, opportunity, and earnings potential on women's initial and continuing participation in science and engineering fields. The rapid and large-scale increases in women's representation should lay to rest any lingering doubts about native abilities.

045 Hosni, D. 1991. **Women: a new vision for year 2000 and beyond.** Equal Opportunities International. Vol.10, No.6, p.15-17.

The adoption of global and national action plans for women's development requires a basic understanding of the changing world. These plans should stem from the realities of the current trends on which future progress can be built. Based on International Labour Organization statistics, the following observations are made: (1) relative to their respective shares in the labor force, women are over-represented in the professional-technical occupations and under-represented in the administrative-managerial positions, (2) in many countries, women have dominated the professional and technical occupations, (3) low female shares in managerial-technical posts are universal. Though qualified for leadership, only a few women make it to the decision-making level. However, some third world countries report much higher shares compared to leading industrialized nations.

046 Hubbard, R. 1979. **Feminism in academia: its problematic and problems.** IN *Expanding the role of women in the sciences.* p. 249-256. Edited by A.M.Briscoe and S.M.Pfafflin. New York, NY, The New York Academy of Sciences. (Annals of the New York Academy of Sciences, vol. 323)

Quotes examples from the nineteenth century to show that our industry and psychology are male constructs. Stated that when the scientific and medical sons of the nineteenth century studied women's biology, they stated quite clearly that there are ways in which it differs from their own. They interpret these so as to disqualify women on scientific grounds from participation in the world. Women's physiology thereby came to be judged as abnormal and their life cycle was classified into five debilities: menstruation, pregnancy, childbirth, lactation, menopause and fecundity. Asserts that feminists in academia must have as program nothing less than the re-examination and the re-evaluation of everything that has been taught about women and the world. Urged that women continue to foster networks that assist in providing the courage and determination to continue to look hard, see clearly and report honestly.

047 Hubbard, R. 1984. **Should professional women be like professional men?** IN *Women in scientific and engineering professions.* p. 205-211. Edited by V.B.Haas and C.C.Perrucci. Ann Arbor, MI, The University of Michigan Press.

Coming as women into professions whose structure and content have been shaped by men presents problems for women. There are the heavy demands in terms of hours, the need for total immersion in one's work, and the assumption that work comes first. Of course, there is nothing intrinsic or "natural" about any of these requirements. They result from the fact that the men who have shaped the professions have been able to count on the services of

a bevy of paid and unpaid helpers, many of them women, assistants, secretaries, wives, sisters, to take care of their physical, social and emotional needs, so as to leave them free to devote inordinately large amounts of time to their work. However, for historical reasons, we find ourselves in a situation where the professions are much more hierarchical than are families, and many women find that uncongenial and uncomfortable.

048 India, **Centre of Science for Villages and India**. Department of Science and Technology. 1982. Science and technology for women: a compendium of technologies. New Delhi, India: Department of Science and Technology. v, 193p.

049 Ingvarson, C. and Jones, A. 1981. **Sexism in science**. SASTA Journal. No. 813, p.18-24.

Following a definition of sexism, discusses (1) how sexism can be recognized in science, (2) reasons for concern that science is male dominated, and (3) studies on problems of women in science, and what teachers can do to encourage girls to study science at school, including whole school, faculty, and classroom initiatives.

050 Jamaica. Women's Bureau. 1976. **The nature and extent of women's participation in agriculture, industry, trade, science and technology**: report to the permanent representative of Jamaica to the United Nations. Kingston, Jamaica: Women's Bureau. 7p.

051 Jenkins, E.W. **The scientific education of girls since 1902**. Durham Research Review. Spring, p.873-886.

In the early part of the century, sex differentiation was seen as desirable and was built into the curriculum. In girls' schools practical instruction in the domestic subjects was compulsory; physics, chemistry and manual instruction were often replaced by botany and general science; and mathematics/science instruction was offered only a few hours per week. In the post-war period as the importance of science was clearly being emphasized, scientific/technological manpower was in great demand and an increasing emphasis was placed on science education for girls. Girls flocked to biology and general science, though not the physical sciences, such courses were not even offered in the 1960's. Explanation for girls' alleged aversion to study science have been offered since the turn of the century but most lack solid research information. Staffing/facility deficits in girls' schools were commonly cited as a prime problem - yet mixed sex schools did not seem to alleviate the problem. The lack of economic/career incentive for girls in the physical sciences seems plausible, 'women's' fields as nursing may explain the popularity of biology. Other explanations discussed include possible sex differences in mathematics ability, beliefs about the female role and the image of science, parental expectations of marriage, and the flexibility of a particular career.

052 Jenkins, S.Y. 1985. **Gender differences in graduate student relationships with their major faculty advisors**. Thesis (Ph.D.). University of Oregon. 99p.

The present study sampled two universities, the University of Oregon in 1983 and the University of Minnesota in 1984, to obtain eight comparison groups of male and female students with male and female advisors at the two institutions. While men and women reported differences in time spent and other aspects of their relationships with faculty, the differences are not significant. Student ratings of their major advisors showed some change since the first study, in the negative direction. These findings suggest that while previous studies concerning gender differences in student/faculty interactions have examined only one setting at one point in time, that time and setting are important aspects of the impressions derived from the data.

053 Johnson, J.H. 1991. **Effects of a career program on adolescents' attitudes toward nontraditional careers for women**. Thesis (Ph.D.). Arizona State University. 147p.

Subjects were 360 eighth-grade students in two middle schools in a middle-class metropolitan area in Northern California. The instructional program took approximately eight class periods and was taught by the students' regular teachers. Experimental materials prepared for the study consisted of a 29-page teacher guide and a 22-page student booklet. Instructional activities included such topics as sex-role stereotyping, two careers in science that are traditionally male, issues in dual-career families, and other issues that affect men and women entering nontraditional jobs. Student attitudes were assessed toward the two careers presented in the program and toward two additional related careers. Data from the study generally indicate that when students, especially girls, had more information about specific science careers, they felt that the careers were less appropriate, they had less interest in them, and they reported that they were less likely to pursue them. The results suggest that girls' and boys' rather strongly held attitudes toward traditional work roles are difficult to change through classroom instruction and activities.

054 Jones, M.G. and Wheatley, J. 1990. **Gender differences in teacher-student interactions in science classrooms**. Journal of Research in Science Teaching. Vol.27, No.9, p.861-874.

Thirty physical science and thirty chemistry classes, which contained a total of 656 male and 676 female students and 17 male and 33 female teachers, were observed using the Brophy-Good Teacher-child Dyadic Interaction System. Analysis yielded a significant main effect for teacher praise, call outs, procedural questions, and behavioral warnings based on the sex of the student and a significant teacher-sex main effect for direct questions. Significant 2-way interactions were found for the behavioral warning variable for teacher sex and subject by student sex. Female teachers warned male students significantly more than female students. Male teachers warned both genders with similar frequency. Male students also received significantly more behavioral warnings in physical science classes than female students. In chemistry classes, both male and female students received approximately the same number of behavioral warnings.

055 Kelly, A. 1984. **Girls into science and technology**. Final report. Manchester, UK: GIST. Department of Sociology, University of Manchester. 56p.

Girls into Science and Technology (GIST) was an action-research project which took action to improve girls' achievement in science and technology and investigated the reasons for their under-achievement. The project followed a cohort of students in eight co-educational comprehensive schools from the time they entered secondary school until they made their option choices at the end of the third year. During this time, project staff worked with teachers to devise and implement strategies to reduce sex stereotyping. Among these strategies were a program of visits by women working in technical fields, posters and worksheets about women's contributions to science, curriculum development to produce female-oriented materials, and career advice linked to option choices in schools. Results indicate that the project was successful in refining the understanding of girls' and boys' attitudes and stereotypes about science and the process of option choices. The specific focus of interventions was the stereotyping of science and technology as masculine, and in this respect the children's attitudes were considerably modified. However, children's option choices were less susceptible to GIST interventions and in addition, some teachers' attitudes altered in the desired direction.

056 Koblitz, A.H. 1988. **Science, women, and the Russian intelligentsia**. Isis. Vol.79, p.208-226.

The 1860s and 1870s could be called the golden age of Russian science. In addition, the period witnessed a rise in women's consciousness and the beginnings of the Russian revolutionary movement. Largely as a result of this combination of circumstances, these years marked a time of substantial gains in scientific opportunities for Russian women. Encouraged by the social

philosophy of the nineties and by the new women's consciousness, young women of the gentry and intelligentsia sought education and careers in the natural sciences and medicine. Russian women were among the first women in the world to receive doctorates in mathematics, physiology, zoology, chemistry, and other scientific fields.

057 Lane, M.J. 1988. **The current status of women and minorities in engineering and science.** *Engineering Education*. Vol. 78, No. 8, p. 750-755.

Reviews the status of employment, market conditions and the education pipeline for women, racial minorities and Hispanics in science and engineering in the United States. Employment growth, women's representation in careers, intended undergraduate major, selected characteristics, and SAT score comparisons are graphically displayed.

058 Le Guin, U.K. 1990. **The world of science fiction. Women authors.** Ms. Vol. 1, (November-December), p.52-54.

For decades it was a man's world. The only visible women in it were a few daughters of mad scientists but, it had been infiltrated secretly by a few heroic women writers with tight-lipped names but all the other writers, all the editors, and most of the readers over age fourteen, were male. It was the planet of the Good Old Boys. When women invaded science fiction they brought a lot of luggage with them containing very durable materials from other worlds, things the devotees of wiring-diagrams and weaponry had little knowledge of, things like men, women, and children. Alice Sheldon's story "The Women Men Don't See" offers the paradigm this essay was built on: that ordinary women, the plain women, the women men don't see, do not belong to the man's world. They are, literally, aliens. To make their own world they must remake it. Few of this generation were yet fully or overtly feminist, but they wrote a science fiction hospitable, and credible, to women. Along with some of the male writers, they proved that science fiction can be an intensely personal and intensely political means of examining and revisioning human society and humanity's place in the larger household of the planet and the cosmos, a narrative form where any assumption can be tested, and any rule rewritten. Including the rules of who's on top, and what gender means, and who gets to be free.

059 Linn, M.C. and Hyde, J.S. 1989. **Gender, mathematics, and science.** *Educational Researcher*. Vol.18, No.8, p.17-19, 22-27.

Males have greater access to science and technical fields and greater earning power than females. Many argue that cognitive and psychosocial gender differences explain these career differences. In contrast, evidence from meta-analysis and process analysis indicate that (a) gender differences on cognitive and psychosocial tasks are small and declining, (b) gender differences are not general but specific to cultural and situational contexts, (c) gender differences in cognitive processes often reflect gender differences in course enrollment and training, and (d) gender differences in height, physical strength, career access, and earning power are much larger and more stable than gender differences on cognitive and psychosocial tasks. These trends imply that small gender differences in cognitive and psychosocial domains be de-emphasized and instead that learning and earning environments be redesigned to promote gender equity.

060 Long, A.R. 1986. **Implications of low scale five scores for university women.** Thesis (Ph.D.), Ball State University. 75p.

The purpose of this research was to examine relationships between Scale five scores on the Minnesota Multiphasic Personality Inventory (MMPI) and adjectives endorsed on the Adjective Check List (ACL) for University Women. The groups being studied were undergraduate and graduate women, psychology and science women, and, women under 28 years old and women over 28 years old. The participants in the research were 93 women enrolled in courses at Ball State University during Spring Quarter, 1986. The

sample consisted of 31 undergraduate women (15 psychology women and 16 science women), 32 graduate women (17 psychology women and 15 science women), and 30 women who were matched for area of study and level of education and then divided into two groups, under 28 and over 28, of 15 each. The participants were administered the MMPI, the ACL, a Demographic Data Sheet and a Closeness Rating Scale. They were asked to have a significant person in their life endorse the ACL as it applied to the participant and to complete a Closeness Rating Scale. A 2 x 2 ANOVA was utilized to analyze the impact of level of education and area of study on Scale 5 scores on the MMPI. A One Way Analysis of Variance was used to analyze the relationship of age and Scale 5 scores on the MMPI. Each of the 300 adjectives on the ACL's were compared using Chi Square or Fisher's Exact Test to derive lists of adjectives descriptive of the subgroups. The results of the research indicated that science women had a significantly higher 5 scale score than psychology women. Lists of adjectives for each group were derived.

061 Lummis, M. and Stevenson, H. W. 1990. **Gender differences in beliefs and achievement: a cross-cultural study.** *Developmental Psychology*. Vol.26, No.2, p.254-263.

Gender differences on tests of achievement in reading and mathematics, and on tests of cognitive ability, were assessed. Students were children in kindergarten and grades 1 and 5 in elementary schools in Taiwan, Japan, and the US (n 1,975 - 4,266). Few gender differences were observed on curriculum-based tests of math computation and reading. Boys were more effective, however, in solving word problems and in answering questions involving estimation, visualization, and measurement. Cognitive tests revealed some gender differences at the 5th-grade level in all three cultures. Children and their mothers tended, as early as the first grade, to believe that boys were better at math and girls were better at reading. Children in the three cultures differed consistently in their scores in reading and math, but there were very few interactions between gender and location. The lack of frequent significant interactions between gender and location indicated the gender effects for both achievement scores and ratings were equivalent across Chinese, Japanese, and American contexts.

062 Manning, K.R. 1991. **The complexion of science.** *Technology Review*. Vol.94, No.8, p.60-69.

Historical evidence does not indicate that science is color-blind. The attitude of the scientific community toward diversifying and integrating its ranks has followed the pattern of other social institutions. Traditional outsiders in society, minorities and women, have had to persevere in a centuries-old and continuing struggle for full-fledged participation. A review of the history of science in the US shows that women, blacks, and Jews were often excluded. The 1964 Civil Rights Bill created educational opportunities for blacks and other minorities, making academic and industrial careers in science a reality. In the 1970s and 1980s, many scientific organizations, universities, and learned societies made an effort to be more inclusive. The representation of blacks in scientific careers is around 2-3 percent. In 1986, women constituted 15 percent of all scientists and engineers.

063 Marinez, D.I. 1979. **Innovative approaches: meeting the needs of women faculty in the eighties.** IN *Expanding the role of women in the sciences*. p.268-275. Edited by A.M.Briscoe and S.M.Pafflin. New York, NY, The New York Academy of Sciences. (Annals of the New York Academy of Sciences, vol. 323)

Provides a synthesis of many conversations with women colleagues and friends about the needs of faculty women. Asserts that women in academia suffer from a lack of unity in articulating their needs, or for that matter accepting the system as it is. Women in science have not been visible in the initiation of change, just as men in science have seldom left the labs to view the impact of their discoveries. As much as the time-demands of the profession account for at least part of this lack of participation in initiating

change. It is now imperative that women in science join forces with other academic women in initiating change. Outline benefits and programs at Michigan State University system that would attract women into nontraditional fields and would provide opportunities for shared parenting and career development.

064 Math-science. **Math-Science Bill Voted by Senate.** 1990. Congressional Quarterly Weekly Report. Vol.48, No.32, p.2595.

The Senate recently passed a bill (HR 996) to improve elementary students' math and science education and to increase the number of people obtaining advanced degrees in math, science and engineering, particularly women and minorities.

065 McTeer, J.H. 1986. **Gender differences in relationship to likes and dislikes of four subject areas.** High School Journal. Vol.69, No.4, p.260-263.

Studied the impact of gender on students' preference toward four academic areas of the secondary school english, mathematics, science, and social studies--surveying 1,820 high school seniors. Results show that girls selected english as the most-liked subject and selected science and social studies as the least-liked subjects more often than boys. Boys selected mathematics and social studies as the most-liked subjects and English as the least-liked subject more often than girls.

066 Merchant, C. 1980. **Death of nature: women, ecology and the scientific revolution.** San Francisco, CA, Harper & Row. xx,348p.

Reassesses the scientific revolution of the sixteenth and seventeenth centuries, during which western culture took on its present technologically oriented, progress-minded form. Explores the historical connections between women's issues and ecology, and concludes that the advancement of science set back the cause of women. When the scientific revolution took hold, the earth was no longer regarded as a nurturing mother to be cherished. Interprets this crucial shift as the death of nature and contends that it accelerated the exploitation of human and natural resources in the name of culture and progress.

067 Moulton, R. 1979. **Psychological challenges confronting women in the sciences.** IN Expanding the role of women in the sciences. p. 321-335. Edited by A.M.Briscoe and S.M.Pfafflin. New York, NY, The New York Academy of Sciences. (Annals of the New York Academy of Sciences, vol. 323)

Discusses the internal psychological challenges that threaten to undermine a woman's effectiveness to fight for her rights because of inner fears of which she may not be aware. Successful women scientists have been shown to be intellectually superior to their male counterparts in many instances. This is not surprising, since the women usually have to obtain better grades and work harder to advance in the man's world. These women often appear to be unusually independent, having gone against the mainstream rather than following the expected domestic, marital path. Thus they often appear more self-confident and stronger than they really are. When one looks at their inner psychic lives, their doubts and anxieties hidden even from themselves are evident to the psychiatrist, who discovers them in the process of therapy. Of course, there are many who could profit from psychotherapy who do not come because they feel it would be an admission of weakness. But from those who do, observations could be made that apply to many others. One of the purposes of this paper is to spell out some of the hidden conflicts. Increased awareness of them may be quite helpful to others who are faced with similar dilemmas. The most prominent intrapsychic conflicts are discussed under the headings of 1) Hidden dependency needs, leading to fear of disapproval and separation anxiety; 2) Fear of assertion, aggression, and anger; 3) Fear of failure and/or success, leading to performance anxiety; 4) Fear of being unfeminine, sexually unattractive, unable to attract or hold on to a man; being childless, or a "bad" mother. These various problems may overlap and

reinforce each other.

068 Mozans, H. J. 1991. **Woman in science: with an introductory chapter on woman's long struggle for things of the mind.** South Bend, IN, University of Notre Dame Press. 452p.

The major thesis of this book is that woman have not made greater contributions to science because of societal constraints, not because of inherent biological limitations. Although the author vigorously champions the scientific potential of women, he nonetheless reveals a somewhat patronizing attitude, when he points out that educated women make intellectually sympathetic companions for their husbands. Provides a brief introductory chapter on women's struggle for intellectual liberation.

069 Murphy, P. 1991. **Assessment and gender.** Special Issue: Assessment: tensions within a changing framework. Cambridge Journal of Education. Vol.21, No.2, p.203-214.

Examines research on the assessment of British girls and boys at ages 11 and 13 years in science and mathematics and discusses areas of potential bias in such assessment. Research shows that boys outperform girls on the use of certain scientific apparatuses, but that boys also use these instruments more often than do girls outside the classroom. Girls often perform better on questions concerning such areas as reproduction or domestic situations. Girls have lower self-esteem in math and science than do boys, and this may be due to the type of classroom feedback they receive and to biased forms of task presentation.

070 National Research Council (U.S.). Committee on the Education and Employment of Women in Science and Engineering. 1979. **Climbing the academic ladder: doctoral women scientists in academe: report to the Office of Science and Technology Policy.** Washington, D.C., National Academy of Sciences. xv, 155p.

Focuses on the status of women scientists in academic institutions, the major employer of doctoral scientists. It also examines their current situation in postdoctoral training and their role in national science advisory bodies, entities that draw their membership primarily from academe. The study assessed whether and to what extent earlier patterns of faculty appointments have changed since the advent of affirmative action regulations and examined extensive trend data on the production and employment of men and women doctorates. The study indicated that the status of women Ph.D's in academic science has improved in the past decade, but that further gains are necessary before equal opportunity is realized.

071 Navarro, C. 1989. **Why do women have lower average SAT-math score than men?** Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA, March 27-31, 1989. 12p. (ED 312277)

A study involving 716 male and 1,113 female first-year students admitted to the University of Delaware in the fall of 1985 was conducted to investigate the differential performance of men and women on the mathematics section of the Scholastic Aptitude Test (SAT). Data collected included SAT math score; gender; and number of years of high school mathematics, physics, and computer science courses taken by the students. Results indicate that approximately 25 percent of the difference between men and women on SAT math scores is due to the difference between sexes in the number of years that mathematics, computer science, and physics courses were taken. The remaining approximately 75 percent difference between SAT math scores of men and women is due to differences between sexes not investigated in this study.

072 Nulty, P. 1989. **The Hot Demand for new scientists.** Fortune. Vol.120, No.3, p.155-163.

The need for engineers and scientists is strong as fewer and fewer Americans are interested in the sciences. This trend shows great opportunities available for women and minorities.

073 O'Connell, L., Betz, M. and Kurth, S. 1989. **Plans for balancing work and family life: Do women pursuing nontraditional and traditional occupations differ?** *Sex Roles*. Vol.20, No.1-2, p.35-45.

Compared work-involvement plans of women pursuing training in three fields. Three approaches to the connection between gender and work are reviewed: an occupational, a differential gender socialization, and a role conflict approach. Data from 173 female students in traditional (nursing) and nontraditional (engineering and veterinary medicine) fields are used. Results show that the work plans of women pursuing these traditional and nontraditional occupations were similar. A minority in each field expected to work full time when their children were of preschool age. Modest support was obtained for the structural and differential gender socialization approaches, and substantial support for the role conflict approach. Plans to pursue nontraditional professions did not appear associated with plans for nontraditional family life.

074 Parrish, J.B. 1988. **Women continue to rise in the professions.** *Chemical Engineering Progress*. Vol.84, No.1, p.50-55.

Discusses the rise of training for the elite professions namely engineering, science, business and management, and accounting. Advances in medical technology, contraceptive technology, the technological advance in lighting, heating, cooling, cleaning, washing, food storage, preparation and disposal save time and improve the quality of life; advances in transportation technology provides convenience and flexibility; rising educational attainment; the employment market; the declining hours of work; the equal rights movements for minorities and women and to maintain or raise family living standards are discussed.

075 Pfafflin, S.M. 1979. **Equal opportunity for women in science.** IN *Expanding the role of women in the sciences*. p.341-344. Edited by A.M.Briscoe and S.M.Pfafflin. New York, NY, The New York Academy of Sciences. (*Annals of the New York Academy of Sciences*, vol. 323)

Asserts that discrimination today may be increasingly covert, but both statistics and individual experiences suggest that it is still powerful. It has proved extremely difficult to mobilize effective governmental action, especially in the case of academia. Individual lawsuits are sometimes effective, but as our experience with them increases, it has become clear that the costs, both in money and in damage to careers, are often prohibitive. The difficulties still encountered make it clear that the optimistic view that equal opportunity for women scientists should receive strong support was based on incorrect assumptions. Science is not the objective, unemotional endeavor that is often portrayed. Scientific research takes place in a social context and is profoundly influenced by that context. The social context of American society is profoundly sex-typed. Given this context, it was not to be expected that change would come readily in the sciences, on the contrary, greater resistance might be expected because of the insecurity of scientists; and difficulty academics face in identity.

076 Pyle, J.L. and Dawson, L. 1990. **The impact of multinational technological transfer on female workforces in Asia.** *Columbia Journal of World Business*. Vol.25, No.4, p.40-48.

Multinational Corporations (MNC) have been an important component of the export-led development strategy adopted by successive tiers of Asian nations. MNCs have made significant contributions to the structural adjustments necessary for export-led development, particularly in the expansion of manufacturing sectors. Their most important and controversial contribution has been the transfer of technology. While the production and managerial technologies transferred are intended to reduce costs, their negative impact on the predominantly female workforces employed often undermines this objective. Because women also are consumers, their alienation is counterproductive to marketing goals. Rather than

acquiescing to cultural traditions that subordinate and demean women, MNCs can and should demonstrate leadership in recognizing women's contributions and in ensuring equality of opportunity on a global basis. As Asia becomes a low-cost production site and a dynamic growth market, strategies must be reassessed and reformulated if corporate goals are going to be met.

077 Raat, J.H. 1982. **Girls and science and technology (GASAT).** Congressbook: backgrounds and emphases of the conference, 1st, Eindhoven, The Netherlands, November 9-13, 1981. Netherlands, Eindhoven University of Technology. 97p. (ED 262997)

The project on Girls and Science and Technology (GASAT) consists of bringing together individuals involved in research and development projects to examine ways to increase the participation of girls and women in science and technology education, by organizing international conferences. This seven-part document provides: (1) a discussion of the GASAT problem leading to the first international GASAT conference, considering causes of the GASAT problem and other topics; (2) the opening conference address by the deputy secretary-general of the Dutch Ministry of Education; (3) a discussion of schooling in the Netherlands, England and Wales, Sweden, Norway, Federal Republic of Germany, Portugal, Canada, and the United States; (4) descriptions of initiatives taken in these countries to resolve the GASAT problem; (5) summaries of working group suggestions/recommendations related to teacher education, support activities for women and girls, and curriculum and teaching materials; and (6) a consideration of future directions.

078 Reis, S.M. 1987. **We can't change what we don't recognize: understanding the special needs of gifted females.** *Gifted Child Quarterly*. Vol.31, No.2, p.83-89.

Discusses major issues, questions, and problems related to gifted females. Research related to the issues of ability, achievement, personality, social and environmental pressures, and gender is discussed. Suggestions are made for new research to help females both recognize and realize their potential. Topics of discussion include: underachievement of gifted females, creative productivity of females, male dominance in mathematics and science, cultural stereotyping, sex roles and mixed messages, fear of success, the perfection complex, and the imposter syndrome.

079 Roberts, M.G. 1984. **Achievement motivation, femininity-masculinity traits, and self concept as characteristics of university women enrolled in professional career programs in two selected universities.** Thesis (Ph.D.), Purdue University. 135p.

The purpose of this study was to investigate the manifestation of three selected variables--achievement motivation, androgyny, and self concept in women enrolled in selected professional schools of law, medicine, engineering, and management, and to compare these measures to a second sample of women. This second sample of women were enrolled in graduate programs of home economics, nursing, education, and library science. Additionally, male classmates of the first group of women comprised the third sample. All subjects were enrolled at two major midwestern universities. Three instruments to several demographic questions were used in this investigation. The instruments were the Texas Social Behaviors Inventory which measured social competence/self esteem, the Work and Family Questionnaire-II which measured achievement traits, and the Personal Attributes Questionnaire which measured traits of masculinity, femininity, and masculinity-femininity. Responses of 542 subjects were gathered for analysis. The statistical analyses used were one way analysis of variance, Pearson correlation and frequency distributions. It was found that the two samples of women differed on the three selected variables: these differences, however, tended to be small. They also differed on selected demographic characteristics. The first group of women, enrolled in schools that are male dominated and their male classmates showed little difference in regard to the selected variables and demographics.

Based on the findings, which tended to be significant, although small, and in keeping with other study limitations, the following conclusions were made: (1) Higher levels of mastery and competitiveness can be anticipated in groups of women pursuing non-traditional careers than among women pursuing traditional careers. (2) Higher levels of masculine traits occur among women pursuing non-traditional careers than among women pursuing traditional careers. (3) Higher levels of feminine traits are more common among women pursuing traditional careers than among women pursuing non-traditional careers. (4) Higher levels of social competence/self esteem are likely to be demonstrated among women pursuing non-traditional careers than among women pursuing traditional careers.

080 Rose, C., Menninger, S.A. and Nyre, G.F. 1978. **The study of the academic employment and graduate enrollment patterns and trends of women in science and engineering. Summary.** Los Angeles, CA, Evaluation and Training Institute. 39p.

Women have been active members of the scientific community for well over a century, but their numbers have been few and their status have been low. They have had few job opportunities, frequent unemployment, and they have seldom been considered eminent by their fellow scientists. The proportion of women scientists in academe continues to be small, and it drops significantly the higher the level of degree, academic rank, salary or administrative responsibility. These facts raise serious questions about the real impact of equal opportunities for women as far as job access, position, promotion and salaries are concerned. The present study was designed to address these questions and to provide insight into the problems, issues and concerns of women scientists/engineers in academe.

081 Rosser, S.V. 1990. **Female-friendly science applying women's studies methods and theories to attract students.** New York, NY, Pergamon Press. xii,159p.

Explores the potential of feminist pedagogical methods and theories of women's studies to attract women to science. The exploration begins with an evaluation of the current reports surrounding the crisis in American higher education. The crisis and its correlated dearth of scientists and engineers is accurately depicted in the reports. However, the back to basics solutions suggested by their authors are unlikely to attract the women and minorities needed to fill the shortage. An examination of feminist scholarship and pedagogy developed for teaching women's studies courses reveals information and techniques that contrast with the back to basics approaches advocated in the reports. Comparing the feminist critiques of science with African-American, Marxist, and non-Western critiques reveals the similarities among them as well as the unique features that each perspective provides.

082 Ryckman, D.B. and Peckham, P. 1987. **Gender differences in attributions for success and failure situations across subject areas.** *Journal of Educational Research.* Vol.81, No.2, p.120-125.

To examine gender differences in attributions for success and failure across subject areas, the Survey of Achievement Responsibility (SOAR) was administered to 165 female and 160 male 4th-12th graders. The SOAR assesses attributions for success and failure in language arts and mathematics/science (M/S). Findings show that girls had a more learned-helpless orientation in math/science than did boys; however, in language arts, both were mastery-oriented.

083 Sandler, B.R. 1979. **Women in academe: why it still hurts to be a woman in labor.** IN *Expanding the role of women in the sciences.* p. 14-26. Edited by A.M. Briscoe and S.M. Pfafflin. New York, NY, The New York Academy Sciences. (Annals of the New York Academy of Science, vol. 323)

Describes the famous Peter Principle and explains how it applies to women in academe. States that women to a large degree, have

been exempt from the effects of the Peter Principle because they do not get promoted to their level of incompetence; indeed, they hardly get promoted at all. Study after study, whether in academe, industry, or government, shows that women and minorities, no matter how well qualified, simply do not move up the promotion ladder with the same speed as their white male counterparts. This often means that at any given job level, where both men and women work side by side, the women seem brighter, but simply because the men who are their equals have been moved upward and above to their level of incompetence, and the men who are at the same level with the women have moved up from below to their level of incompetence. Certainly it is a myth that women are being hired in droves, that the problems of discrimination have been solved, and that the major problem is simply a shortage of qualified women. Over the past years, most of the major changes have been in the legitimacy of women issues and our awareness of women rights.

084 Schiebinger, L.L. 1984. **Women and the origins of modern science.** Thesis (Ph.D.), Harvard University. 382p.

The purpose of this thesis was to explore the rise of modern science in Europe and the circumstances--both social and intellectual--which led to the exclusion of women from science. Focuses on the seventeenth and eighteenth centuries when modern norms of science and femininity were being formed. The ambivalence of early modern science toward the participation of women is traced to elements, on the one hand, which encouraged the participation of women and elements, on the other hand, which discouraged the participation of women and their exclusion from universities and scientific academies. It is argued that by the late eighteenth century social developments, the professionalization of science and the rise of the ideal of motherhood, and intellectual developments provided the foundation for the exclusion of women from the public worlds of science and scholarship. It is argued further that by the nineteenth century the question whether or not women could do science had become a scientific one, which led to a paradox central to the social history of science. At the same time that women and their values have been excluded from science, science has often been used to justify their continued exclusion. This paradox is discussed through the concrete example of the appearance of the first representations of the female skeleton in modern anatomy. This thesis raises the larger philosophical question of the social consequences of a science which emphasizes one set of values, the masculine over another set of values, the feminine.

085 Schiebinger, L.L. 1989. **The mind has no sex? Women in the origins of modern science.** Cambridge, MA, Harvard University Press. xi,355p.

This book explores the long-standing quarrel between science and what western culture has defined as "femininity." What is it about being a woman that has made men of science fearful of female intrusion? What is it about science that has made it susceptible to such fears? To answer these questions the author analyzed the rise of modern science in Europe in the seventeenth and eighteenth centuries, focusing especially on the circumstances that led to the exclusion of women. In the seventeenth century science was a young enterprise forging new ideas and institutions. Men of science either sweep away the traditions of the medieval past and welcome women as full participants, or they could reaffirm past prejudices and continue to exclude women from science. This book answers such questions as: what were the social, political, and intellectual circumstances that directed science down one road? and what was the cultural cost of that journey?

086 Shea, K.A. 1984. **Gender differences in college students' attributions for success in two subject areas.** Thesis (Ph.D.), University of Miami. 88p.

This study centered on the problem of attribution as a causal variable in a model of academic choice as proposed by Meece et al

(1982). In order to be considered a causal variable in such a model however, the assertion was made that attributions for women in areas where they do participate, such as english, must be different from attributions in areas where they do not participate, such as mathematics, and different from those of men. The current study was undertaken to test hypotheses concerning apparent gender differences in attribution patterns for success in two subject areas. An instrument was constructed to measure ten student attributions for success in natural classroom settings. 1,110 undergraduate community college students completed the instrument in either an english, social science, or mathematics class. Analysis of data from the 421 successful students indicated that there are no gender differences in attributions for success. However, attributions did depend upon the particular course being taken. Thus, attributions for success in mathematics were different from those in english.

087 Shemesh, M. 1990. **Gender-related differences in reasoning skills and learning interests of junior high school students.** *Journal of Research in Science Teaching*. Vol.27, No.1, p.27-34.

249 students, from 7th-9th grade, were assessed for their level of mastery of formal reasoning skills by a test based on videotaped simple experiments. Learning interests were assessed by a written response to an open question. Adolescent boys developed patterns of formal reasoning before their girl classmates. In addition, boys tended to prefer science and technology subjects, while girls tended to prefer language, social studies, and humanities. Boys' tendency toward science and technology was positively correlated to their age and development of formal reasoning, while girls' tendency was positively related to their development of formal reasoning capacity, but inversely related to their age.

088 Skaalvik, E. M. 1990. **Gender differences in general academic self-esteem and in success expectations on defined academic problems.** *Journal of Educational Psychology*. Vol.82, No.3, p.593-598.

In this study, gender differences in different dimensions of academic self-concept were examined. General academic self-esteem and expectations of being able to master particular math and verbal problems were measured in 231 sixth-grade Norwegian students. The girls had a substantially higher level of achievement and higher success expectations than their male classmates in Norwegian and English tasks, whereas there were no gender differences in achievement or success expectations in mathematics or in general academic self-esteem.

089 Stanley-Muchow, J.L. 1986. **Outstanding scientists: A participatory study of inquiry and creativity in human development.** Thesis (Ph.D.), Arizona State University. 392p.

The process of inquiry in human development was the topic of this participatory research. In collaboration with the nine leading scientists who participated in the study, three broad questions were addressed. These questions were (a) What is science like from the inside out? (b) Are there common themes in the development and activity of leading, inquiring minds in science? and (c) What can be learned from science about inquiry, the growth of knowledge, and human development in general? The three women and six men who participated were identified by their colleagues as outstanding scientists. Their fields of science included astronomy, biology, chemistry, and physics, and their ages ranged from 42 to 73 years. All participants lived and worked in the southwestern United States, but they varied in cultural heritage and in the geographical regions in which they spent their early years. The study findings were shared through brief summaries of each participant's unique history and activities in science and through more general discussions of the various foci of the interviews and observations. Common themes in participants' development and activity included curiosity and inferiority, faith, hope, and caring; individuality and creativity; and meaning and commitment. Women were found to need an extra

measure of determination to succeed in science. The insiders' view of science suggested consideration of the discipline as a culture and a developmental context. From a broader view, several findings indicated areas of usefulness to a society in transition to a knowledge age.

090 Stinson, S. 1990. **Dorm for women science, math majors opens on Rutgers campus.** *Chemical and Engineering news*. Vol. 68, No. 8, p. 26-27.

Describes a college dormitory to give support and encouragement to women majoring in science, engineering, or mathematics. Discusses the program provided including peer study groups, a computer room and library, visits from women scientists, and outreach programs to high school students.

091 Vetter, B.M. 1990. **Supply and demand for scientists and engineers in the coming decade.** *Journal of Career Planning and Employment*. Vol. 50, No. 2, p.57-63.

With fewer traditional students in the population, and fewer of these electing to earn a degree in natural science and engineering, American colleges are reaching out for women, minorities, and foreign students. Concludes, barring unexpected decline in American economy, job opportunities, especially in engineering, should be excellent.

092 Vetter, B.M. and Babco, E.L. 1986. **Women's participation in the professional work force levels off--minority representation at near standstill.** *Science*. Vol.232, May, p.661.

Although fewer women are enrolling as students of engineering, geology, earth sciences, mathematics, and biology, more are studying computer sciences, medicine, business administration, and law. Minority representation appears to be at a standstill in the professional labor force and shows mixed progress in education.

093 Wajcman, J. 1991. **Patriarchy, technology, and conceptions of skill.** *Work and Occupations*. Vol.18, No.1, p.29-45.

Explores the nature and persistence of gender divisions in the workplace. Although new technologies disrupt established patterns of sex-stereotyping and open opportunities for changing sexual divisions of labor, change to women's advantage may often be foreclosed by male power. The assessment of skill in women's and men's work may be gender biased, perpetuating the belief that women are low paid because they are unskilled. This affects technological change in that employers may seek technology that enables them to replace expensive male workers with low-paid, less unionized female workers. It is suggested that legislation for improving women's position in the labor market should consider the way the design and use of technology itself locks women into an inferior position in the labor market.

094 Weimer, L.J. 1985. **Sex differences in achievement beliefs of bright children.** Thesis (Ph.D.), University of Washington. 149p.

Forty-three girls and thirty-seven boys were previously enrolled in a longitudinal study of precocious preschoolers. Now ages 9 to 12 years, they ranged in current measured ability from average to extremely gifted. Children responded to the Self-Perception Profile for Children, Cognitive Abilities Test, Wide Range Achievement Test, self-evaluation of their performance on academic tests, scales measuring their expectancies for success academics, and a questionnaire assessing preferred theory of intelligence. The only predicted sex differences found was that females expected to find school work more difficult and to do less well in science. For males, but not for females, higher perceived competence was related to greater confidence in future performance. There was no evidence that differences in achievement beliefs were greatest between the brightest males and females. Females actually endorsed an incremental theory to a greater extent than males. It was the brighter males who more strongly favored entity theory. Theory of

intelligence was not found to be a significant predictor of achievement beliefs with the exception of attributing success to effort. Measured ability was not related to confidence in scholastic ability or future success. Children who scored higher in verbal ability gave lower perceptions of self-worth. These findings suggest that high ability does not necessarily ensure confidence and self-esteem.

095 Wight, A. and Burn, S.M. 1991. **Will the use of "interesting" examples as a teaching tool help improve the performance of college students on science tests?** *Journal of Psychology*. Vol.125, No.3, p. 279-289.

Tested whether 27 students in a college chemistry course would learn the material better if the lesson contained examples that they had judged to be interesting. Students received a 2-page lesson followed by a test. The treatment group was expected to perform better on the posttest than the control group (textbook lesson). Data showed that students who learned material using the textbook version performed better than the group who learned it through the interesting version. Men performed better than women.

096 Wiley, E. III. 1989. **Minorities key to maintaining nation's competitive edge, analyst says.** *Black Issues in Higher Education*. Vol. 5, No. 23, p.13.

Under-representation of minorities and women in mathematics, science, and engineering education will have serious ramifications for America's technological future. A workforce comprised of increasingly large percentages of Blacks, Hispanics, females, and the economically disadvantaged will be inadequately prepared unless more of these groups are attracted to science and technology fields.

097 Wilson, L.S. 1992. **The benefits of diversity in the science and engineering work force.** IN *Science and engineering programs on target for women?* p.1-14. Edited by M.L. Matyas and L.S. Dix. Washington, D.C., National Academy Press.

There are four compelling arguments for opening the doors, removing the barriers and encouraging and enabling the full participation of women. The first is for equitable treatment of all citizens, the second is the economic arguments. The third is that women and minorities as new entrants to the work force represent an important source of renewal. The fourth argument can be made for women and minorities' full participation in society especially in science and engineering fields. Discusses the full meaning of the term "access", a framework for discussing and evaluating interventions to enhance access and achievements. Identifies fundamental issues that will be important to the pursuit of achieving these goals.

098 Worthley, J.S. 1987. **The role of gender-related values in persistence in undergraduate science.** Thesis (Ph.D.), Claremont Graduate School. 61p.

Although college science attrition affects both sexes, women leave the sciences at higher rates than men. This differential attrition is reflected in women's under-representation in the physical sciences, mathematics, and engineering. Some factors affecting science persistence are well established, but much of the variance in science persistence remains unexplained. This study investigated the hypothesis that sex differences in value perspectives distinguished science able students who persist in science from non-persisters.

099 Zuckerman, H. 1987. **Persistence and change in the careers of men and women scientists and engineers: a review of current research.** IN *Women: their under-representation and career differentials in science and engineering.* Proceedings of a workshop, Washington, D.C., October 9, 1986. p.123-156. Edited by Linda S. Dix. Washington, D.C., USA: National Academy of Sciences. Office of Scientific and Engineering Personnel.

This report is divided into four parts. The first briefly describes

the population of American scientists and engineers. The second inventories the main findings of research on comparative career attainments of men and women, earmarking the three patterns of similarity and difference just noted. The third reviews the principal explanations, or "theories," that have been proposed to account for gender differences in careers and assesses how well the data square with these explanations. The last identifies some directions for further inquiry, based on "specified ignorance".

100 Zuckerman, H., Cole, J.R. and Bruer, J.T. (Eds.). 1991. **Outer Circle: women in the scientific community.** New York, NY, W.W.Norton. 351p.

Drawn from papers presented at four symposia held at Stanford University between 1983 and 1986, this study examines the recent history, participation and rate of productivity of women and men in the scientific community.

Bibliography

101 1984. **Gender and Mathematics Association (GAMMA), bibliography.** London, England: GAMMA, Dept of Mathematical Sciences, Goldsmith's College. 27p.

About 200 references on gender and mathematics, arranged in the following sections: Ability/attainment, adult education; assessment of performance; attitudes to math; careers, choosing math at school/college; cross cultural; female mathematicians; government reports, etc.; initiatives, resources, reviews of research, social factors; teachers' attitudes, and texts are given.

102 Chinn, P.Z. 1979. **Women in science and mathematics: bibliography.** Washington, DC, American Association for the Advancement of Science. 38p.

This is an unannotated list of works on women in science and mathematics. It also lists some bibliographies of the 1970s, and some special issues of periodicals.

103 Chinn, P.Z. (Comp.). 1988. **Women in science and mathematics: bibliography.** Arcata, CA, USA: Humboldt State University. 81p.

This bibliography contains over 1,000 entries organized into seven sections. These include: (1) women in science bibliographies; (2) journals and periodicals which devoted whole issues or frequent articles to women in sciences; (3) biographies and autobiographies of women scientists; (4) differences between the sexes--as proposed by science in various eras, or as related to differing scientific and mathematical abilities; (5) increasing the participation of women in science, including descriptions of organizations and programs and career booklets; (6) women as scientists--characteristics, historical information, problems, rewards, etc.; and (7) technology and women.

104 Eldredge, M. 1990. **Gender, science, and technology: A selected annotated bibliography.** *Behavioral & Social Sciences Librarian*. Vol.9, No.1, p.77-134.

Presents 196 annotated listings of works on science, technology, and gender, under 9 headings: Biography and history; women scientists; science education; feminists look at science and technology; effects of technology on women; medicine and reproductive technologies in women's lives; women and evolution; women and agriculture; gender, scientific responsibility, and the peace movement.

105 Hoyrup, E. 1978. **Women and mathematics, science and engineering: a partially annotated bibliography with emphasis on mathematics and with references on related topics.** Roskilde, Denmark: Roskilde University Library. 62p.

A listing of books, chapters, articles and reports, most from the

1960s and 1970s, but some dating from the early 1900s.

106 Kaminski, D.M. 1982. **Girls and mathematics and science: an annotated bibliography of British works (1970-1981)**. IN *Studies in science education*. Vol. 9, p.81-108. Edited by David Layton. Leeds, UK: Leeds University. (ED 266941)

This bibliography is intended to help the researcher quickly review the literature on the topic, being able to select easily those articles she or he wants to examine in greater detail. The 62 entries are written in enough detail to avoid having to locate each article, especially difficult for those without easy access to academic libraries with extensive education collections. Some studies which measured sex differences/similarities in mathematics and science have been missed. Prior to the mid-70's, this was generally not seen as an area of pressing concern or central academic interest. And though the variable 'sex' was commonly used in data gathering and analysis, it was not included in the title nor list of key words for indexing as it was only a passing concern of the study. The British Education Index was the guiding source, and references from the articles listed there were followed through well. The search began with the 1970 literature, up to mid-1981.

107 Kelly, A. 1976. **Women in science: a bibliographic review**. Durham Research Review. Vol.36, p.1092-1108.

A review article, with 131 references, covering such topics as intellectual ability, occupational choice and school subjects.

108 Kennedy, R. and Cadoree, M. (Comp.). 1990. **Women in the sciences**. LC Science Tracer Bullet. Washington, D.C., USA: Library of Congress, Science and Technology Division. 23p. (LB-TB-90-6)

This is a guide to sources of information related to the history and contributions of women in the fields of science, medicine, and engineering. Also included are writings on present-day women scientists, as well as materials on the current status and concerns of women in the sciences.

109 Searing, S. 1986. **Further readings on feminism and science**. IN *Feminist approaches to science*. p.191-195. Edited by R. Bleier. New York, Pergamon.

A list of references up to 1985 which highlights recent feminist critiques of scientific theory and practice is presented.

110 Tuana, B. and Imber, B. 1988. **Bibliography - women in science**. Hypatia. Vol.3, p.145-155.

This is an unannotated list of nearly 200 books and articles, divided into three sections: women in science, Feminist critiques of sexism in the practice of science, and science and feminist epistemology. Some items are starred to indicate their suitability as an introduction to the subject.

111 Women in Science Project. Center for Continuing Education of Women. University of Michigan (Ann Arbor). [n.d.]. **Women in science. Resource list of national organizations of and for women in science**. Washington, D.C., USA: American Association for the Advancement of Science. Directorate for Education and Human Resources Programs. [18]p.

This is a resource list of national organizations of particular interest to women who are considering majoring in and entering science and engineering career fields. It is organized by subject areas, and an alphabetical index is provided. Areas covered are anthropology, astronomy, biology, chemistry, computer science, education, energy, engineering, geoscience, history of science and technology, mathematics and statistics, health and medicine, meteorology, physics, and science.

Biography

112 Abir-Am, P.G. 1987. **Synergy of clash: disciplinary and marital strategies in the career of mathematical biologist Dorothy Wrinch**. IN *Uneasy careers and intimate lives women in science 1789-1979*. p. 239-280. Edited by P.G. Abir-Am and D. Outram. New Brunswick, Rutgers University Press.

Dorothy Maud Wrinch (1894-1976) was a scientist who insisted on achieving success in combining an academic career with marriage, motherhood, and personal freedom. She accomplished this feat in two different disciplines and countries. She was a Victorian-born polymath who moved from Britain to America in 1939, when she was forty-five. Wrinch is best known for her work on protein structure in the late 1930s, when she was the first to propose a theory covering many then accepted facts. In later days her theory, like others proposed in the late 1930s, did not become part of the scientific consensus; but hers in particular came to be regarded by both scientists and some historians as "notorious." This scapegoatism, grounded in a variety of disciplinary, philosophical, social, and gender-related biases, was further reinforced by Wrinch's own lifelong obsessive defense of her theory and refusal to follow the shifting scientific frontier. Her nonconventional stance in science bears on the most important episode in the transition from classical to molecular biology, namely the evolution of solutions to the problems of protein structure. That stance cannot be understood without a proper exploration of her career, especially prior to her involvement with proteins, but also afterward. Since that career was the product of uniquely intersecting disciplinary and marital trajectories, we are confronted not only with a biographical problem, but also with one pertaining to the major problem of social theory, namely the connection between individual action and social conventions. Moreover, since the social conventions in this case focus on both science and gender, Wrinch's story has direct relevance to the history of science and women's studies.

113 Afanasyeva, O. 1991. **A "blue angel" with wings**. Soviet Life. No.3, p.24-27.

Lyudmila Pukito teaches jet aerodynamics to cadets in the Soviet Air Force. Pukito is profiled.

114 Altany, D. 1992. **F. Suzanne Jenniches: sharp isn't strong enough to describe her**. Industry Week. Vol.241, No.5, p.32-36.

Suzanne Stewart Jenniches left teaching in 1971 to join Westinghouse Electronic Systems. She worked her way up the ladder and now is general manager of the Civil Systems Division, based in Baltimore. Jenniches works hard to develop and communicate her vision of where she would like to lead Westinghouse. Bench-marking and metrics to measure employee and manufacturing progress, teamwork, and diversity are the ingredients Jenniches feels are necessary to carry out her vision. As president of the Society of Women Engineers, she counsels young members that sometimes the best glory is reflected glory - the credit given by peers, subordinates, and supervisors. Unlike many other executives, Jenniches does not believe that Westinghouse has to develop every important technology internally, and her division may even choose to align with competitors and share information.

115 Altany, D. 1992. **Jeanne F. Savage: excitement incarnate**. Industry Week. Vol.241, No.5, p.38-39.

Jeanne F. Savage is the director of IBM Corporation's Geographic Information Systems (GIS) Division, based in Southbury, Connecticut. GIS technology, a new way of analyzing information with "smart maps," visually plots out information that normally would be a lifeless list. Savage's customer market for GIS is one of the most diverse, including ambulance services, insurance companies, newspaper publishers, and the IRS. Savage is excited to work in a field as new and fast-growing as GIS, thrilled about new customer

markets her group is developing, and is excited about the potential of GIS in the future.

116 Arnold, L. 1984. **Four lives in science: women's education in the nineteenth century.** New York, Schocken Books. xii, 179p.

This book examined the ways that women gained a scientific education in the nineteenth century and the consequences in the lives of four individuals: Maria Martin Bachman (1796-1863), Almira Hart Lincoln Phelps (1793-1884), Louisa C. Allen Gregory (1848-1920) and Florence Bascom (1862-1945). These women obtained their education in a diversity of ways and places and with a diversity of outcomes: the first became a naturalist and illustrator; the second, a science educator; the third, what would now be called a home economist; and the fourth, a scientist.

117 Arnold, L.B. 1982. **Women's education in the nineteenth century: Four lives in science.** Thesis (ED.D.), Columbia University Teachers College. 185p.

Various reasons for the disproportionate number of men in science, by comparison with women, have been suggested. However, no major attempt has been made to look at the historical background of the education of women in science for clues as to how this situation developed over time. This dissertation uses the technique of educational biography to determine how women gained a scientific education in the nineteenth century and what the consequences were in the lives of four Americans: Maria Martin Bachman (1796-1863), Almira Hart Lincoln Phelps (1793-1884), Louisa Catherine Allen Gregory (1848-1920), and Florence Bascom (1862-1945). Maria Martin exemplifies the tradition of private study and instruction in science. A naturalist and illustrator, Martin gained a field knowledge of natural history from the naturalist John Bachman, in whose household she lived in Charleston, South Carolina. She was also an associate of John James Audubon, to whose *Birds of America* she contributed watercolor paintings of flowers, plants, and insects. It was in Troy, New York, with its many scientific men and institutions, that Almira Lincoln acquired the education that enabled her to teach science in women's seminaries and to write science textbooks. A sister of Emma Willard and a student of the scientist Amos Eaton, she played a significant role in disseminating scientific knowledge among the next generation of American women. Louisa Allen, a forerunner of the home economics movement, developed a "domestic science" curriculum at the University of Illinois in the 1870s. Her scientific education was used to inflate the traditional female role in the home. The only one of the four to become a scientist, Florence Bascom was trained in research at Johns Hopkins and subsequently taught geology at Bryn Mawr College. There she served as a mentor for a succeeding generation of women geologists. Women who were educated and engaged in science-related occupations in the nineteenth century were similar to men scientists in their social origins and in the importance of personal relationships in the development of their interests. However, women were greatly outnumbered and largely segregated from the mainstream of science.

118 Dalmedico, A.D. 1991. **Sophie Germain.** *Scientific American*. Vol.265, No.6, p.116-122.

Sophie Germain was a remarkably gifted French mathematician who fought 19th-century prejudices to make significant contributions to number theory and the theory of elasticity.

119 Grinstein, L. and Campbell, P. 1987. **Women of mathematics: a bibliographic sourcebook.** Greenwood, NY, 292p.

An edited collection of essays on forty-three mathematicians from all ages and countries, but excluding anyone born after 1925. The entries are arranged alphabetically but a chronological index is provided, as are lists by place of origin, place of work and field of work. Subject and name indexes, and an appendix of references in biographical dictionaries and other works is also given. Each entry in the main work follows a standard format, namely a biographical

section, a description of her work, and a bibliography listing first works by the subject, followed by works about her.

120 Johnson, M. 1990. **Women out on their own.** *Computerworld*. Vol.24, No.50, p.98.

Madeline Weiss, vice-president of the Society for Information Management (SIM), dropped out of the corporate "rat race" several years ago by opening her own information technology consulting firm, Weiss Associates Inc. Similarly, Diane Kamionka aborted a 20-year information systems career at Western Southern Life Insurance Co., where she was the first female vice-president in the company's history, to launch her own software company, Cintech Telemanagement Systems Inc. Both women acknowledge that their actions moved them into a different kind of contest as self-supporting, independent businesswomen. The idea apparently has some appeal to others. The Fall 1990 ADAPSO Directory of Minority and Women-Owned Firms lists nearly a dozen firms that are headed by women. It was the familiar career-family struggle that fueled Weiss' decision to start her own company.

121 Kidwell, P.A. 1987. **Cecilia Payne-Gaposchkin: astronomy in the family.** IN *Uneasy careers and intimate lives women in science 1789-1979.* p.216-238. Edited by P.G. Abir-Am and D. Outram. New Brunswick, Rutgers University Press.

Outlined the course of one woman scientist's family life, from its beginnings among scholarly Englishmen and women through the unusual family of the Harvard Observatory under Harlow Shapley to complex relations with husband and children. Payne-Gaposchkin honored her families, cherished the companionship they provided, and relished activities with them. At the same time, in a culture where women were not expected to combine marriage and professional life, and with a thoroughly unconventional spouse, Payne-Gaposchkin's family life restricted her choices, strained her loyalties, and often left her exhausted. Payne-Gaposchkin's life, like that of other scientists, can only be fully understood if one considers her family, the strengths it provided, and the constraints it imposed.

122 Koblit, A.H. 1987. **Career and home life in the 1880s: the choices of mathematician Sofia Kovalevskaja.** IN *Uneasy careers and intimate lives women in science 1789-1979.* p.172-190. Edited by P.G. Abir-Am and D. Outram. New Brunswick, Rutgers University Press.

The Russian mathematician Sofia Kovalevskaja (1850-91) was the first woman outside of the eighteenth-century Italy to hold a chair at the university level in Europe. During her lifetime, Kovalevskaja was rewarded as one of the most eminent mathematical analysts in the world. She was awarded the Prix Bordin of the French Academy of sciences, and the Oscar in the Russian Academy of Sciences. Her dissertation work is considered basic to the theory of partial differential equations. Her classic memoir on the revolution of a solid body about a fixed point (the "Kovalevskaja top") has been described as one of the most famous works of mathematical physics in the 19th century, linking two main theories of the 19th century mathematics--analytical mechanics and complex function theory--in a beautiful way. Kovalevskaja was a writer as well as a mathematician. Her literary productions included two plays, written in collaboration with the Swedish writer Anna Carlotta Leffler, a memoir of her childhood, a novel, and numerous essays and poems. Moreover, Kovalevskaja was an active campaigner for women's right to higher education and participated in a small way in the revolutionary movements of her native Russia and Western Europe.

123 Kohlstedt, S.G. 1987. **Maria Mitchell and the advancement of women in science.** IN *Uneasy careers and intimate lives women in science 1789-1979.* p.129-146. Edited by P.G. Abir-Am and D. Outram. New Brunswick, Rutgers University Press.

Astronomer Maria Mitchell (1818-89) was well known among her contemporaries as the first woman to win an international medal, the first American woman elected to the American Academy of Arts and

Sciences, the first woman member of the American Association for the Advancement of Science, and the first woman professor of astronomy. Her successes serve to highlight the paucity of recognized women scientists in the nineteenth century. The barriers to women in science were high, limiting even those women who worked on the periphery of the scientific community as illustrators, textbook writers, and herbarium owners. Maria Mitchell became a symbol to her contemporaries, men and women alike, of the contributions women were able to make in science. Her discovery of a comet in 1847 and her calculations of its exact position at the time of discovery brought her a gold medal from the king of Denmark and led to her membership in the American Academy of Arts and Science, in spite of being a woman. Mitchell held a vision and pursued strategies that coincided with changing but cautious views of women's clubs; that is, she sought and utilized the psychological and practical reinforcement found in the sphere of a female world.

124 Ogilvie, M.B. 1986. **Women in science: antiquity through the nineteenth century: a biographical dictionary with annotated bibliography.** Cambridge, MA, MIT Press. 254p.

Biographical entries for nearly 200 Western women are followed by a good bibliography, subdivided into reference material, general histories and collective bibliographies and five chronological sections covering the range of the book.

125 Ogilvie, M.B. 1987. **Marital collaboration: an approach to science.** IN *Uneasy careers and intimate lives women in science 1789-1979.* p.104-125. Edited by P.G. Abir-Am and D. Outram. New Brunswick, Rutgers University Press.

Of the many women who have collaborated with their husbands in science, Ayrton, Sietrich, and Huggins were selected as the subjects of this essay instead of better-known examples, such as Marie and Pierre Curie and Irene and Frederic-Joliot Curie, precisely because they are not so well known. They represent three different fields, have made documentable contributions, to science offer an opportunity for further research, and demonstrated vastly different ways in which marital collaboration gone awry. Their scientific contributions, educational backgrounds, relationships with spouses and children, and views about the role of women are explored in order to elucidate what proved to be a viable approach to the alternatives of a career or a family.

126 Werman, J. 1990. **Eleanor Baum: engineering change.** *Working Woman.* Vol.15, No.6, p.40.

Engineer Eleanor Baum is profiled. Baum is crusading to increase the number of women who enter the field of engineering.

Recruitment and Career Guidance

127 Alfke, D.E. 1953. **Professional opportunities for women in conservation and natural science.** Thesis (Ph.D.), Cornell University.

128 Anderson, M.R. 1981. **Women in science and engineering: a case of awareness and encouragement.** IN *Girls and science and technology (GASAT).* Contributions to the conference, 1st, Eindhoven, The Netherlands, November 9-13, 1981. Vol. 2, p.1-18. Edited by Jan H. Raaij. Netherlands, Eindhoven University of Technology.

States that the primary causes for the dearth of women in industrial engineering or any area of engineering, is the fact that they have not been made aware of the opportunities nor been encouraged to prepare for and persevere in such a career. Women in general have a very limited knowledge of the possible careers in engineering and almost no knowledge of industrial engineering. Furthermore, they have never associated themselves with such a career. After viewing a role model and considering options within the field of engineering,

many young women then choose to go into engineering. Summaries Jewell Cobb's female filters in science. The first two filters include a lack of awareness and positive association with science and mathematics. The third filter is the junior high and high school experience. The high school years are the most critical. College-level mathematics is a prerequisite for mathematics, science and engineering majors. However, women students experience a lack of encouragement by family, counselors and society to continue their studies in mathematics. The fourth filter, college, is also usually a period of lack of encouragement for girls who have the ability to major in science. The fifth filter of graduate school may also be characterized by a lack of encouragement. While the sixth filter centers on the senior scientist or advisor who may control development of the dissertation, its acceptance and publication, referrals, post-doctorate job placement and career progression. A seventh filter for women after formal schooling includes a "superwoman" dilemma. She often must be career woman, wife, mother and homemaker all at the same time. Those women who were filtered out of science have a second chance in some science career projects through the National Science Foundation supported science career facilitation project. The last two years of high school may not be too late to encourage women to consider engineering as a career. Young women need to be told that engineering, science or technology as the case may be is no longer nearly closed to women. Industry is now actively seeking women engineers and myths about the engineering profession are disappearing. In addition to general job availability information, young women need to be made aware of career options in industry, government, laboratories and academia. There are also misconceptions that need to be put to rest. One of the myths for engineering is that engineers work mostly with things. A second myth is that an engineering curriculum is unsuitable or too strenuous for a woman. A third misconception is that you have to like mathematics to go into engineering. An enthusiastic attitude toward mathematics will probably make pursuing a career in engineering more pleasant, but it is not necessary. Another is that engineering students have such a stringent class and laboratory schedule that they don't have time to enjoy college life.

129 Arbanas, R.J. 1988. **Girls + math + science choices. A conference for young women interested in exploring career options. A handbook for planners.** Marshall, MI, Calhoun Intermediate School District. 73p. (ED 313241)

This handbook is intended for use at a 1-day conference for 170 seventh and eighth grade girls, their parents, counselors, and math/science teachers. It is meant to stimulate interest in exploring career options in mathematics and science related areas.

130 Arbanas, R.J. and Lindquist, G.R., (Ed.). 1989. **Girls + math + science choices. A handbook for educators.** Marshall, MI, Calhoun Intermediate School District. 41p. (ED 313242)

This handbook is intended to stimulate interest in career choices for young women in mathematics and science related areas. The dearth of women in science professions and solutions are presented. Survey questions for measuring sex bias; instructions for improving attitudes toward mathematics; worksheets; factors predicting college science major choice; organizations; resource media and material; and strategies for the future are included.

131 Arbanas, R.J. and Lindquist, G.R., (Ed.). 1989. **Girls + math + science choices. a handbook for parents.** Marshall, MI, Calhoun Intermediate School District. 33p. (ED 313245)

This handbook is intended to help parents to stimulate their daughters' interest in career paths for young women in mathematics and science-related areas. Discussed the dearth of women in the sciences, includes a fact sheet; practical advice and guidelines; activities; reading materials; resource information. Books, periodicals, and organizations are among other topics included.

132 Armstrong, L.S. 1991. **Program to send middle-grade students to colleges.** *Education Week*, Vol.10, No.36, p.8.

As part of its pre-freshman enrichment program, the Department of Energy has awarded \$1.28 million in grants for programs enabling middle-grade students to study on college and university campuses in order to promote science careers for female and minority students.

133 Bagasao, P.Y. 1983. **Factors related to science-career-planning among Asian and Pacific American college-bound high school seniors.** Thesis(Ph.D.), University of California, Los Angeles. 227p.

The study sample included 226 college-bound high school seniors who participated in a national study entitled *High School and Beyond (HS&B)*, conducted by the National Center for Education Statistics in the spring of 1980. A sample of 384 college-bound white high school seniors from the HS&B study served as the comparison group. The analyses conducted for the study included comparisons among various ethnic groups within the Asian and Pacific American (APA) sample, comparisons between the aggregate APA sample and the White sample, and comparisons between pure and applied science students within the group of science-career-choosers. In addition to the cross-tabulations, multiple discriminant analysis was used. The major findings to emerge from the study were as follows: (1) Contrary to popular belief, Asian and Pacific Americans are not "all alike." Rather, the different ethnic groups that make up the APA population vary, especially with respect to residence history, home environment, proficiency in English, and orientation toward mathematics and science. They also vary with respect to science-career-planning and type of science career planned. (2) The shorter the time the APA student had lived in the U.S., the more likely he/she was to plan to major in science, especially an applied science field. (3) APA men were more likely than APA women to plan to major in science, and this gender difference persisted even after differences in mathematical and verbal ability were taken into account. The following profile of the APA science-career-planner emerged from the study: they are more likely to manifest superior quantitative ability, to take a large amount of math and science course work in high school, and to consider their math classes valuable and interesting. They are not socially or verbally oriented, and tend to be more practical in their values than non-science career planners. This profile of the APA science career planner was strikingly similar to that of the White science career planner.

134 Benson, T.M. and Austin, M. 1989. **'Insight' courses for encouraging more young women to become professional engineers.** *IEE Proceedings, Part A: Physical Science, Measurement and Instrumentation, Management and Education*, Reviews, Vol.136, No.2, p. 95-99.

There is considerable scope for the greater employment of women in engineering, and numerous attempts have been made to encourage more girls to consider careers in this field. Describes the aims, programs and evaluation of 'Insight' residential courses held at universities/polytechnics since 1979 which have been designed to tell academically able girls about the education, training, work and career prospects of professional engineers. It is concluded that a strong case exists for continuation, or even expansion, of the scheme.

135 Blosser, P.E. 1990. **Procedures to increase the entry of women in science-related careers.** *ERIC/SMEAC Science Education Digest No. 1*. Washington, D.C., USA: Office of Educational Research and Improvement. 4p. (EDO-SE-90-25; ED 321977)

Girls and boys start off equal in mathematics and science performance and interest in school. They appear to do equally well in both subjects in elementary school. Once courses become optional in secondary school, the down hill spiral in enrollment of female students in mathematics and physical science begins,

accompanied by decreases in achievement and interest. This means that women are inadequately prepared for most college majors as well as those in technical fields. The findings of research, improvements in the situation, and intervention strategies to help increase girls' participation in science are discussed. Several resources for the identification of intervention programs are listed including four national networks of women in science and engineering.

136 Borman, S. 1991. **College science studies: women, minority recruitment lags.** *Chemical & Engineering News*, Vol.69, No.44, p.6-7.

Current efforts to recruit and retain female, minority, and disabled students in university science and engineering programs fall far short of what is needed, according to a study by the American Association for the Advancement of Science. The study proposes to boost such efforts by including a school's commitment to under-represented groups among the criteria used to award research grants. Narrowly focused recruitment and retention programs are in operation at many schools, but they frequently do not involve the faculty as a whole in nurturing students. Concludes that without government intervention at the national and local levels, participation rates will not improve.

137 Brodsky, S.M. 1989. **Staff development to improve recruitment and retention of women and minorities in Associate degree science & engineering technology programs.** *Final report*. New York, N.Y., USA: City University of New York, Institute for Research and Development in Occupational Education. 99p. (CASE-07-89; 152-89-5143)

The problems of under-representation of women and minorities in science and engineering occupations are complex and variant. Many institutions have to learn how to attract more women and minority students to the hard sciences and technologies which are still relatively non-traditional areas for both groups. The project described here provided the participants with direct access to experts and information in these areas so that some of the successful retention techniques used at other institutions could be adapted within their own institution. Two separate full-day workshops, one on recruitment and the other on retention, were conducted for professional registrants from 15 regional colleges. Each event included morning sessions which featured a keynote address of national scope followed by a panel of experts. Summaries of the presentations are included in this report.

138 Brodsky, S.M. 1990. **Campus seminars/workshops to improve recruitment and retention of women and minorities in associate degree science and engineering technology programs.** *Final report*. New York State Education Dept., Albany. Bureau of Grants Administration.; New York State Education Dept., Albany. Office of Occupational and Continuing Education. 1990. p.89.

In light of the projected growth in the percentages of women and minorities in the work force, as well as the need for increased skills among workers, a project was developed to improve recruitment and retention of women and minorities in associate degree in science and engineering technology programs. The project involved on-campus seminars/workshops at three community colleges in the New York City area offering associate degree science and/or engineering technology programs (i.e., Bronx Community College, New York City Technical College, and Queensborough Community College). More than 140 college personnel attended, primarily teaching faculty, counselors and academic administrators. Each on-campus event was jointly planned with key campus personnel and was configured to meet local area needs. Expert presenters communicated both formally and informally with the participants and specially assembled kits of materials were distributed. More than 60 percent of all participants completing program evaluation forms from the three colleges rated the program as excellent. Programs and activities related to this project on each of the three campuses were

enhanced, reinforced, and or newly created as a result of the seminar/workshops.

139 Celender, I.M. 1979. **Careers in industry for scientifically trained women.** IN *Expanding the role of women in the sciences.* p. 179-189. Edited by A.M.Briscoe and S.M.Pfafflin. New York, NY: The New York Academy of Sciences. (Annals of the New York Academy of Sciences, vol. 323)

Industry presents an entirely new spectrum of job opportunities for women and advancement opportunities completely different from the traditional academic research setting. The greatest opportunities for advancement are in management as companies meet their affirmative action guidelines. Despite some bias and the pay discrepancy, management careers hold much promise for women in science. Identifies the characteristics of a good manager as professional excellence, teamwork and dynamic leadership. In addition to advancement in corporate positions, women need strong motivation, commitment, discipline, hard work, long range goals, power orientation and a supportive family.

140 Conwell, E.M. 1992. **Promoting science and engineering careers in industry.** IN *Science and engineering programs on target for women?* p.119-139. Edited by M.L. Matyas and L.S. Dix. Washington, D.C., National Academy Press.

The challenges of increasing competition and declining numbers in the traditional white male pool, however, are beginning to force corporations to recruit, retain, and develop the talents of women at every level. This is true for positions in science and engineering as well as management positions. Some companies have developed good programs for recruiting and retaining women scientists and engineers. Since less is known about this type of intervention than programs in academe, for example, this chapter provides a description of a few of these programs. Successful corporate models appear to have certain characteristics in common: high-level support, up to and including the CEO level, mentoring programs that are institutionalized and continuing, grass roots efforts, such as internal women's self-help of networking groups, an open corporate culture that permits such job options as flex time, part-time, job sharing, and work at home, institutionalized efforts to create gender sensitivity in the work place, such as training programs of "diversity" and gender-related issues, and incentives and accountability for managers on these issues, and continuing program evaluations in terms of keeping data on recruitment and retention rates and attitudes of women toward their work.

141 Cooper, E.F. 1982. **Women in science and technology careers.** Washington, D.C., USA: Congressional Research Service, Library of Congress. 8p. (Library of Congress. Major Issues System. Issue brief, no. IB80065)

142 Cordes, C. 1988. **Colleges try to attract women and minority students to the sciences.** *Chronicle of Higher Education.* Vol. 35, No. 12, p.A33-34.

While many institutions are actively and successfully recruiting women and minority students into the under-represented fields of science, mathematics, and engineering, the faculty and financial resources to train adequate numbers of students must be found. Severe shortages already exist in some professions.

143 Cremer, C. 1980. **Women moving up: a resource directory focusing on careers in science, engineering and technology.** Berkeley, CA, USA: Lawrence Hall of Science, University of California. 133p.

144 Daniels, A.K. 1979. **Development of feminist networks in the professions.** IN *Expanding the role of women in the sciences.* p. 215-227. Edited by A.M.Briscoe and S.M.Pfafflin. New York, NY: The New York Academy of Sciences. (Annals of the New York Academy of Sciences, vol. 323)

Identifies how networks helps in making the difference between success and failure on an important projects for women. It also helps when one needs information on strategies for an administrative or political action, how to approach a strange agency or a difficult mission. Other benefits include socialization and the pooling of resources. Discusses job networks, special problems for women in the professions and the feminist movement as impetus for change and growth of these feminist networks.

145 David, D.S. 1971. **Career patterns and values: A study of men and women in science and engineering.** Thesis (Ph.D.), Columbia University. 258p.

146 Deboer, G.E. 1986. **Perceived science ability as a factor in the course selections of men and women in college.** *Journal of Research in Science Teaching.* Vol.23, No.4, p.343-352.

Hypothesized that high school students develop beliefs about their abilities in science that are based in part on their participation and performance in certain science courses, and that those who believe they have ability in science are more likely to choose a science curriculum than those who do not. 140 female and 109 male juniors and seniors at a highly selective university in the Southeast completed a questionnaire about science and mathematics courses they had taken, grades received, and perceptions of their ability in these courses. As many female students took high school biology and chemistry as male students, but significantly fewer females took physics. Similarly, whereas 74 percent of both males and females took one college science course, only 28 percent of the females took three science courses, compared to 45 percent of the males. Females performed better in biology and chemistry classes than males but rated their ability in science lower.

147 Dick, T.P. and Rallis, S. F. 1991. **Factors and influences on high school students' career choices.** *Journal for Research in Mathematics Education.* Vol.22, No.4, p.281-292.

Parents and teachers influenced career choices more often for students choosing careers in engineering and science. Pay was an important factor in college choice (CC) for males in general, and genuine interest was a more important factor for females not choosing careers in engineering and science. These gender differences disappear among subjects with extremely strong mathematics and science coursework background. Teachers may play a particularly important role in influencing the CCs of females. Equity of access and encouragement in math and science is certainly a necessary, but insufficient, condition for improving the representation of women in engineering and science.

148 Dickman, C.B. 1991. **Women scientists in academia: factors affecting their career choice and their career continuation.** Thesis (Ph.D.), University of South Florida. 306p.

This exploratory multi-method study incorporated both qualitative and quantitative aspects to explore focused research questions and to generate the hypotheses. Data drawn from the Myers-Briggs Type Inventory, The Bem Sex Role Inventory, a Likert-type scale, a demographics form, and semi-structured interviews were used to generate hypotheses, either pertaining to the research questions or to other factors which emerged during the study. At the same time, data from the Myers-Briggs Type Inventory and the Bem Sex Role Inventory were statistically tested to look at relationships between variables such as age, marital status and scientific discipline and scores on these instruments. All instruments were mailed to women in the state of Florida who possessed an advanced degree in a natural science and were employed at a community college, college or university teaching and/or engaging in research in the natural sciences during the 1990-91 academic year. One hundred eligible women were included in the final data analyses. Significant factors affecting career choice were mothers' attitudes toward women working in male dominated fields, parental expectations regarding grades, perception of science throughout the

academic pipeline, peers' reactions toward choice of science as a field of endeavor, science teachers, and attitude toward science activities. Career continuation was mainly influenced by the work atmosphere women experienced. They sought and obtained, for the most part, a cooperative environment. Attributes of successful female scientists were found to be: attitudes (Introversion/Extraversion) varied with age, a majority of women scored as Extroverted-Intuitive-Thinking-Judging or Introverted-Intuitive-Thinking-Judging on the MBTI, judgement scores are affected by marital status, Masculine and Androgenous classifications increase with decreasing age, and life and physical scientists were more often categorized as intuitive than were mathematicians. The results show that differences in perceptual mode, judgement, and attitudes exist across age groups and disciplines. Sex role preferences also change across age.

149 Dix, L.S. 1992. **Promoting science and engineering careers in the federal government.** IN Science and engineering programs on target for women? p.141-159. Edited by M.L. Matyaas and L.S. Dix. Washington, D.C., National Academy Press.

The federal government has begun to be more proactive in its efforts to recruit and retain not only its scientific and engineering work force, but more particularly its employees who are women scientists and engineers. Many of the federal initiatives in the area can be traced to the establishment of the Office of Personnel Management in 1972. However, most have been implemented during the past five years, as attention has been drawn to the changing U.S. demography and its implications for employment policies. Nonetheless, change in the actual percentages of women scientists and engineers employed by federal agencies comes slowly, especially at the higher levels of the general schedule of salaries, partly because of the low turnover among members of the existing federal work force. It is heartening, though, to learn that some federal agencies are setting examples for their counterparts by addressing the situation and creating programs to enhance the recruitment and retention of women scientists and engineers.

150 Ember, L.R. 1989. **Luce Foundation Program helps women develop science careers.** Chemical and Engineering News. Vol. 67, No. 30, p. 23-25.

A fund established by the will of Clare Boothe Luce is announced. Fourteen university beneficiaries are listed. Other programs which help to promote the participation of women in science and engineering are discussed.

151 Ethington, C.A. and Wolfe, L.M. 1988. **Women's selection of quantitative undergraduate fields of study: direct and indirect influences.** American Educational Research Journal. Vol.25, No.2, p. 157-175.

Examined the manner in which complex interactions of various factors influence women's choice of undergraduate fields of study by proposing a structural equation model indicating hypothesized patterns of effects in 1,312 women. Although no academic performance measure influenced field of study choice, the number of mathematics and science courses taken in high school was the predominant factor in the model. This factor had the greatest direct influence on the field of study and served as the mediating variable for all indirect influences. Other significant effects were exerted by the initial choice of a quantitative field of study as a high school sophomore and student background characteristics and attitudes.

152 Everett, M. 1988. **How to top the old boys' network.** Graduating Engineer. Special Issue, p.23-25.

Describes some of the problems facing female engineers and their career advancement. Discusses strategies for successful networking and mentoring that will help facilitate promotion and lasting friendships in an engineering career.

153 Fee, E. 1978. **Science and the "woman question," 1860-1920: A study of English scientific periodicals.** Thesis (Ph.D.), Princeton University. 360p.

Three kinds of concerns characterized most of the discussions about women in the articles, editorial pages and correspondence columns of the scientific press. First, should any women be admitted to scientific societies and to professional schools? Second, should women's work and education in the society at large be similar to, or different from, that of men? Third, could scientific analysis uncover any real, unalterable, biological differences in the capacities of the sexes? The understood purpose of these investigations was to decide whether any limitations had to be placed on women's activities and claims to equality. The task of the social and biological sciences was to make the connections between nature and society clear and explicit, so that social policy could be rationally, "scientifically," based, and society organized in accordance with natural law.

154 Gardner, A.L. 1986. **Effectiveness of strategies to encourage participation and retention of precollege and college women in science.** Thesis (Ph.D.), Purdue University. 191p.

College women in nursing, biology, and engineering major programs were surveyed with regard to selected demographic and affective variables in order to identify strategies that are important for their retention in scientific disciplines. The effectiveness of career-planning seminars for developing career commitment among the college women was also evaluated. Discriminant function analysis of the data from the college students accurately differentiated women in the nursing, biology, and engineering programs. The derived discriminant equations may be useful as a counseling aid for females undecided about their college majors. Strategies that help retain college women in male-dominated majors may be equally effective for women in non-gender-dominated majors. Comparisons of biology and engineering majors who had and had not completed career-planning seminars indicated that the course was somewhat effective for increasing career commitment among women in biology. Both biology and engineering students' comments indicated that the courses helped develop their career plans, feelings of peer support, and the idea that having both a family and a career is possible.

155 Gbamarja, S.P.T. 1980. **Distinguishing reasons for choice of science versus non-science collegiate majors by science-able secondary school leavers in Sierra Leone.** Thesis (Ph.D.), University of Illinois at Urbana-Champaign. 213p.

This exploratory survey was conducted to uncover some of the main reasons science-able secondary school leavers in Sierra Leone choose not to pursue science beyond secondary school level. Data was collected using structured questionnaires and personal tape-recorded interviews with science and non-science students, and with some science teachers. The findings show that non-science students decided to pursue disciplines other than science because they were discouraged by the methods of teaching used in their GCE classes, specifically forms 4 and 5, and were not satisfied with the GCE syllabus and examinations, which essentially define the curriculum for the secondary school. Another factor which entered into students' decisions to pursue non-science studies was the prevalent belief that the science-related careers available to them offered lower socio-economic benefits than those available to arts and humanities graduates. They believed that the only esteemed position the study of science could lead to is the doctor of medicine, but most science graduates would end up in teaching which offered little economic or social reward. On the other hand, arts and humanities graduates could assume and advance rapidly in esteemed positions in the civil service. The problem of a weak background in mathematics was also raised as a subsidiary reason for students not pursuing science beyond GCE. But this mathematics issue and the socio-economic issue were not seen as compelling as the problem of inappropriate curriculum and teaching methods. An important finding in this study is that the majority of

students felt that men and women are equally capable of learning and understanding science. However, they said that men are more satisfied and successful in science careers than women. The investigator speculated that this connection, especially to investigate possible roles for girls in science in Sierra Leone. Despite the unhappy experiences which the students said they had at school, and their prevalent belief that science careers have little or no socio-economic rewards in Sierra Leone, the students did not lose their interest in science. They had positive attitudes toward science and were interested in it, even though they decided not to pursue it. The investigator recommends that the Core Course Integrated Science (CCIS), having been preferred by students and teachers in the present study, be expanded to include material suitable for senior secondary school. This expanded curriculum for the senior secondary school should be diversified to incorporate the development of job skills, combined with development of general education based on the needs of the Sierra Leone society. Such a curriculum would provide diverse areas of content which should stimulate students' understanding and interests and thereby encourage them to study science at advanced levels.

156 Granville, R.C. 1985. **The influence of science role models on the attitudes of middle school students toward women in science.** Thesis (ED.D.), University of Miami. 143p.

A sample of 154 students of which 75 are boys and 79 are girls, in six sixth grade classes from three urban middle schools in a large school district participated in this study. Each career unit consisted of ten one hour science presentations by either male scientists for the control group or female scientists for the experimental group. Each scientist presented a science concept, related it to his/her job, discussed science career preparation and his/her work, and answered student questions. The third group of students received no treatment but supplied baseline data. All students were pretested and posttested using two attitudinal instruments, the Women in Science Scale and the Image of Scientists Scale. The control and experimental groups were retested five weeks after treatment had terminated. Concludes that (1) Science career education units utilizing scientists as role models are an effective means for altering student attitudes; (2) presentations by role models of either sex results in improved attitude toward scientists; (3) females exhibit less sex stereotypical attitudes toward women in science than males prior to and after treatment; (4) treatment is more effective for girls than for boys in that girls achieved greater gains and thus evidence is less sex stereotypy; (5) changes in attitude as a result of treatment are maintained when treatment is discontinued; (6) there is a carry over effect of treatment as evidenced by significant increases in retest scores on the Image of Scientists Scale.

157 Healy, B. 1992. **Women in science: from panes to ceilings.** Science. Vol.255, No.5050, p.1333.

An editorial discusses the fact that even though women receive negative treatment in the classroom and face discouraging employment and funding prospects, it is important that women pursue careers in science and medicine.

158 Hoehlein, J.L. 1985. **A descriptive study of the relationship among sex-role, self-confidence, and career selection in women returning to college.** Thesis (Ph.D.), Michigan State University. 115p.

Examined the connection among a woman's sex-role identity, self-confidence level, and her selection of a career in one of the sciences. It was hypothesized that the more self-confident and androgynous a woman was, the more likely she was to select a scientific or scientific-related career. The sample had been drawn from female community college students (30 years old or older) who had just recently returned to a formal learning environment after being away from an academic environment for five or more years. Concludes that (1) In adult females there was a high correlation between sex-role identity and self-confidence. A woman with an

androgynous sex-role identity was more likely to have a positive self-confidence level. (2) There was no statistically significant prediction of sex-role identity or self-confidence, alone or jointly, upon career selection.

159 Holden, C. 1989. **Wanted: 675,000 future scientists and engineers.** Science. Vol. 244, No. 4912, p.1536-1537.

Employment projections in science and engineering are presented. A shortfall is predicted unless more women and minorities can be attracted to science. Projections are based on a number of demographic and educational statistics.

160 Hopkins, P. 1989. **Women, minorities, and the private sector in science and mathematics education. A review of the literature.** Houston, TX, Austin Independent School District, Texas. Office of Research and Evaluation. 27p. (ED 309987)

In order to interest women and minorities in science and teaching, a proposal by the Science Academy of Austin, Texas specifically recommended recruiting high school minority and female students as future science teachers, providing elementary students with opportunities to experience science, and increasing the number of women and minorities in the Science Academy program. A search of the literature was undertaken to explore the background conditions for these objectives. The attraction to teaching for minorities; factors of mathematics and science teacher shortages; sex-role models in science; secondary school programs which promote science teaching as a career; and business alliances with precollegiate science education are explored.

161 Hussey, S.W. 1987. **Leading girls to mathematics, science, and technology: into the world of today and tomorrow.** Contemporary Issues Series. New York, NY, Girl Scouts of the U.S.A. 40p. (ED 309087)

This document is designed to help Girl Scout leaders and others to encourage girls to become involved in mathematics, science, and technology activities. This booklet includes: (1) a rationale for encouraging girls; (2) a discussion of educational and social influences; (3) activity ideas for exploring science, mathematics, and technology; (4) suggestions for encouraging girls; (5) a discussion of role models; (6) linkages to the Girl Scout program; and (7) a set of computer activities. A list of national organizations, museums and science centers, magazines, books, and local resources is appended.

162 Iadevaia, D.G. 1989. **A study of the relationship between student enrollment in first year/second year science courses and gender at Pima College.** Societal factors affecting education. Ed.D Practicum, Nova University. 32p.

A study was conducted on the enrollments of students in first and second year science courses at Pima Community College, Arizona, over a 5-year period. Of those students who passed these courses with a C grade or better, frequency distributions by sex were made. It was found that the distribution of male/female registered as well as male/female passed was approximately 50 percent. Also, females seemed to do better than males in the upper level science courses. An unusually high dropout rate of students who registered for these courses was uncovered, indicating a possible problem with students selecting science courses without adequate preparation. This drop out rate did not affect the male/female ratio regarding passing the course with a C grade or better. Several recommendations are made: (1) that the college maintain programs to keep the enrollments of female science students at current levels; (2) that some form of program be established to allow female science students to interact with female scientists; and (3) that the college study the reason for the high dropout rate of students in the sciences.

163 Ivey, E.S. 1987. **Recruiting more women into science and Engineering.** Issues in Science and Technology. Vol. 4, No. 1, p. 83-87.

Calls for increasing the number of women into science and engineering professions, while improving the competitiveness of the United States at the same time. Suggests that more of the current statistics regarding women in these professions be publicized, and programs to initiate, to actively recruit more women into these careers.

164 Ivey, E.S. 1988. **Recruiting more women into engineering and science.** Engineering Education. Vol. 78, No. 8, p.762-765.

The number of women faculty members in engineering correlates directly with the number of women who pursue careers in this field. Ways to break the cycle of too few role models producing another generation of too few women engineers are outlined.

165 Jagacinski, C.M. 1987. **Engineering careers, women in a male-dominated field.** Psychology of Women Quarterly. Vol. 11, No. 1, p.97-110.

Conducted a national survey comparing background and career characteristics of men and women engineers. Parents of women engineers were more likely to have college degrees and to be professionals. Women engineers were less likely to be married or have children than were men. Men made career decisions sooner than women. Gender differences in supervisory responsibility and salary favored men.

166 Killian, J.R. 1965. **Enhancing the role of women in science, engineering and the social sciences.** IN Women and the scientific professions, the M.I.T. symposium on American women in science and engineering. p.128-138. Edited by J.A.Mattfeld and C.G.Van Aken. Cambridge, MA, The M.I.T. Press.

Any examination of trends in the employment of women must be made against a background of recent social changes. There has been a trend in recent decades to earlier marriages and more children. The peak years for the participation by women in the labor force is now in the late forties. This is simply another one of the paradoxes in our current situation where there is an obvious desire on the part of an increasing number of women for professional careers along with a more demanding commitment to marriage and children. Clearly, however, there is a great opportunity for productive employment of married women after their childbearing is over. From these statistical trends, employer comments, and general observations, the following conclusions are presented. 1) The rapid growth of population in the professions, especially in science and engineering, will bring enlarged opportunities for women, although the increase in opportunities for women will not be in proportion to the increase in the total numbers of scientists and engineers. 2) Much remains to be done to increase the opportunities for women in these professional fields. Of first importance, more women must prepare themselves more adequately for the practice of science and engineering and 3) the role of women in the professions must be designed to be compatible with marriage and the rearing of families.

167 King, C. and Collarini, C. [1988]. **Career guidance ideabook.** New York, N.Y., USA: Society of Women Engineers. 157p.

This ideabook was created to share career guidance ideas between sections of Society of Women Engineers to help improve and build career guidance programs. The book is divided into six chapters: basic programs; outreach programs; student sections; scholarships; fund raising; and national committee.

168 Kren, J.A. 1979. **Effects of non-traditional occupational role models on factors related to occupational choice of college women.** Thesis (Ph.D.), University of Missouri - Columbia. 104p.

The purpose of this study was to assess the efficacy of videotaped role models and role reinforcers in the modification of levels of achievement motivation, internality of control, self-esteem, and interest in non-traditional occupations in college women. The assumption was made that, because of an external locus of control and low self-esteem that characterize many college

women, they are unlikely to defy sex-role stereotypes and choose traditionally masculine occupations. The three role models selected for this study were women successfully employed in scientific fields. The role reinforcers, both engineers and husbands of two of the models, were presented as supporting and approving of their wives' occupational goals. Specifically, the investigation considered the following questions: (1) Does the presentation of videotaped role models and role reinforcers lead to changes in achievement motivation, locus of control, or self-esteem? (2) Is the presentation of videotaped role models and role reinforcers accompanied by an increase in expressed interest in the exploration of applied mathematics, physical science, and engineering fields? It is concluded that the use of videotaped role models and role reinforcers has no effect on the achievement motivation, internality of control, or self-esteem of undergraduate college women. The treatment employed in this study does not increase willingness to explore non-traditional occupations.

169 Kurth, K. 1987. **Factors which influence a female's decision to remain in science.** South Bend, IN, Indiana University. 46p. (Exit Project - 591; ED 288739)

The purpose of this literature review was to analyze research dealing with the factors influencing female retention in the sciences. These factors were considered from personal, sociological, and educational perspectives, with the intention of making people more aware of the influences which they may have on the future education of females. The studies cited in this project are arranged in alphabetical order and are annotated. These studies reveal several personal (biological, individual self-concept, and locus of control), social (stereotyping and the influence of significant others), and educational (classroom environment and science experience) variables which are responsible for this lack of female participation in the sciences.

170 Lantz, A.E., Whittington, M.C., Fox, M.L., Elliott, L. and Sackett, K. 1980. **Reentry programs for female scientists.** N.Y., Praeger. xviii, 195p.

In order to aid women seeking to reenter science, the National Science Foundation made twenty one awards, eleven in 1976 and ten in 1977 to colleges and universities for Science Facilitation projects designed to update and augment the scientific knowledge obtained by women who received bachelor's or master's degrees in science at least two years before their acceptance as participants in the project. The objective was to bring the participants to the point where they were eligible to enter graduate school or to obtain scientific employment immediately. The Science Career Facilitation projects supported have been of three main types: those to upgrade participants from a single field, for example chemistry, in that same field, those to provide training in a field different from the original field(s) of the participants or those to upgrade a group of participants from a variety of field so that the participants will acquire interdisciplinary backgrounds. This book presents the results of the evaluation of this project. Among the conclusions reached, the Career Facilitation Project concept is a viable strategy to assist these women and some projects have been highly successful in assisting the participants to obtain employment or graduate school entrance. The projects have been most successful in serving women who are not currently employed, who have adequate incomes, and who do not have small children.

171 Low, D. 1981. **A description of the science career workshop project for women in science.** IN Girls and science and technology (GASAT). Contributions to the conference, 1st, Eindhoven, The Netherlands, November 9-13, 1981. Vol. 2, p.145-149. Edited by Jan H. Raaij. Netherlands, Eindhoven University of Technology. (ED 262998)

Recognizing the need both to offer encouragement to women entering into mathematics and science-related fields of study, and the need to recruit more women into those fields, Orange Coast

College in Costa Mesa, California, submitted a proposal to the National Science Foundation in the Spring of 1981, outlining and seeking financial support for a program that involved faculty felt would produce that end result. The proposal was selected for funding, and one of only 34 from among all colleges that received support. This paper describes the college, and project as it was proposed and as it is currently being developed.

172 Lyons-Lepke, E.M. 1986. **Choosing majors and careers: An investigation of women persisters and defectors in mathematics and science majors in college.** Thesis (Ph.D.), Rutgers. The State University of New Jersey - New Brunswick. 274p.

Studies 50 women students who entered a large northeastern state university to major in mathematics or science. All had scored at least 500 on the M-SAT. By the end of their junior year, 25 had defected from their intended majors and 25 persisted. This study reports factors which the subjects believe influenced their decisions. The analytical framework utilized six concepts: role modeling, identification, encouragement, self esteem, gender identity and attributions for success and failure. Areas to which these concepts are applied are: influence of parents, professors and peers, individual characteristics, classroom and work experiences. Concludes that (1) the most important factor for persistence is having a father who is encouraging, who holds a scientific position and with whom daughters identify. (2) High levels of self confidence, "other directed" personality traits and strong career commitment are also associated with persistence. (3) Mothers do not have much influence on daughters' decisions to either persist or defect. (4) Both persisters and defectors attribute their academic success more often to hard work than to ability. (5) Defectors tend to be discouraged by the general atmosphere in mathematics and science classes. (6) Both persisters and defectors report that mathematics and science classes are too large and that teaching is poor. (7) They also report that classroom peers, mainly males, are competitive and unfriendly. (8) The meshing of family and career roles is of considerable concern to both groups. (9) Counselors, roommates and boyfriends have little influence on either persisters' or defectors' decisions regarding choice of major.

173 Malcolm, S.M. 1990. **Essay: who will do science in the next century?** *Scientific American*, Vol.262, No.2, p.112.

State that the country is not training enough scientists and engineers, and that is largely because it is not convincing enough young people to opt for careers in science and engineering. The finger is routinely pointed at science education in the elementary and secondary schools. The competing forces of cramming in, "dumbing down", expecting little in the way of understanding and weeding out allow few students to emerge with their interest in science intact and with the kind of preparation that is essential for further education and career in science or engineering. In order to maintain a large pool of talent, the scientific community should be actively recruiting women and minorities.

174 Matyas, M.L. 1992. **Overview: The status of women in science and engineering.** IN *Science and engineering programs on target for women?* p.27-39. Edited by M.L.Matyas and L.S.Dix. Washington, D.C., National Academy Press.

Lists current statistics and research to show the status of women in science and technology and to define the problem that intervention programs seek to solve. Understanding the problems that lead to the under-representation of women in science and engineering is a necessary first step in moving to alleviate that problem, but it is not sufficient. While we need to understand better the particular obstacles that prevent women from entering careers in science and engineering, we also need to continue, at the same time, to develop and implement programs that do something about removing those obstacles and increasing women's participation in science and engineering. There is no one unique formula for developing such programs. Furthermore, the development of new programs is made

very difficult by current funding constraints at all levels of government and in the private sector. A clearinghouse that would collect and share information about programs that work is needed to facilitate the task of improving the participation of women.

175 McMillen, L. 1986. **Women flock to graduate school in record numbers, but fewer blacks are entering the academic pipeline: women.** *Chronicle of Higher Education*, Vol. 33, No. 2, p.1,25.

Many academic administrators consider the future job market a golden opportunity for universities to increase the representation of women on their faculties. However, lingering sexual bias in hiring and promotion decisions, as well as a shortage of women with doctorates in scientific fields, may cloud that promise.

176 McMillen, L. 1987. **Step up recruitment of women into science or risk U.S. competitive edge in field, colleges are warned.** *Chronicle of Higher Education*, Vol. 33, No. 48, p.9,12.

Fewer women are choosing science and engineering careers at the same time that the college-age population is shrinking, threatening a dire shortage of scientists in academe and the general labor force. Affirmative action is seen no longer as only a moral responsibility, but also as a matter of national survival.

177 McMillen, L. 1989. **Clare Boothe Luce Fund to spend \$3.5 million a year to encourage women to study and teach science.** *Chronicle of Higher Education*, Vol. 35, No. 43, p.A23-24.

Clare Boothe Luce left a special trust whose sole purpose is to encourage women to enter, study, graduate, and teach science. Fourteen institutions were designated by her to use the money to support the advancement of female students and faculty members in science and engineering.

178 Metz, S. 1991. **ECOES: a summer engineering and science program for high school women.** *Gifted Child Today*, Vol.14, No.3, p.40-43.

Exploring career options in engineering and science at the Stevens Institute of Technology (New Jersey) introduces talented female students (entering grade 11 or 12) from all over the country to engineering and science in a 2-week residential program involving hands-on laboratory work; on-site visits and seminars; and student research.

179 Morrow, D. and Goertzen, S. 1986. **A commentary on gender differences.** Winnipeg, Canada: Manitoba Department of Education, Planning and Research Branch. 13p. (ED 301469)

The development of knowledge and skills in the areas of mathematics, science, and computers is considered to be important for all students, both males and females. These subjects are prerequisites for many post-secondary education programs. Some of the most highly paid sectors of the labor market are those which require math, science, and computer knowledge. The importance of these fields in a person's everyday life should not be underestimated. Women tend to be under-represented in these fields. This paper provides an overview of this issue and a description of what is known about the situation in the province of Manitoba. Discussions in this report center around enrollment, achievement, and social factors. Six suggestions to improve the situation are included.

180 Oakes, J. 1990. **Lost talent: the underparticipation of women, minorities and disabled persons in science.** Washington, D.C., USA: National Science Foundation. 114p. (RAND/R-3774-NSF/RC)

Reviews research on the relationship between educational practices and policies and the low rates of participation of women, minorities, and disabled persons in science related careers. The information presented is designed to contribute to the discussion of how schools might create conditions that will help under-represented groups prepare for careers in science and mathematics. The report

has two central messages. There is much that is not understood about the low participation rates of these groups and what is known suggests that there are alterable features of schools that appear to constrain participation. Discussed the following issues: the current status and policy concerns involved in this issue; the scientific pipeline; cognitive and attitudinal factors; school factors; societal factors; intervention strategies; and suggestions for further research.

181 Obleton, N.B. 1984. *Career choice among black professional women in selected nontraditional careers*. Thesis (Ph.D.), Arizona State University. 187p.

The data were obtained through a one hour and fifteen minute audio-tape recorded interview and a personal data questionnaire. In identifying factors affecting their career choice, most of the Black professional women identified an influential person, belief, or circumstance. All of the participants held the belief that education was important. Among the doctors and the nurses, parents were the most influential persons, whereas, among the scientists/engineers math instructors were the most influential persons. The influential circumstances varied among the participants. Scientists/engineers credited innate abilities, whereas, the doctors and the nurses credited being in the career atmosphere or environment. The impact of counselors on the career choice of Black professional women in science/engineering and medicine was found to be negligible.

182 Pascarella, E.T. and Staver, J.R. 1985. *The influence of on campus work in science on science career choice during college: a casual modeling approach*. Review of Higher Education. Vol. 8, No.3, p.229-245.

A casual model, which included background/family traits, secondary school experiences, pre-college career choice, college major, college achievement and on-campus science-oriented work experience, was tested on 5162 students from 74 institutions. Science oriented on-campus work experience positively influenced science career choice for both sexes, as did parental science careers.

183 Phillips, P. 1990. *The scientific lady: a social history of women's scientific interests 1520-1918*. New York, NY, St. Martin's Press. xiii, 279p.

Concentrated mainly on the media through which science was conveyed to women, and those who enjoyed and produced these media; the formal or informal education in the sciences that some women were lucky enough to experience; some of the scientific recreations in which women participated; and the complex arguments that were evolved to justify their interest in science. Recounts the activities of women in the newly founded Royal Institution and in the British Association for the Advancement of science. Some participants in these bodies are discussed at greater length. Attention is drawn to the central place of science in the minds of those who spearheaded the influential movements that had begun to upgrade and further the education of middle-class women. The science education of women of the lower classes is discussed by way of contrast.

184 Raloff, J. 1991. *Science, recruiting nontraditional players*. Science News. Vol. 40, (December), p.396-398.

Overcoming the education obstacles facing women, minorities, and the disabled is discussed. A report published by the American Association for the Advancement of Science (AAAS) on the topic of bringing under-represented groups back on track for careers in science, math, and engineering.

185 Ramaley, J.A. 1979. *Strategies for change: a summary*. IN Expanding the role of women in the sciences. p.228-233. Edited by A.M.Briscoe and S.M.Pfafflin. New York, NY, The New York Academy of Sciences. (Annals of the New York Academy of Sciences, vol. 323)

Concentrates on issues affecting women as individuals, the self,

interactions with other people and the nature of institutions in which women work.

186 Raskin, B.L. 1968. *The relative effect of occupational and socio-occupational information on high school girls' expressed opinions of women scientists and science as a career*. Thesis (Ph.D.), The Johns Hopkins University. 71p.

The subjects in this study were 115 college-bound girls in the senior year of high school who were asked to express their intentions of becoming scientists and their opinions of women scientists before and after two lectures were given. Experimental Group 1 of 33 students heard Lecture 1 about career opportunities for young women in the sciences. Experimental Group 2 of 42 children heard Lecture 2 which was Lecture 1 plus some favorable information about social aspects of the life of women in the sciences. The Control Group of 40 children received no information. The total number of favorable changes in response made by each group and the magnitude of favorable change in response, as reflected by total scores, were evaluated using the Kolmogorov-Smirnov two-sample test and the Mann-Whitney U test. Results showed that Lecture 2 had no more effect than Lecture 1 on the girls' expressed intentions of becoming scientists. Lecture 2 had more effect than Lecture 1 on the girls' expressed opinions of women scientists only when the magnitude of favorable change in response was the criterion.

187 Raymond, C. 1991. *Continuing shortage of women in science decrised; many drop out*. Chronicle of Higher Education. Vol.38, No.16, p.A31-A32.

Despite a variety of efforts to narrow the gap, men still vastly outnumber women in science and engineering. Also, two national studies have concluded that schools are losing the female students whose interest they had piqued by special recruiting efforts.

188 Rosser, S.V. 1990. *Female friendly science: applying women's studies methods and theories to attract students to science*. New York, Pergamon Press. xii, 159p.

Explores the potential of feminist pedagogical methods and theories of women's studies to attract women and people of color to science. The exploration begins with an evaluation of the current reports surrounding the crisis in American higher education. The crisis and its correlated dearth of scientists and engineers is accurately depicted in the reports. However, the back to basics solutions suggested by their authors are unlikely to attract the women and minorities needed to fill the shortage. An examination of feminist scholarship and pedagogy developed for teaching women's studies courses reveals information and techniques that contrast with the back to basics approach advocated in the reports. Comparing the feminist critiques of science with African-American, Marxist, and non-Western critiques reveals the similarities among them as well as the unique features that each perspective provides.

189 Rossi, A.S. 1965. *Barriers to the career choice of engineering, medicine, or science among American women*. IN Women and the scientific professions the M.I.T. symposium on American women in science and engineering. p.51-127. Edited by J.A.Mattfeld and C.G.Van Aken. Cambridge, MA, The M.I.T. Press.

Presents a brief overview of women's positions in these fields now, and how they have changed in recent years; a preliminary report of the results of a study of women college graduates, summarizing some of the factors that differentiate women who have chosen career fields that are now predominantly chosen by men from those who have chosen careers of a more traditionally feminine nature and from those who see no career field other than homemaking in their future. A brief profile of how the broad spectrum of career fields differ in the occupational values associated with their choice, with particular attention to the most salient characteristics of the scientist, and what they imply for an interpretation of why women seldom choose scientific careers, or why women have difficulty implementing a choice of a scientific

career. Concludes with the report of results from the college graduate study, on the kinds of success women admire in other women, and the kind of success they would like to have themselves.

190 Russell, D.H. 1979. **How a scientist who happens to be female can succeed in academia.** IN *Expanding the role of women in the sciences.* p.283-295. Edited by A.M.Briscoe and S.M.Pfafflin. New York, NY, The New York Academy of Sciences. (Annals of the New York Academy of Sciences, vol. 323)

Describes the forces which have changed her life and the decisions which were instrumental in her achievement of the proper title and job security i.e. professor with tenure; with efforts to obtain independent grant support to develop her own scientific ideas and inspire students which is the only way to impact in a major and long-term manner in the scientific world.

191 Rutherford, F.J. 1979. **The role of the national science foundation.** IN *Expanding the role of women in the sciences.* p. 276-282. Edited by A.M.Briscoe and S.M.Pfafflin. New York, NY, The New York Academy of Sciences. (Annals of the New York Academy of Sciences, vol. 323)

Discusses how the National Science Foundation has responded to the need to increase women in science. Describes the current activities in NSF's women in science program. These include science career workshops, science career facilitation workshops and the visitor women scientists project.

192 Smith, W.S. and Erb, T.O. 1986. **Effect of women science career role models on early adolescents' attitudes toward scientists and women in science.** *Journal of Research in Science Teaching.* Vol.23, No.8, p.667-676.

Describes a study in which middle school/junior high school students were exposed to women science career role models as a part of their science instruction. Results indicated that the student's attitudes toward scientists and women in science were positively affected.

193 Spanier, B. 1980. **Critical filters in science careers.** IN *Choices for science. symposium proceedings.* Bunting Institute working Paper. p.33-41. Cambridge, MA, USA: Mary Ingraham Bunting Institute of Radcliffe College. (ED 235006)

The critical filters for women entering science and developing as scientists are numerous, complex and intertwined. Among these are the major factor is outright discrimination in hiring and advancing women through the scientific system. For example in academe, women are concentrated in the lower ranks, are not advance as rapidly, are not given tenure, are paid lower salaries, and are concentrated in the less prestigious, less research-oriented institutions. Women are under-represented in the elite Ivy League Schools. The importance of access to the inner circle is linked to another significant factor influencing success in science. That is the supportive function of the mentor, an older, established scientist, whose recommendation can issue the newcomer into the inner circle and who stands behind the younger scientist along the career path: graduate school, post-doctoral research, assistant professorship up through tenure. Well-meaning letters of recommendation written for women often include comments about their demeanor and psychological state, while omitting any statement about their potential as young scientists. Low expectations of a woman in science are reflected in this striking absence of any judgment about her scientific development and future contributions in her field. Women scientists are breaking into inner circles in some fields and learning how to use the system to their own advantage. More importantly, they are mobilizing their own networks and professional groups for support and increased visibility, groups such as American Women in Science. The major problem of integrating a career with family responsibilities is one which half of all females raising children confront everyday. Today, the special problems of a scientific career are created mainly by the rigid time sequence of

the career path, which requires the greatest time and energy commitment during the years considered safest for childbearing - that is, up to age 35. Women's problems are also compounded by the erroneous belief that science cannot be done on a part-time basis. The last problem mentioned is the attitude that women are less successful in science than men because they are innately less suited to the rational, objective, creative work of good science. All the research on sex differences, if analyzed closely, tells us nothing about possible innate differences in scientific ability whatever that is, just as it has told us nothing about differences in intelligence between males and females although there is a long tradition of male scientists claiming objective, "scientific" proof of the inferior intelligence of women.

194 Splaver, S. 1973. **Nontraditional careers for women.** New York, NY, Julian Messner. 224p.

Ten large occupational categories are covered in this book. These are legal, medical, healing arts, the helping professions, math and science, engineering, creative fields, business administration, skilled trades and government services. The history of women in the occupations, number of women, nature of the work, qualifications and preparation necessary or desirable for entry into the occupations, entrance and advancement, places of employment, advantages and disadvantages, supply and demand of workers in the occupations, future outlook for women, professional associations and/or unions and sources of further information.

195 Stage, E. 1992. **Interventions defined, implemented, and evaluated.** IN *Science and engineering programs on target for women?* p.15-26. Edited by M.L. Matyas and L.S. Dix. Washington, D.C., National Academy Press.

Describes a brief conceptual framework of intervention programs. Identifies intervention targets and strategies. In identifying the challenges for the 90s the following needs consideration: What is the problem that is to be solved? If young women's confidence and self-esteem is built a little, will they make it through the existing system? Or are there ways to create a more effective and supportive education and professional environment that can better foster achievement and self-esteem among both women and men? Advocates that for future intervention, the focus needs to be on systemic change; work at every level and target more than just the transition points. Tackling the issues facing girls and women in mathematics, science, and engineering on a one-by-one basis and through isolated intervention programs is labor-intensive and provides for only slow and sporadic change. Attempting systemic change using these methods is virtually impossible. Collaborative strategies implemented by coalitions of administrators, faculty, and community leaders both within an institution and among institutions are needed to begin to build the ultimate intervention programs, the ones that can resolve the disparity in science, mathematics, and engineering for women and men, once and for all.

196 Tsuji, G. and Ziegler, S. 1990. **What research says about increasing the numbers of female students taking math and science in secondary school.** Ontario, Canada: Toronto Board of Education. Research Department. 5p.

Summarizes research which investigated the ways in which female participation in math and science can be encouraged. Areas of emphasis include reasons for under-representation of females, and increasing female participation. Three types of intervention in educational setting described are: one day conferences; staff development; and curriculum.

197 Tullis, C.E. 1980. **The interrelationships between sex role identities, educational and career aspirations, and parental educational levels of women in a science careers workshop.** Thesis (ED.D.). The University of Southern Mississippi. 173p.

The sixty-nine subjects participating in the study were the college women attending the Women in Science Careers Workshop. The

workshop participants complete a questionnaire and the Bem Sex Role Inventory. The Bem Sex Role Inventory was completed in two segments on the pretest: first, as the participants realistically saw themselves and, second, as they ideally saw themselves. One week later, posttests were mailed, and the same process took place. Control groups were tested using the questionnaire and The Bem Sex Role Inventory. The real and ideal selves were tested with the control groups. Multiple linear regression technique, reflecting the use of analysis of covariance and multiple correlation, was utilized to test the hypotheses of the study. It was concluded that the participants were more androgynous in both the real and ideal sex role as a result of the Women in Science Careers Workshop. The ideal self and real self of the participants were considered congruent. The ideal self was more androgynous, as predicted; however, the real self means were also considered androgynous sex roles on the posttest. Accordingly, results concluded that real and ideal career aspirations (traditional vs. nontraditional) educational aspirations and parents' educational levels did not have a significant relationship with real and ideal sex role identity.

198 Vetter, B.M. 1984. **Changing patterns of recruitment and employment.** IN *Women in scientific and engineering professions.* p. 59-74. Edited by V.B. Haas and C.C. Perrucci. Ann Arbor, MI, The University of Michigan Press.

Uses statistics to trace the historical development of women entry in the sciences in the United States. States that women scientists not only have more difficulty finding employment than do men with comparable education and experience, they also find it more difficult to advance as can be seen by examining their salaries. Annual salaries of scientists and engineers vary by degree level, by field, by age, and employment sector. They also vary by sex within each of these categories.

199 Watson, D.S. 1986. **An analysis of selected factors influencing career choices of women in science.** Thesis (ED.D.), University of Northern Colorado. 123p.

A seventy-four item questionnaire using a Likert type of scale was designed for this study. 667 tenth grade female students from four different sizes and types of communities were sampled. Frequencies, percentages, means, ANOVA summary tables and the Scheffe test of multiple comparisons were employed for presenting and analyzing the data. Approximately 10 percent of the questionnaire respondents were selected by systematic sampling for interviews. Predictors of interest, teacher influence, sex-role stereotyped ideas, parental influence, overall grade average, and the population of the community in which the high schools are located.

200 Watts, V.S. 1981. **Women in science career workshop.** Atlanta, USA: College of Sciences and Liberal Studies. Georgia Institute of Technology. 3 vols.

201 Weaver, E.C. 1979. **Implications of giving women a greater share of academic decision-making.** IN *Expanding the role of women in the sciences.* p.257-267. Edited by A.M. Briscoe and S.M. Pfafflin. New York, NY, The New York Academy of Sciences. (Annals of the New York Academy of Sciences, vol. 323)

Answers the question why should a college or university have any interest in increasing the number of women in academic administration? States that women acquire special skills in interpersonal relationships and learn to achieve their ends by less direct means. They are sensitive to the emotional state of those with whom they deal. They are trained as diplomats from the time of the cradle and they also learn early to redefine issues, so that the issues may be viewed from a fresh perspective thus enabling differences to be resolved. Women tend to simplify things; they are also more willing to ask dumb questions and they sometimes find out that in a group of men, no one else knew the answer but no one was willing to reveal that he did not know. The male ego makes it hard to admit ignorance. The qualities that are intrinsic to women are the qualities

that are most needed by our universities today. As we move toward a woman-centered university, the greatest beneficiary will be the university itself. The talents of distinguished women teachers and researchers will foster the aspirations of women, and the vision of all will be broadened.

202 Widnall, S.E. 1988. **AAAS Presidential lecture: voices from the pipeline.** *Science.* Vol. 241, No. 4874, p.1740-1745.

Discusses the issue of who will do science in the future. Reports on several graduate student surveys that concluded that women were indistinguishable from men in objective measures of preparation, career aspirations, and performance in graduate school. They differed significantly in their perceptions of preparation, pressures and coping strategies.

203 Wiggins, E.E. and Soldwedel, B.J. 1989. **Increasing technological employment opportunities for women in the armed forces.** *Journal of Employment Counseling.* Vol. 26, No. 1, p.19-23.

Analyzed occupational distribution of female officers and enlisted personnel in the armed forces. Data confirmed that women were underrepresented in high-technological occupational fields. Suggests that civilian counselors be proactive in counseling women towards preparing for science, engineering and technical career fields. Suggests strategies to improve women's representation in the science, engineering and technical fields.

Salary

204 Haberfeld, Y. and Shenhav, Y. 1990. **Are women and blacks closing the gap? Salary discrimination in American science during the 1970s and 1980s.** *Industrial & Labor Relations Review.* Vol.44, No.1, p. 68-82.

Two longitudinal surveys of US scientists conducted by the Census Bureau, one for the years 1972-1976 and one for the years 1982-1986, are used to estimate salary discrimination against black scientists and female scientists. In counterpoint to the results of some other studies, which have suggested that race and gender-based salary discrimination has been either declining or stable in many occupations, this analysis provides evidence that salary discrimination against black scientists and female scientists worsened between the 1970s and the 1980s. Female scientists earned about 12 percent less than similarly qualified male scientists in 1972, but 14 percent less in 1982. Black scientists earned about the same amount as white scientists in 1972, but 6 percent less in 1982.

205 Ross, S.S. 1988. **Salaries...can you make as much as a man?** *Graduating Engineer.* Special Issue, p.54-57.

Describes recent statistics regarding job opportunities and compensation for female engineering graduates as compared to males. Presents data from the College Placement Council by sex and discipline. Includes several possible explanations for the discrepancies that are shown in the data. Discusses the implications for graduating female engineers.

Biology

206 Ainley, M.G. 1987. **Field work and family: North American women ornithologist, 1900-1950.** IN *Uneasy careers and intimate lives women in science 1789-1979.* p.60-76. Edited by P.G. Abir-Am and D. Outram. New Brunswick, Rutgers University Press.

Discusses the career and home life of North American women

ornithologist who took advantage of the opportunities provided by an incompletely professionalized science to pursue research as independent scientists. Those profiled are Althea R. Sherman, Margaret M. Nice, and Amelia Laskey.

207 Blockstein, D.E. 1990. **Women and minorities--How are the AIBS societies doing?** *Bioscience*. Vol.40, No.8, p.607-609.

Recent studies have identified a continued under-representation of women and minorities in science, which will, if not changed, lead to a shortage of scientists and engineers in the late 1990s.

208 Bottomley, J. and Ormerod, M.B. 1981. **Stability and lability in science interest from middle schools to the age of science choices (14+).** *European Journal of Science Education*. Vol. 3, No. 3, p. 329-338.

Investigated factors affecting science interests of 592 students by administering three questionnaires to them at ages 12+, 13+, and 14+. Conclusions drawn from numerous findings suggest that early science activities have positive and negative long-term effects. Dealing with animals seems detrimental to some females' future interest in biology.

209 Burrows, A.C. 1991. **A social study of women in contemporary biological sciences.** Thesis (Ph.D.), Virginia Polytechnic Institute and State University. 183p.

Women in different fields of biological science were interviewed and the data analyzed by picking out emerging themes. These themes were compared with issues in the feminist literature and with accounts from the social studies of science. Women in biology are far from developing alternative epistemologies, but see themselves as different from their male colleagues in several important respects. They expressed the difficulties in balancing demanding scientific careers with private lives which usually include partners and often included children. At the same time, single women often face problems which married women do not. Concludes that women scientists married to scientists in different specialties may be particularly advantaged.

210 Gardner, A.L. 1989. **Equity, excellence & just plain good teaching.** *American Biology Teacher*. Vol.51, No.2, p.72-77.

Discusses the problem of fewer women participating in science, mathematics, and engineering. Provides guidelines for teachers to use as an effort to change this gender-biased pattern of participation. Includes information on selecting teaching strategies, criteria for equitable science activities, relevancy of learning and skills, careers, and role models.

211 Hall, D.L. 1979. **Academics, bluestockings, and biologists: Women at the University of Chicago, 1892-1932.** IN *Expanding the role of women in the sciences*. p.300-320. Edited by A.M.Briscoe and S.M.Pfafflin. New York, NY, The New York Academy of Sciences. (Annals of the New York Academy of Sciences, vol. 323)

Discusses the development of the biological sciences at the University of Chicago from 1890 to 1930 underrating the importance there of ecology and sex biology. Provides a brief statistical and historical analysis of the careers of 138 women who took Ph.D's in the natural history and biomedical disciplines at the university since its inception. The women who chose the competitive and elitist careers open to Ph.Ds in the first four decades of the University of Chicago needed strength and creativity. Present evidence of their successful survival as academics in the face of a system that discriminated against them as women to a degree that made the professional career patterns of their male mentors at the University almost inaccessible to them. The creativity of these women in surviving and even outflanking the obstacles, suggests not only their inner resources, but some peculiar features of early twentieth century academic science. In spite of the professional limitations on women, the biological sciences were sufficiently diverse and flexible to provide unusual opportunities for individuals who were conscious of

what was happening to professional life, to the biological sciences, to traditional disciplines such as zoology, and to women.

212 Jegede, O. J., Alaiyemola, F. F. and Okebukola, P. A. 1990. **The effect of concept mapping on students' anxiety and achievement in biology.** Special Issue: perspectives on concept mapping. *Journal of Research in Science Teaching*. Vol.27, No.10, p.951-960.

Studied the effects of the meta-cognitive strategy of concept mapping on anxiety and achievement in biology among 30 boys and 21 girls (aged 14-18 yrs) in Nigeria. Those in the experimental group became familiar with concept mapping strategy over 3 weeks; the controls were introduced to the treatment's science concepts via expository teaching. The Affect Adjective Checklist and a biology achievement test were used in pre- and post-test administrations to measure the treatment effect. Concept mapping was significantly more effective than expository teaching in enhancing learning in biology. In addition, concept mapping reduced anxiety toward the learning of biology, particularly in males. Overall, females had a higher anxiety scores than did males.

213 Kahle, J.B. 1985. **Women biologists: a view and a vision.** *Bioscience*. Vol.35, No.4, p.230-234.

An analysis of the education, employment, and the productivity of women in science today suggests ways to increase their contributions to tomorrow. Today's research in science education identifies specific changes in science curricula and teaching while practices in other countries suggest improvements in the marketplace.

214 Kelly, A. 1975. **Why do girls study biology.** *School science review*. Vol. 56, No. 196, p.628-632.

Up to A-levels, more girls than boys take biology. To test this a sample of 1970 Scottish university entrants rated the importance of various aspects of their ideal job including 'working with people rather than things'. Though women and arts/social science students thought it some what more important than men and biology/physical science students, there was no difference between those women in biology and those in the physical sciences. Though this data did not support the traditional hypothesis, perhaps girls are drawn to biology because they wish to be concerned with people not necessarily work with people. Other explanations for biology's popularity are considered. Is biology a compromise with society's expectations for women, physical science is prohibited, social science is respectable and biology falls in between?

215 Malik, P.B.P. 1981. **Factors related to women's choices of careers in life sciences and letters: A comparison of a nontraditional with a traditional discipline.** Thesis (ED.D.), Indiana University. 154p.

The problem was to ascertain personal characteristics of women pursuing graduate study in biological sciences and their attitudes related to career choices by women, to compare these characteristics and attitudes with those of women pursuing graduate study in letters, and to identify differences between the two groups resulting from the comparison of relationships between childhood and school experiences, participation in school activities, parents' education and occupations with subsequent career choices and interests. A comparison of attitudes was also made using the Attitudes Toward Women Scale. The comparison also involved differences between the two groups of women in institutions highest in proportions of women in life sciences with those lowest in the same regard. Questionnaires were mailed to 1,097 women graduate students at 14 universities which were leaders in employment of women scientists and engineers. Of the women in biological sciences, 457 responded, and 249 of the women in letters responded. Graduate women in biological sciences tended to continue in or to return to universities earlier than did women in letters, and they were more confident of their abilities to do as well

as males in graduate school but less certain than women in letters that their discipline was a suitable choice for women. Women in biological sciences had more mathematics and sciences in junior and senior high school than did women in letters. Women in letters participated in extracurricular activities more than did women in biological sciences. Subject matter grades in elementary school were of less concern to women in biological sciences than to those in letters, and women in biological sciences, when they were children, were less lonely, were more apt to have had hobbies, and had more help with hobbies from their close relatives than did women in letters. Women in biological sciences learned to use simple tools, engaged in gardening activities, and cared for pets more than did women in letters as children. Mothers and fathers of women in biological sciences had more education than did the parents of women in letters, although both groups exceeded national averages. There were no differences in attitudes as measured on the Attitudes Toward Women Scale between graduated women in biological sciences and letters. It was concluded that early life influences, male influences, and mathematics and science preparation are important in female choices of science. Levels of parent education is important for women in academic choices of science, and the higher the levels, the more likely that science will be selected. Graduate women are more militant in support of women's rights in institutions where smaller proportions of women hold faculty appointments in science, and women in letters are militant than are women in science. The relative independence of mothers is also important in female choice of careers in science.

216 Mason, C.L. 1986. **Student attitudes toward science & science-related careers: An investigation of the efficacy of a high school biology teacher's intervention program.** Thesis (Ph.D.), Purdue University. 187p.

Despite the recent renewed interest in science, a majority of capable girls has not elected to pursue a career in science or even to strive for literacy in science. There is a need to emphasize the usefulness of science in future professional and non-professional work in order to nurture the underdeveloped national resource of women knowledgeable about scientific, technological, and engineering fields. Specifically, this project sought ways to ensure that girls attain full and fair participation in educational programs in science by removing obstacles, both perceived and actual. In order to modify existing classroom techniques and environments, a Teacher Intervention Program was designed. During a workshop, and through periodic personal communication, teachers were sensitized to the necessity of providing a stimulating gender-free learning environment. In addition, they were presented with a variety of methods and materials which have been shown to encourage females in science. The random sample of twelve teachers represented a wide variety of classroom and socio-economic environments. Therefore, it was assumed that the student subjects could be taken to be representative of the general populace of science students in twenty-four biology classes taught by twelve secondary school teachers. In order to test the effectiveness of the Teacher Intervention Program both qualitative and quantitative measures were employed. Using two-way ANOVA's, treatment group by student sex, a comparison of the mean scores was made for all students, for all females and for all males. The results indicated that the experimental group, compared to the control group, had significantly higher mean scores on tests of attitudes, perceptions, extracurricular science activities, and interest in a science-related career. In order to assess behavioral changes, additional information about students and teachers was secured through qualitative methodologies, such as interviews and observations.

217 O'Hern, E.M. 1979. **Women in the biological sciences.** IN *Expanding the role of women in the sciences*. p.110-124. Edited by A.M.Briscoe and S.M.Pfafflin. New York, NY, The New York Academy of Sciences. (Annals of the New York Academy of

Sciences, vol. 323)

Presents an overview of the women employed in the biological sciences, the number of women involved and the opportunities available to them.

218 Pearson, G.A. **Gender, race, nationality, and the graduate student entomology experience.** *American Entomologist*. vol.38, no.2, p.103-114.

Many recent analyses of the under-representation of women and minorities in science place the blame primarily on the structure of science itself, rather than discrimination. These groups are theorized to have different cultural and cognitive styles that do not fit well into the current hierarchical structure of science. The primary resistance to women and minorities comes not from continuing racist and sexist activities, but a general resistance to change and a reluctance to interact with those unlike ourselves. The practice of agricultural monoculture has been criticized by entomologists, who cite decreased diversity and loss of ecosystem stability as arguments against these practices. However, most entomologists have not recognized the presence of a "monoculture" in their discipline and a science populated and created predominantly by middle- and upper-class white men. As more people from differing races, genders, and socioeconomic classes become entomologists, the science is likely to evolve to reflect their diversity of perspective. The research questions asked, the methods used to find answers, and the interpretation of these answers will benefit from a heterogeneous population of scientists. The challenges that face entomology in the coming century will require their utmost creativity and innovation.

219 Rosser, S.V. 1985. **The feminist perspective on science: Is reconceptualization possible?** [S.l.: s.n.], 20p. (ED 266985)

Some feminists have become discouraged because the theoretical and conceptual changes leading to a feminist science have not yet occurred. A scheme has been developed which charts the phases through which the disciplines in the social sciences and humanities progressed before reconceptualization from the new scholarship on women transformed those disciplines. Application of this scheme to biology, the discipline within the sciences with the most activity regarding feminism and science, suggests that biology is only beginning to approach the phase of reconceptualization. The roots and form of a feminist science undoubtedly lie in the phases which we have completed. We may be on the threshold of discovering the framework of the feminist science.

220 Shteir, A.B. 1987. **Botany in the breakfast room: women and early nineteenth-century British plant study.** IN *Uneasy careers and intimate lives: women in science 1789-1979*. p.31-43. Edited by P.G. Abir-Am and D. Outram. New Brunswick, NJ, Rutgers University Press.

This essay concerns the foremothers, women who were botanically active in the early nineteenth century, but were peripheral to mainstream botanical science as it then was being shaped and codified, and as we find the codifications in all histories of botany to date. The discussion makes the peripheral central and looks at nineteenth-century British botany from the vantage point of women who were active participants in botanical culture at that time. When we place women at the center of the history of botanical culture in nineteenth-century England, we can better trace a picture of the place of one science in relation to everyday life. The most startling change in the picture that results is that the locus of science shifts from the public sphere to the domestic sphere. Home becomes the geographical locus for learning and for botanical activity. We then see the family of pre-professional botany, the presence of women in botanical culture, and the centrality of mothers in botanical education.

221 Tamir, P. and Gardner, P. 1989. **The structure of interest in high school biology.** *Research in Science and Technological Education*, Vol.7, No.2, p.113-140.

Examined the structure of interests associated with the study of

high school biology and how these interests relate to such variables as gender, achievement, and parental occupation. 900 Israeli 10th-grade boys and girls completed 7 instruments to assess interest in science topics and activities, activity motives, interest in social aspects of science, career orientation, attitude toward biology, and learning mode preference. Students also completed a background questionnaire. While there were no differences in achievement between boys and girls, boys generally showed more interest in careers involving scientific research. Students with a parent in a scientific occupation were more science-oriented. For all students, the highest levels of interest concerned topics in human biology, with medicine as the occupation with the highest priority.

222 Young, S. 1991. **A new foreign secretary for science.** *New Scientist*. Vol.132, No.1797, p.44-47.

On Nov 30, 1991, Anne McLaren, one of the most successful biologists of her generation, assumed the post of foreign secretary of the Royal Society. In doing so she becomes the first woman to hold office in the Royal Society in its entire 330-year existence.

Chemistry

223 Amato, I. 1992. **Profile of a field: chemistry.** *Science*. Vol.255, No.5050, p.1372-1373.

Some well-known females in the field of chemistry claim that sexism has virtually vanished and that women are on their way to standing shoulder to shoulder with men in chemistry. Statistics tell a different story because they indicate that there are few women at the upper levels of academia. Several obstacles that women encounter are discussed.

224 Bazler, J.A. and Simonis, D.A. 1991. **Are high school chemistry textbooks gender fair?** *Journal of Research in Science Teaching*. Vol.28, No.4, p.353-362.

Compared the analyses of gender fairness in illustrations and concrete analogies in 7 high school chemistry texts (1970/1973) and current editions (1978/1987) of the same texts. Overall, gender ratios improved from 5 male images to every female image in the earlier editions to three male images to every female image in current editions. Only one text decreased the disproportion of male-female images to become gender fair in its current edition. Gender ratio of illustrations of named and unnamed adults improved in two current editions. One current edition increased in representation of female youths. There was no significant change in relative frequencies of male and female verbal analogies in two current editions of texts compared to the earlier editions.

225 Brickhouse, N.W. 1990. **Women and chemistry: shifting the equilibrium toward success.** *Journal of Chemical Education*. Vol.67, No.2, p.116-118.

This paper focuses on both the implicit assumptions and biases in chemistry curricula and the institutionalized influences on women's participation in science-related courses and careers. Stereotypes of science and femininity and the use of the feminine perspective in teaching science are discussed.

226 Briscoe, A.M. 1984. **Scientific sexism: the world of chemistry.** IN *Women in scientific and engineering professions*. p.147-159. Edited by V.B.Haas and C.C.Perrucci. Ann Arbor, MI, The University of Michigan Press.

This chapter deals partly with sexism in chemistry, partly with the author's career, as a particular illustration. Provide a program of action for women individually and collectively.

227 Creese, M.R.S. 1991. **British women of the nineteenth and early twentieth centuries who contributed to research in the**

chemical sciences. *British Journal for the History of Science*. Pt.3, Vol.24, No.82, p.275-305.

Three groups of British women researchers who were active in the chemical sciences in the late 19th and early 20th centuries: Cambridge women, graduates of the London colleges and a few outstanding women from other locations--are discussed.

228 Deboer, G.E. 1987. **Predicting continued participation in college chemistry for men and women.** *Journal of Research in Science Teaching*. Vol.24, No.6, p.527-538.

Tested the effectiveness of a cognitive motivational model of course selection patterns to explain the continued participation of 143 men and women in college science courses. No sex differences were determined in course performance, perceived ability or past achievement in science, and plans to continue in chemistry. Of the variables measured, the decision to continue in science centered on self-perceived ability, which was dependent on the interpretation of past success.

229 Gamse, B.C. 1991. **A curriculum of matter or a matter of curriculum: an evaluation of an innovation in high school chemistry.** Thesis (ED.D.). Harvard University. 170p.

Investigated the effects of the new curriculum on students' attitudes, academic achievement, and subsequent high school science course-taking through a combination of survey, interview, and observational data collection and analysis strategies. Students completed three rounds of a survey on attitudes, behaviors, and plans. Classroom observations, two sets of student interviews, and teacher interviews were also done. Students' survey responses for curriculum, gender, and grade level differences, and observational and interview data provided information on students' and teachers' experiences in the two curricula. Additionally, growth analysis was used to learn whether students' reported science-related attitudes, behavior, or plans changed over the course of one academic year. Students in both curricula entered chemistry with negative attitudes toward chemistry and science, and students in the innovative curriculum had only marginally more positive attitudes than their peers in the traditional curriculum by the end of the school year. Although both teachers and the students who were interviewed spoke quite differently about the two curricula, students' attitudes toward chemistry did not change after a year of chemistry. Students differed in their science course enrollment in the subsequent school year. Young men were an estimated five times more likely to take another science course than were young women, controlling for both current and prior academic achievement.

230 Harpole, S.H. 1987. **The relationship of gender and learning styles to achievement and laboratory skills in secondary school chemistry students.** Paper presented at the annual meeting of the Mid-South Educational Research Association, Mobile, AL, November 1987. 11p. (ED 288728)

Some researchers have argued that it is important to match teaching styles with students' learning styles, although a relatively small amount of research has been done on learning styles in science. This study focused on the differences between male and female secondary school chemistry students in an effort to determine the relationship of gender and learning styles to achievement and laboratory skills. The sample consisted of 41 chemistry students in grades 10 and 11 in a Mississippi high school. The Canfield Learning Styles Inventory Form S-A was used to determine each student's learning style. The results of the study indicated that male chemistry students preferred situations that involved numbers and logic, computing and solving mathematical problems, and benefitted from course work that was logically and clearly organized and assignments that were meaningful. Female chemistry students tended to need laboratory activities in which they could work with people and help each other. It is suggested that the planning of different types of laboratory activities for males and females may enhance laboratory skills, and that consideration should be given to

the structure of instructional procedures with females being allowed to set their own objectives and males given more logical, well-defined instructional procedures.

231 Hopkins, E.A.H. 1984. **Alternative development of a scientific career.** IN *Women in scientific and engineering professions*. p. 137-146. Edited by V.B.Haas and C.C.Perrucci. Ann Arbor, MI, The University of Michigan Press.

To understand the topic of an alternative development of a scientific career, we need to consider the meanings of the word "career", the conventional route to a scientific career, the range and source of alternative routes. Discusses some details on one specific alternative development, that of a chemist.

232 Kralina, L. 1989. **Meet Suzy science and the whiz kids.** *Science Teacher*. Vol.56, No.2, p.60-61.

Describes a chemistry club project. Explains the three goals: to enhance hands-on science in elementary classrooms, to encourage females to enter the field of science, and to encourage high school students to consider teaching as a career choice. Provides an outline and examples of the characters and demonstrations.

233 Levine, D. 1985. **Encouraging young women to pursue science and engineering careers through chemistry.** *Journal of Chemical Education*. Vol.62, No.10, p.837-839.

FEMME (Females in Engineering, Methods, Motivation, Experience) is a pre-college summer program for 25 bright and gifted ninth-grade females who like mathematics and science. This program, now in its fourth year, is described, providing information about program goals, operation, trips, student laboratory experiments, and topics discussed by guest speakers.

234 Lindee, M.S. 1991. **The American career of Jane Marcet's conversations on Chemistry, 1806-1853.** *Isis*. Vol.82, No.311, p.8-23.

Jane Haldimand Marcet's "Conversations on Chemistry," the most successful elementary chemistry text of the nineteenth century, is examined. The text was especially popular in women's colleges.

235 McDade, L.A. 1988. **Knowing the "right stuff": attrition, gender and scientific literacy.** *Anthropology and Education Quarterly*. Vol. 19, No. 2, p.93-114.

For undergraduate women, attrition from chemistry and mathematics disciplines because of their noncompetitive performance involves abandoning their original goals. Male students explain their attrition as pragmatic moves toward more rewarding fields and do not, unlike women, question their talents as math wiz kids. Reasons for this difference are discussed.

236 Nixon, A.C. 1979. **Changing attitudes toward women in the profession of chemistry.** IN *Expanding the role of women in the sciences*. p.146-172. Edited by A.M.Briscoe and S.M.Pfafflin. New York, NY, The New York Academy of Sciences. (*Annals of the New York Academy of Sciences*, vol. 323)

Provide an assessment of the status on women in chemistry, their status in professional societies, their progress in the academic world, discrimination women face, their progress in industry. Recognition for women in chemistry has improved markedly with respect to their acceptance in the major professional societies and in the public eye but only slightly with respect to employment and salaries. Discrimination has continued, and is difficult to combat. Neither men nor women chemists generally recognize sufficiently the lack of effective affirmative action, although measures to increase perception are being taken. This lack is probably only partly due to male chauvinism but rather largely reflects the difficulty of satisfying the aspirations of women and minorities in the face of the realities of an increasingly severe employment situation.

237 Pycior, H.M. 1987. **Marie Curie's "anti-natural path": time only for science and family.** IN *Uneasy careers and the intimate lives women in science 1789-1979*. p.191-214. Edited by P.G.Abir-Am and D.Outram. New Brunswick, Rutgers University Press.

This essay seeks to analyze the thematic patterns most closely associated with her successful combination of the roles of scientist, wife, and mother, and then widow and single parent. The essay is divided into three main chronological parts. The first, covering Curie's early years, emphasizes the importance of her parents as role models, as well as the development of a close relationship, built on shared dreams and mutual support, with her sister Bronia. The next two sections--the core of the essay--are devoted to the scientific collaboration and family life of Marie and Pierre Curie, and finally Marie Curie's twenty-eight years as widow, single parent, and independent woman scientist. The overriding theme of these later periods is the Curies' "anti-natural path"--a simple way of life that allocated the couple time only for science and family. The essay also shows that Curie's marital status and family arrangements were key elements of the socio-cultural matrix in which she practiced science.

238 Reeves, R. 1985. **Filtrates and residues.** *Journal of Chemical Education*. Vol.62, No.12, p.1060-1068.

Discusses: (1) applications of chemistry problems encountered in the forensic science laboratory; (2) chemistry and the courtroom, inspired by a Scherlock Holmes story, and (3) the 41 women who have won the Garvan award for achievement in chemistry.

239 **Report on the NSF workshop on undergraduate chemistry education, 1989-1990.** *Journal of College Science Teaching*. Vol.19, No.3, p.134-139,46-47.

Presents the highlights and an analysis of the Neal Report on undergraduate science education. Includes an overview of the report and discussions and recommendations on laboratories; curriculum; industry/academic coupling; centers for instructional research and development; faculty exchange; teaching internships; undergraduate women, minorities, and the handicapped.

240 Roscher, N.M. 1987. **Chemistry's creative women.** *Journal of Chemical Education*. Vol.64, No.9, p.748-752.

Summarizes some of the contributions to society made by women who have received the Garvan medal. Addresses accomplishments in nutrition, industry, biochemistry, government, and group research projects. Includes anecdotal descriptions of some of the women made by colleges, authors, and students.

241 Seiden, R.H. and Gleiser, M. 1990. **Sex differences in suicide among chemists.** *Omega Journal of Death and Dying*. Vol.21, No.3, p. 177-189.

Investigated suicides among 28 female and 63 male chemists for age, marital status, educational qualifications, type of employment, minority status, chemical specialties, and method of suicide. Isolation, the leading work-related factor, occurred more frequently and with greater intensity among women. Similarly, while the majority of women suffered some form of sex discrimination, none of the men did. The leading nonwork-related causes were interpersonal problems and mental illness, the latter also more common among women. Low self-esteem coupled with high achievement orientation was a dangerous combination of personality characteristics found twice as frequently in suicides by female as by male chemists. Suicide prevention guidelines are proposed.

242 Spradley, J.L. 1989. **Women and the elements: the role of women in element and fission discoveries.** *Physics Teacher*. Vol.27, No.9, p.656-662.

Describes the scientific work of several women, including Marie Curie, Lise Meitner, Ida Noddack, Irene Curie, Marguerite Perey, Chien-Shiung Wu, and Maria Mayer. Discusses the connections between their discoveries. Thirty-six references are listed.

Communications Industry

243 Jenkins, S. 1991. **Who let them in?** Sports Illustrated. Vol.74, No.23, p.78-92.

Women have invaded the former men's domain of TV sportscasting, but they receive less air-time, pay and prestige. TV sportscasters Robin Roberts, Gayle Gardner, Lesley Visser, Andrea Joyce and Mary Carillo are profiled.

244 Lang, S. 1992. **"Good evening, sports fans"**. New Woman. Vol.22, No.3, p.69-71.

There are many obstacles in the way of women wanting to break into the male-dominated world of TV sports, but some have fought the battle and won. Sportscasters Hannah Storm, Lesley Visser and Donna de Varona are profiled.

245 Ralston, J. 1991. **Waiting for a station break: The making of a Network-News Star**. Mademoiselle. Vol.97, No.10, p.154-155.

The struggles of female TV news reporters are described. The climb up the broadcast ladder is demanding and requires a lot of pushing. Several women anchors discuss how they obtained their coveted positions.

Computer Science

246 Arenz, B.W. and Lee, M.J. 1990. **Gender differences in the attitude, interest and participation of secondary students in computer use**. Paper presented at the Annual Meeting of the American Educational Research Association, Boston, MA, April 16-20, 1990. 68p. (ED327389)

The lower level of participation of females in computer science courses is a continuing concern for educators. A number of different reasons for this lack of participation have been put forward, including differences in attitudes, bias, role models, differential treatment by classmates and teachers, patterns of computer use, availability of computers and their associated subject areas. This series of studies, conducted over a three year period, examines potential factors affecting computer course participation by males and females in middle and high school grades. Differences in role models, attitudes, interest and computer use between gender as well as within gender were found to exist which may contribute to a continuing stereotype of computers as a male domain.

247 **Barriers to equality in academia: women in computer science at M.I.T.** 1983. Cambridge, MA, USA: Massachusetts Institute of Technology. ii, 44p.

248 Breakwell, G.M. and Fife, S.C. 1987. **Young people's attitudes toward new technology: source and structure**. New Directions for Child Development. No.35, p.51-67.

1,751 British school children (aged 14-18 yrs) were asked to indicate, from a checklist of 16 products and processes, which ones they thought were new technologies (NTs). Gender, age, and scientific training influenced what was considered an NT. Other studies concerning adult attitudes toward NTs and other socioeconomic beliefs, the effects of gender and training on attitudes toward NTs, and the structure of school children's attitudes toward NTs are reviewed.

249 Brecher, D.L. 1985. **The women's computer literacy handbook**. New York, New American Library. 254p.

The co-founder of the Women's Computer Literacy Project and the National Women's mailing list has written this book out of her

experience as a teacher. She explains that the title emphasizes that the explanations of computer technology reflect her own very personal frame of reference, the analogies and examples are drawn from female experience, because almost all books on technological subjects do the reverse, they base themselves on a male environment. Describes how computers work, what they do, types of software, how to buy one, how to set up a system, word processing, etc.

250 Clarke, V. A. and Chambers, S. M. 1989. **Gender-based factors in computing enrollments and achievement: Evidence from a study of tertiary students**. Journal of Educational Computing Research. Vol.5, No.4, p.409-429.

Explanations for gender differences (GNDs) in enrollments in computer courses place varying emphasis on social learning explanations; category-based explanations of computer selection and avoidance; beliefs about GNDs in abilities; and GNDs in attributions for success and failure. Using a sample of 110 male and 112 female Australian 1st-yr college students enrolled in a compulsory unit of computer studies, data were collected from questionnaires and the university data base. Initial GNDs in computing experiences and attitudes were found. Women were less likely to intend to pursue further computing studies, although their achievement was comparable to that of men. Achievement was related to computing experience and, for men, to mathematics experience. Intentions to pursue further computing studies were related to attitudes toward computing and, in the case of women, to mathematics experience and attitudes toward statistics.

251 Cox, S. and Swarbrick, A. 1987. **Women and technology: A review of training initiatives**. Special issue: Women and work. Work and Stress. Vol.1, No.3, p.285-291.

Considers the entry of women into technological areas of work, their subsequent career progression, and their return to work after a career break. Discussion focuses on role models and stereotyping and the development of training programs to encourage girls and young women to enter nontraditional areas of work and to help women return to work after a career break. It is emphasized that such training needs to address the psychological and social issues that arise as well as provide for new technical knowledge and skills.

252 Durnell, A. 1990. **Gender differences and computing in course choice at entry into higher education**. British Educational Research Journal. Vol.16, No.2, p.149-162.

Findings of a Scottish study using questionnaires and interviews to investigate views of 387 college freshmen on course selection, specifically addressing low female enrollment in computing areas are reported. Finds computing students motivated by extrinsic awards. Reveals stereotypes, intimidation fears, lack of role models, and teacher guidance influencing women who avoided computing and technological subjects.

253 Durnell, A. 1990. **Why do female students tend to avoid computer studies?** Research in Science and Technological Education. Vol.8, No.2, p.163-170.

The results of a questionnaire which concerned students' course choices and why students chose not to study computing are discussed. The lack of human orientation, mathematical ability, and lack of computer contact in secondary schools are identified.

254 Gibbons, A. 1992. **Creative solutions: electronic mentoring**. Science. Vol.255, No.5050, p.1369.

The Systems network for female computer scientists was developed due to a lack of mentors available for women scientists. There are 900 members in the network ranging from undergraduates to senior faculty, and their communications cover career advice, information on who is doing research on a particular topic, requests for guidance on writing papers and what to wear when presenting papers at conferences.

255 Jagacinski, C.M., LeBold, W.K. and Salvendy, G. 1988. **Gender differences in persistence in computer related fields.** *Journal of Educational Computing Research*. Vol.4, No.2, p.185-202.

Evaluated the effectiveness of precollege and college achievement measures in predicting persistence rates for 2,331 males and 981 females who declared majors in computer related fields. It was found that persistence rates were similar for men and women in computer technology, electrical/computer engineering, and industrial engineering. Fewer women than men persisted in computer science. Discriminant function analysis correctly classified persisters and nonpersisters (64-72 percent) in each field except computer technology, where the classification rate was considerably lower for women (58 percent). Grade point average (GPA) was generally the most important variable, followed by a measure of math ability. High school science grades and number of semesters were often selected for the discriminant function for men but not for women.

256 Kvande, E. and Rasmussen, B. 1989. **Men, women and data systems.** *European Journal of Engineering Education*. Vol. 14, No.4, p.369-379.

Discusses the possibility that changing the arrangement of computer courses from association with technical and mathematical subjects to a broader course based on social subjects and arts will lead to an increase in the proportion of women studying and working in the computer field.

257 Lage, E. 1991. **Boys, girls, and microcomputing.** *European Journal of Psychology of Education*. Vol.6, No.1, p.29-44.

Investigated normative mechanisms governing the relationships of boys and girls to technology. Twenty-two male and twenty-five female 10-11 yr olds and eighteen male and twelve female 14-15 yr olds were administered a questionnaire measuring general attitudes toward technology and an impressions formation test. Younger students considered boys and girls to be equally involved in technical fields, and a female computer enthusiast was perceived as a very attractive person. Older students no longer perceived this equality of gender in technical interests and judged a female computer enthusiast negatively. Moreover, girls considered that too keen an interest in computers was evidence of loneliness and problems with sexual identity. A boy's involvement with computers did not change his image, whatever the gender or age of the students. Thus, the influence of the normative model of feminine identity can explain, in part the drop in interest for computers observed in secondary-school girls.

258 Leighton, C. 1992. **Women: scarce at the top.** *Computerworld*. Vol.26, No.12, p.33.

US firms are missing opportunities by failing to reward and promote talented women with technical backgrounds. Women now comprise more than 50 percent of enrollees and degree recipients at all levels of higher education, except the doctorate level. At present, women scientists earn less than men in every field of science, regardless of their academic degrees or experience levels. A survey of attendees at the recent International Network of Women in Technology meeting found that only 27 percent of the respondents felt that they had equal access to jobs that positioned them for advancement. Profitability and success are often viewed as unrelated to the effort to increase the participation of females in top management. This perception ultimately has a negative effect on the bottom line. Women technologists must bear greater responsibility for advancing their careers.

259 Molloy, M. 1991. **Women still face hurdles within networking arena.** *Network World*. Vol.8, No.7, p.29,56.

Women have made great strides in the network arena since divestiture, but women in the networking field say that it will probably be another decade before the number of female network managers equals that of males in large companies. They acknowledge that women need to increase their visibility within corporations, hone their

managerial skills, and take better advantage of educational opportunities in order to secure more of the top-level positions currently held by men. Northwestern Technologies Group President Patricia Todus says that women have an edge over men in that they have strong skills in consensus building and participatory management, a leadership style that is increasingly in demand in large corporations today. Women can increase their visibility by becoming more involved in professional organizations. The chances of reaching top network positions are improved for women who work at large organizations that have major network operations.

260 NSF grant to fund mentoring project for women & minorities. 1992. *Communications of the ACM*. Supplement. Vol.35, No.1, p.2.

The National Science Foundation has awarded a grant of \$47,000 to the Association for Computing Machinery (ACM) for support of its project on "Mentoring of Women and Minorities in Computer Science." ACM's project in computer science is discussed.

261 Rasmussen, B. and Hapnes, T. 1991. **Excluding women from the technologies of the future? A case study of the culture of computer science.** *Futures*. Vol.23, No.10, p.1107-1119.

A study conducted at the Norwegian Institute of Technology (NIT) found that male domination in computer science is created because the dominant groups among the professors and the students share certain values with the hackers. These values are: (1) machine fascination and interest in the possibilities of computers, (2) work addiction and total absorption in computers, and (3) playful attitude toward the computers. These values are opposed to the values and interests of the female students. They are not especially interested in computers as machines, they do not want to play with the computers, and they definitely want to do other things than to sit at a computer. The hackers as a group are a pure type of these values. Therefore, the female students come to see them as the exponent of these values and, in some ways, the source of their discontent. It is, however, the powerful groups of actors - the professors and teachers and their disciples, the dedicated students - who, through their attitudes and actions, make these values dominant within computer science at NIT.

262 Schwartz, E.I. 1992. **The Lucie Show: Shaking up a stodgy IBM.** *Business Week*. No.3260, p.64-65.

One of 3 women among the 76 corporate officers at IBM, Lucie J. Fjeldstad is in charge of about 1,000 employees as vice-president and general manager of its multimedia business. Her mission is to find a way for IBM to capitalize on technology that incorporates video, sound, and digital information. Fjeldstad joined IBM's Silicon Valley laboratory in 1968 as a computer programmer. In 1977, she moved to headquarters, where she rose steadily through the management ranks. By 1983, she became the first woman to head an IBM development lab. After seeing a presentation in which Fjeldstad combined music, video, and computer graphics, top executives asked her to turn IBM into a multimedia company. Within the industry, IBM is renowned for breakthroughs in multimedia research and development. However, because it has focused on business customers for years, it lacks other retail channels, is a high-cost producer, and has few entertainment or software products for its machines. IBM is working on a multimedia joint venture with Apple Computer Inc.

263 Sheridan, J.H. 1990. **Sandy makes connections.** *Industry Week*. Vol.239, No.11, p.24-27.

In 1972, Sandra M. Kurtzig invested \$2,000 of her personal savings to start what is now ASK Computer Systems Inc. (Mountain View, California), a leading supplier of manufacturing software. The company is the largest high-technology firm ever founded by a woman. After spending about 4 years in semi-retirement, Kurtzig returned to ASK in 1989 as chairman, president, and chief executive

officer. In February 1990, ASK announced a totally new manufacturing software system to facilitate "global inter-connectivity" in a multi-vendor hardware environment. The product will be built around a new relational database management system created by Ingres Corp. (Alameda, California) that will have the capability of accessing information in a variety of database systems and hardware environments.

264 Siann, G. 1990. **The effect of computer use on gender differences in attitudes to computers.** Computers and Education. Vol.14, No.2, p. 183-191.

Gender differences in response to instructional technology highlights a study of attitudinal consequences of a Logo programming exercise among primary school children in Edinburgh, Scotland is discussed. Attitudinal measures before and after the computer experience are described, and gender differences in interactions at the computer terminal are examined.

265 Siann, G., Durnell, A., Macleod, H. and Glissov, P. 1988. **Stereotyping in relation to the gender gap in participation in computing.** Educational research. Vol.30, No.2, p.98-103.

As part of a survey into students' attitudes toward, knowledge about, and experience of computers, 928 college students rated 1 of 2 target figures on 16 personal attributes. Half of the students received questionnaires describing a female computer scientist and the other half received questionnaires describing a male. Responses were analyzed to determine whether there were any differences in the rating of the 2 target figures. Results indicate that of 8 of the attributes, the female target figure was rated more positively than the male. The implications of these results for the hypothesis that female scientists are negatively stereotyped are discussed, and it is concluded that the negative stereotyping of female computer scientists is becoming increasingly less likely.

266 Taylor, H.G. and Mounfield, L.C. 1989. **Effect of high school computer science, gender, and work on success in college computer science.** SIGCSE Bulletin. Vol.21, No.1, p.195-198.

Researchers have often linked factors such as mathematics ability and overall academic achievement to success in computer science. In this study, a group of students with common mathematics backgrounds was examined to determine if some other new factors were also involved in success in computer science. In particular, the roles of prior computing experience, work, and sex are discussed. A composite picture of the typical successful student is drawn and the implications for computer science departments are identified.

267 Temple, L. and Lips, H.M. 1989. **Gender differences and similarities in attitudes toward computers.** Computers in Human Behavior. Vol.5, No.4, p.215-226.

Examined gender differences among 178 female and 127 male 17-60 year old undergraduates in attitudes toward and involvement with computers. Males had taken more computer sciences (CS) courses, were more knowledgeable about computer languages, were more likely to want to major in CS, and had played video games more than females. Nonvideo-game computer use and exposure to computers in non-CS courses were similar for all students, as was reported personal interest in enjoyment of computers. Males, however, reported more comfort and confidence with computers and more positive attitudes toward mathematics.

268 Van Brussel, C. 1992. **Software skills in crisis: study.** Computing Canada. Vol.18, No.7, p.1.4

A recent study, co-sponsored by the Canadian Information Processing Society and the Canadian Advanced Technology Association, projected 12,000 to 14,000 job vacancies in the software industry within the next 3 years. Canada is facing a severe human resources shortage. People with software skills have a strategic role to play in the transformation of the Canadian economy.

yet the human resource dimensions of this shift to the information age have not been adequately addressed. Software workers do not enjoy a positive image, particularly at the high school level, promoted by the "computer nerd" stereotype. The study also indicated that women are under-represented in the industry at a rate of 30 percent among software workers compared to 56 percent in white-collar jobs in other industries.

269 Voogt, J. 1987. **Computer literacy in secondary education: the performance and engagement of girls.** Computers and Education. Vol. 11, No. 4, p.305-312.

Examines sex equality in computer literacy in Dutch secondary education using a Dutch version of the Minnesota Computer Literacy Awareness Assessment. Research on sex differences in mathematics and science education is used as a basis for testing hypotheses regarding computer literacy, and analyses of results are explained.

270 Weil, M. M., Rosen, L. D. and Wugalter, S. E. 1990. **The etiology of computerphobia.** Computers in Human Behavior. Vol.6, No.4, p.361-379.

Interviewed 43 female and 12 male university students, ages ranging from 17-53 years, classified as computerphobics, uncomfortable computer users, or nonanxious controls to examine their retrospective computer and mechanical experiences, personality style, and media influence on the development of computer feelings. Psychological reactions to early mechanical and computer experiences differed between the 3 groups, with etiological roots of computerphobia evident as early as childhood. Gender and attitude of the technology introducer were important in predicting later psychological reactions to computers. Computerphobics appeared to suffer from a more generalized technophobia, while uncomfortable computer users were apprehensive only about computers. Personality styles differed only slightly between the 3 groups, with computerphobics being less persistent in problem solving and less likely to seek assistance.

Engineering

General

271 Committee on Women in Science and Engineering. Office of Scientific and Engineering Personnel. National Research Council. 1991. **Women in science and engineering: Increasing their numbers in the 1990's.** Washington, D.C., National Academy Press. xi,152p.

This report is the culmination of an initial examination by the Committee on Women in Science and Engineering of the status of women scientists and engineers in the United States. In addition to providing statistics on the participation of women in the education/employment pipeline, it summarizes the Committee's deliberations relating to its role in increasing the participation and improving the status of women in science and engineering. The report further offers an ambitious strategic plan of both short-term and long-term activities. As evidenced by the comprehensiveness of this first report, issued within its first year of operation, the Committee on Women in Science and Engineering has taken a proactive stance in this arena. By stimulating research on issues relevant to women scientists and engineers, by establishing study panels that can explore some subset of these issues in greater depth, and by briefing appropriate officials on matters leading to the development of programs for women in science and engineering, this Committee plans to keep the issue of women's participation in science and engineering at the forefront.

272 Abelson, P.H. 1979. **Women in science-related activities.** IN Expanding the role of women in the sciences. p.27-34. Edited by

A.M. Briscoe and S.M. Pfafflin. New York, NY, The New York Academy of Sciences. (Annals of the New York Academy of Sciences, vol. 323)

Personnel practices in industrial laboratories with respect to the recruitment of women in science are presented. Provides highlights on the employment of women in Bell Labs, General Electric, IBM, Exxon, and General Foods. The managers of these industrial corporations agree on two points: (1) the performance of women in engineering and scientific tasks was good as that of men. In fact there was no difference (2) They were trying to increase the number of professionals on their staff.

273 Barozzi, A. and Toschi, V. 1989. **A cross section of women engineers in Italy.** European Journal of Engineering Education. Vol. 14, No.4, p.381-388.

Provides statistical data of female representation in college, engineering majors, and engineering careers in Italy. Discusses the reasons for choosing engineering as a major field and the difficulties of the choice.

274 Baum, E. 1989. **Why so few women in engineering?** Engineering Education. Vol. 74, No. 5, p.556-557.

The obstacles of women who choose engineering as their career at the undergraduate and graduate levels are described. Difficulties of women faculty members in their positions are discussed.

275 Bernard, J. 1965. **The present situation in the academic world of women trained in engineering.** IN Women and the scientific professions, the M.I.T. symposium on American women in science and engineering. p.163-182. Edited by J.A.Mattfeld and C.G.Van Aken. Cambridge, MA, M.I.T. Press.

Discusses women as material for the teaching function; for the research function and for the counseling function. States that the subject of discrimination on whatever basis, age or race as well as of sex, is extraordinarily complex, subtle, and difficult to be unequivocal about. Discrimination is extremely difficult to demonstrate, and evidence for or against it, is not interpreted the same way by all observers.

276 Cooper, S.E. and Robinson, D.A. 1987. **A comparison of career, home, and leisure values of male and female students in engineering and the sciences.** Journal of College Student Personnel. Vol.28, No.1, p.66-70.

Studied sex differences in career, home, and leisure values of 100 male and 100 female engineering and science majors. Females scored higher than did males on career values of task completion, job involvement, meaning from work, and career importance. No significant differences were found for leisure or home and family values.

277 Cromwell, R.A. 1986. **The effective recruitment of women students in engineering technology.** Engineering Education. Vol.76, No.8, p. 755-757.

Describes recruitment efforts aimed at attracting women students to the engineering technology program at the University of Arkansas at Little Rock. Discusses five activities undertaken: (1) secondary school visits; (2) counselor's workshops; (3) women's day programs; (4) literature packets; and (5) follow-up surveys. Women's enrollment is 16 percent compared to 8 percent nationwide.

278 Daniels, J.Z. 1988. **Women in engineering: a program administrator's perspective.** Engineering Education. Vol 78, No. 8, p.766-768.

Lists barriers that limit the recruitment of women from the existing pool of eligible women into engineering programs. Discusses several components that are important to the successful recruitment of women. Uses the program at Purdue as a successful example. Suggests special steps for faculty and administrators to follow.

279 Dayton University. School of Engineering. 1981. **Women in Science program. Career facilitation grant 1976-1979. Final report.** Washington, D.C., USA: National Science Foundation. 304p. (ED 287694)

Summarizes the University of Dayton (Ohio) Women in Science Career Facilitation Project entitled Fast Track Late Entry. The University of Dayton Fast Track Program was designed to bring women with bachelor's degrees in mathematics, chemistry, or physics to a technical level in chemical or electrical engineering equivalent to bachelor degree recipients and to qualify them for master's degree work in chemical or electrical engineering. The program consisted of: (1) procedures to diagnose and evaluate backgrounds of participants; (2) examinations to determine placement in the mathematics sequence; (3) six credit hours of reentry mathematics taken by participants in the chemical track; (4) specific chemical and electrical core courses designed for, and made available to, fast track students; (5) courses designed to integrate the students into the regular undergraduate curriculum in chemical and electrical engineering; (6) a professional development course; (7) a tutorial center for fast track students; and (8) evaluation procedures. Seventy-one women were accepted into the fast track program and 63 graduated. Seventy percent of the participants relocated to attend the Fast Track Program. Sixty-one women received employment, many with Fortune 500 companies.

280 Dresselhaus, M.S. 1984. **Responsibilities of women faculty in engineering schools.** IN Women in scientific and engineering professions. p.128-134. Edited by V.B.Haas and C.C.Perrucci. Ann Arbor, MI, The University of Michigan Press.

The life of a woman in academia in one of the science or engineering departments of the university is a multifaceted venture. There are of course the traditional responsibilities that are common to all faculty members, teaching, research, thesis supervision and administrative responsibilities of various types. In addition there are the extra-curricular activities upon which this article focusses. Extra-curricular activities encompass several subareas of activity, which is classified in terms of local activities and national activities. Local activities are directed toward improving the work environment at the university for students, professionals and employees, especially women. National activities are directed toward increasing the opportunities and visibility of women in science and engineering on the national scene. The responsibilities of a woman faculty member in the traditional academic areas already represent more than a full time job. The additional responsibilities of the extra-curricular activities represent an additional burden which we must all bear collectively for the time being. This is a burden we must learn to share until such time when women will have equal opportunities and access, and there will be no further need for affirmative action.

281 Duncan, W.A. 1989. **Engendering school learning: Science, attitudes and achievement among girls and boys in Botswana.** Thesis (FILDR). Stockholms Universitet (Sweden). 222p.

The study argues that student attitudes to the gender of school subjects and fields of work foster gender differences in attitudes and performance across subjects. These propositions are tested using partial least squares (PLS) path analysis to analyze data collected from a national survey of attitudes and school achievement among secondary level students in Botswana. The study focuses upon the example of science. The findings show that gender role ideology is a significant factor in the achievement process, especially for girls. Socioeconomic background is more influential for boys. Girls and boys with feminine gender role identities tend to perform worse in almost all school subjects, including science. Furthermore, both girls and boys show a strong tendency to regard science and science careers, as well as school science, as masculine areas of activity. The casual analysis reveals that, among boys, the gender-typing of school science as male has a small positive influence upon science attitudes and performance. For girls, however, it has a small negative influence. The fact that it is the gender-typing of school

science, rather than of science in general, which depresses the achievement of girls suggests that the school plays a significant role in the gender-typing process. Another finding implicating the school is the consistent negative association between femininity and achievement among both girls and boys, indicating the anti-feminine nature of the school.

282 Ellis, D. 1986. **Educating a growing minority - Canadian women engineers.** *Interchange*. Vol. 17, No.4, p.52-62.

Possible reasons why female representation in Canada's engineering schools and profession has increased rapidly in the last few years are discussed. The findings of a nationwide survey of women engineers regarding their professional and personal lives are highlighted.

283 Ellis, R.A. 1987. **Engineering enrollments, Fall 1986.** *Engineering Education*. Vol.78, No.3, p.155-161.

Reports on the results of the Engineering Manpower Commission's 1986 survey of engineering enrollments, comparing them to the previous ten years of surveys. Provides tables of fall 1986 engineering enrollments categorized by curriculum, women, minorities, foreign nationals, schools, and by all students.

284 Ellis, R.A. 1989. **Engineering and engineering technology degrees, 1988.** *Engineering Education*. Vol. 79, No. 4, p.511-521.

A downward trend in awarded degrees and a projection for the early 1990's are described. Trends in degrees awarded to women and minorities are highlighted. Engineering degrees awarded in 1987-88 by school and level for U.S. institutions are enumerated.

285 Emmett, A. 1992. **A women's institute of technology?** *Technology Review*. Vol. 95, No. 3, p.16, 18.

Despite several outreach programs to encourage women to enter engineering school, female students still comprise only about 16 percent of undergraduate engineering classes in the U.S. At the doctoral level, that figure is less than 9 percent. In actual practice, only 6 percent of engineers are women. Barbara Lazarus of Carnegie Mellon University recently proposed a separate women's engineering institute. While some argue that such an institute would help integrate more women into a traditionally male-dominated profession, others claim it would make women feel more isolated than they already feel. Betty M. Vetter of the Commission on Professions in Science and Technology points out that women's colleges apparently make a big difference. According to Suzanne Brainard of the Women in Engineering initiative at the University of Washington, women at the academic level lack role models and mentors. She thinks that such an institute would further isolate these women.

286 Everts, S.I. and Van-Oost, E.C.J. 1986. **Women in engineering in the Netherlands.** *European Journal of Engineering Education*. Vol. 11, No. 3, p.303-313.

Discusses the conditions and factors contributing to the underrepresentation of women in engineering in the Netherlands. Reports research findings on a study of the dropout rate of female engineering students at the Twente University of Technology.

287 Farrell, C.S. 1989. **Dearth of American engineering graduate students concerns academicians.** *Black Issues in Higher Education*. Vol. 6, No.1, p.1, 6-7.

A shortage of American engineering graduate students, particularly minorities and women, has resulted in the increasing award of research and graduate assistantships to foreign students. The National Consortium for Graduate Degrees for Minorities in Engineering and the National Science Foundation are offering financial encouragement for graduate study in engineering.

288 Fitzpatrick, J.L. and Silverman, T. 1989. **Women's selection of careers in engineering: Do traditional-nontraditional differences**

still exist? *Journal of Vocational Behavior*. Vol. 34, No. 3, p. 266-278.

Compared background and motivation of 82 high-achieving college women in engineering and science to those of 31 women in the humanities and social sciences. Areas of investigation included family composition and parental characteristics, childhood socialization, sources of support for career choice, and work characteristics. Significant differences were found only in the latter two areas.

289 Haemmeli, F. M. and Highfill, L. A. 1991. **Bias by male engineering undergraduates in their evaluation of teaching.** *Psychological Reports*. Vol.68, No.1, p.151-160.

Assessed the gender biases of 126 male undergraduate engineering students enrolled in psychology, calculus, and management courses when evaluating a college teacher of a technical course. Students rated a hypothetical male/female calculus teacher on a variety of personal, interpersonal, and professional dimensions. The class in which students completed the evaluations had a major impact on their ratings, with students in the calculus class giving the instructor the highest ratings. Students rated the male instructor as less likely to be an unfair grader and less likely to be hostile and indifferent toward students and students' learning.

290 Haworth, G., Povey, R. and Clift, S. 1986. **Girls and engineering: perceived influences on career choice amongst female craft and technician engineers and non-engineers.** *British Journal of Guidance and Counselling*. Vol.14, No.2, p.196-204.

Used a postal questionnaire to survey the educational experiences of 22 young women craft and technician apprentices in a variety of engineering jobs. Comparisons are made with 33 similar women who chose more traditional female occupations. Students were aged 16-21 years. Results show significant differences between engineers and non-engineers in terms of their subject choices and curriculum opportunities at school and their perceptions of the attitudes of parents toward their careers.

291 Haworth, G., Povey, R. and Clift, S. 1986. **The attitudes towards women scale (AWS-B): a comparison of women in engineering and traditional occupations with male engineers.** *British Journal of Social Psychology*. Vol.25, No.4, p.329-334.

A British version of the Attitudes towards Women Scale (AWS-B) was administered to 4 groups of 16-21 year olds: 39 male and 27 female trainee engineers, 59 females pursuing careers in traditional occupations, and 14 secondary school girls following an engineering link course. No significant differences in overall attitude emerged between female groups, but males were significantly more traditional in their attitudes toward women compared with the females. On 16 of the 21 scale items, women were significantly more liberal, with strong differences on items concerned with women's position in politics, business, and industry. Men were significantly more liberal on one item concerned with women's freedom to propose marriage.

292 Horn, H. 1990. **A comparative study of Israeli female students in nontraditional (Engineering) and traditional (Humanities) fields of study.** *Research in Higher Education*. Vol. 31, No. 2, p.177-192.

A study comparing personality traits, demographic variables, and sex-role orientation of Israeli women studying engineering as compared with women studying humanities and males studying engineering found female engineering students to be more feminist, have "realistic" or "investigative" personality types, and have college-educated parents. Male and female engineering students differed little.

293 Jagacinski, C.M. 1987. **Androgyny in a male-dominated field: the relationship of sex-typed traits to performance and satisfaction in engineering.** *Sex Roles*. Vol.17, No.9-10, p.529-547.

Among 346 men and 346 women engineers, students scoring high in instrumentality (androgynous and masculine) reported greater levels of supervisory and technical responsibility, salary, involvement in professional activities, and satisfaction than those low in instrumentality (feminine and undifferentiated). Expressiveness was not significantly related to measures of performance or satisfaction. Although a few sex differences were found, the magnitude of the effects were generally smaller than those for instrumentality. Self-ratings of various abilities were also positively related to instrumentality. Only a small percentage of variance in the performance and satisfaction measures was accounted for by sex and sex-typed traits.

294 Jagacinski, C.M. 1987. **Engineering careers: women in a male dominated field.** *Psychology of Women Quarterly*. Vol.11, No.1, p. 97-110.

A national survey comparing the background and career characteristics of 1,961 female and male engineers revealed gender differences in parents' educational level and occupations. Students' marital and parenting status, timing of career decisions, supervisory responsibility and salary among those with more than 5 years of experience, and satisfaction with career advancement opportunities are discussed.

295 Johnson, R.C. 1981. **An exploration of selected social factors related to high school women's consideration of engineering.** Thesis (ED.D.), Columbia University Teachers College. 168p.

This is a study of twelfth grade women with high aptitude in mathematics and science, who have previously expressed an interest in engineering as a potential occupational choice. It was designed to help answer the following questions: (1) At different life stages, what consideration have the women given to various career options, particularly to engineering? (2) How does the women's engineering commitment relate to various opportunities in high school to engage in vocational exploratory behavior related to engineering? (3) How does the women's engineering commitment relate to the presence of significant others in the realm of their family, academic and extracurricular life? (4) How does family background relate to the women's decisions whether to pursue engineering? The data were collected from responses to a questionnaire mailed to 318 graduating high school women who, one year earlier, had applied to the 1979 Women in Engineering Summer Program conducted at Stevens Institute of Technology. Usable questionnaires totalled 256, an 81 percent response rate. Responses from completed questionnaires were tabulated for use in the data analyses.

296 Kvande, E. 1986. **Factors affecting women's decision to study at the Technical University of Norway.** *European Journal of Engineering Education*. Vol. 11, No. 3, p.295-302.

Reports on a study of engineering students at the Technical University of Norway (NTH) which focuses on the factors that influence women to become students at NTH. Compares study results to national and international studies concerning women and work.

297 LeBold, W.K. 1987. **Women in engineering and science: an undergraduate research perspective.** IN *Women: their under-representation and career differentials in science and engineering*. Proceedings of a workshop, Washington, D.C., October 9, 1986. p.59-94. Edited by Linda S. Dix. Washington, D.C., USA: National Academy of Sciences. Office of Scientific and Engineering Personnel. (ED 285752)

States that significant increases in the pool of women who are qualified and interested in education and careers in science and engineering are needed. Increases in the pool of qualified women interested in science and engineering can be achieved by a combination of societal, institutional, disciplinary, and individual

efforts. To achieve more equitable representation of women in engineering and science, special attention at the undergraduate level should focus on engineering and the physical sciences, the two major areas where women are significantly under-represented. Within engineering, the disciplines in which women are most under-represented at the undergraduate level include three of the five largest and well-established disciplines—mechanical, electrical, and civil engineering, as well as some of the smaller but significant disciplines including aerospace, nuclear, and petroleum engineering. In the physical sciences, physics and astronomy seem to be the primary fields requiring attention. Significant progress has been made in the past decade in encouraging a larger percentage of college-bound women to enroll in math and physical science in high school, but the gap between women and men in precollege preparation remains large. A new area of increasing importance is the potential development of gender inequities in the precollege computer backgrounds of women entering science and engineering. Suggests that there is some evidence that a critical mass can have a synergetic impact that facilitates not only recruitment, but also retention, career choice, and career development. Role models and programs designed to meet the special needs of women are also effective. Additional factors that are important in increasing the percentage of women in engineering and science are institutional in nature. Institutions with strong comprehensive and administratively supported programs that stress not only recruitment, but also retention, graduate school, and science and engineering careers seem to be more effective than programs that focus on only one or two areas and are not supported by administration and faculty. The development of comprehensive institutionalized programs may be the key element necessary to ensure full participation of women in science and engineering.

298 Levine, D. 1984. **An innovative approach to attract young women to careers in engineering and science.** *Engineering Education*. Vol.75, No.3, p.162-164.

Objectives of a four-week summer program i.e. Females in Engineering, Methods, Motivation, Experience, designed to attract ninth-grade females to science and engineering careers are listed. Program content and strategies, results of student and parent evaluation of the 1983 program are discussed.

299 Levine, D. 1985. **Adding a woman's touch.** *Science Teacher*. Vol. 52, No. 6.

"Females in Engineering, Methods, Motivation, and Experience" (FEMME) is a precollege program at New Jersey Institute of Technology giving academically talented ninth-grade girls an introduction to engineering. Four experiments (windmill building, burglar alarm construction, electrochemistry, and spatial reasoning activities) helpful in achieving FEMME's major goal of "doing" science are described.

300 Mackneson, R.G. 1983. **Perspectives of some Canadian women in engineering.** Thesis (Ph.D.), University of Toronto (Canada). 4 microfiche.

Two groups of Canadian women in engineering, 308 students in first year Ontario universities, and 272 professional engineers, were surveyed by questionnaires, and 19 of the women engineers interviewed. The survey of the students repeated a similar one in 1976. There were few differences found except for their perceived support for their career choice. Whereas the 1976 students reported about equal support and opposition for their decision to enter engineering, by 1981, the women in first year indicated six times more support than opposition. The fathers and brothers of the 1976 group had been supportive, but their mothers, sisters, and friends opposed their career choice. However, by 1981, the reported support of mothers and sisters equalled or exceeded that of male relatives, and most other people had also become more supportive. Most of the students in both groups had entered engineering because of their interest in mathematics and science, and their

expectations of rewarding and challenging careers on graduation. The questionnaires to the women professional engineers were the first part of a Canada-wide survey undertaken by Dormer Ellis for presentation at the second convention of Canadian Women Engineers in April 1983. Over half these respondents had been educated in Canada, and the median date of registration of this sample was 1975. Most were married and also mothers who had continued their career even while their children were small. Family life was important to them, and most reported that their husbands were supportive of their careers. While most of the women believed that their salaries were equal to those of similarly qualified men, many also felt that their opportunities for advancement were lower, even though very few had refused a transfer for family reasons. Many had experienced gender-based discrimination which they either ignored or handled lightly with humor. These women strongly encouraged suitably qualified women to enter engineering because they felt that it offered them an interesting and well-paid career, and because the profession itself would benefit from a higher proportion of women. The interview data confirmed the questionnaire results and added a personal dimension.

301 McAfee, N.J. 1979. **Women in engineering revisited.** IN *Expanding the role of women in the sciences.* p.94-99. Edited by A.M.Briscoe and S.M.Pfafflin. New York, NY, The New York Academy of Sciences. (Annals of the New York Academy of Sciences, vol. 323)

Although women make up an unimpressive one percent of the engineering population, their ranks are growing. Undergraduate enrollment has been increasing rapidly since 1970, and some universities today have women representing 10-15 percent of their engineering enrollment. Beginning salaries are higher for women than for men, but there is considerable controversy over what happens after the first job. Women initially have it better than men in engineering but the advantage disappears fast, and after the first five years the trend changes and the reverse is true.

302 McAfee, N.J. 1984. **You've come a long way baby: the myth and the reality.** IN *Women in scientific and engineering professions.* p. 160-169. Edited by V.B.Haas and C.C.Perrucci. Ann Arbor, MI, The University of Michigan Press.

Notes significant disparity between women in the professions and women in management. Using engineering as an example, one would expect at least four percent of the engineering managers to be women, and yet only .05 percent of engineering managers are women. One major reason given is that it has been only recently that significant numbers of women entered the engineering field, and it takes experience on the job before one can be promoted into a management position. Among the many factors holding women in traditional jobs are myths or "old husband's tales". (1) Men won't work for women. (2) Women won't work for women. (3) Women won't travel. (4) Women aren't mobile, they can't change job locations. (5) Women are too emotional and can't stand pressure, crisis or conflict. (6) Women can't make decisions or enforce discipline. (7) Women subtly influence men. (8) Women make very poor corporate images.

303 Modeer, C. 1989. **Better balance in gender divided fields.** *European Journal of Engineering Education.* Vol. 14, No. 4, p.363-367.

Describes female representation in science and engineering in the Swedish educational system and labor force. Discusses how to change attitudes toward female scientists and engineers in society.

304 Morell, D. 1989. **Gender differences in science attrition: The role of self-efficacy beliefs and department support.** Thesis (Ph.D.), Claremont Graduate School. 131p.

This study tests the hypothesis (1) that men and women differ in their expectations of self-efficacy and that this difference contributes

to sex differences in science attrition, (2) that perceptions of environmental support significantly contribute to observed sex differences in retention patterns. During the first week of the fall quarter, a measure of academic-related self-efficacy was administered to 89 male and 90 female freshman engineering students. Subjects indicated their degree of confidence in completing the degree requirements in engineering with a grade of 'B' or better. After 12 weeks of instruction, a measure designed to assess perceptions of department support was administered to all subjects who had participated in the self-efficacy phase of the study. Retention was assessed by tracking the registration history of subjects over four academic quarters. Subjects who left the university or changed majors during the course of the study were defined as non-persisters. The results of chi-square analysis revealed that men were retained at a significantly higher rate than women. Controlling for the background characteristics of study participants (i.e., SAT math, high school GPA), analysis of covariance revealed that males had significantly stronger expectations of self-efficacy than females. More importantly, these expectations were shown to be related to the differential attrition rates of the study participants. Perceptions of department support were shown to significantly distinguish persisters from non-persisters. Relative to students who left, students who remained in engineering rated the department as being significantly more supportive. The results of stepwise discriminant analysis revealed that when the variance associated with SAT math, high school GPA, and self-efficacy had been removed, department support remained a significant predictor of retention. Implications for institutions are discussed.

305 Morse, L. 1989. **Re-entry - a source of non-traditional faculty.** *Engineering Education.* Vol. 74, No. 5, p.561-563.

The graduate Reentry Program for Women at the University of Central Florida is discussed. Six components of the program are described: (1) mathematics review courses; (2) the program coordinator; (3) orientation meetings; (4) professional development; (5) co-op jobs; and (6) social events that emphasize information.

306 Mraz, S.J. 1990. **Engineering shortage: prophecy or propaganda?** *Machine Design.* Vol.62, No.18, p.111-115.

Studies by the Office of Technology Assessment, the Commission on Engineering Manpower, and the National Science Foundation (NSF), predict a future with fewer new engineers. The driving factor in the NSF report, the one cited most often by government and industry experts, is the falling number of US college-age students. By the year 2006, the NSF model forecasts a cumulative shortfall of 275,000 engineering graduates. Criticism of this study centers on its method of calculating - or, more precisely, not calculating - the future demand for engineers. The model lacks any feedback mechanism between supply and demand and does not allow for unforeseen events. Two approaches suggested to head off this shortfall are improving science and mathematics education and increasing number of women, minorities, and disabled people in engineering.

307 Nunziata, S. 1991. **Few producers, engineers are women, but chances improve.** *Billboard.* Vol.103, No.41, p.1,78.

The number of female engineers and producers in the recording industry is gradually increasing, though women still only make up 15 percent of the applicants at most engineering schools.

308 Opsata, M. 1985. **Pros and cons of having a mentor.** *Graduating Engineer (Women's Issue).* Feb, p.12-15.

Discusses mentoring relationships for women in engineering. Advantages and disadvantages are outlined.

309 Opsata, M. 1988. **Legal gains.** *Graduating Engineer. Special Issue.* p.41-44.

Describes legal decisions from 1963 to 1987 that helped to

remove barriers to equality in job conditions for female engineers. Discusses some barriers that still exist. Suggests a few antidotes for still existing problems and discusses job search implications.

310 Peacock, S. 1986. **Engineering training and careers for women in Britain. An overview of the initiative undertaken by the Engineering Industry Training Board.** *European Journal of Engineering Education*. Vol. 11, No. 3, p.281-294.

Outlines the initiatives taken by the Engineering Industry Training Board of the United Kingdom to increase the number of women in engineering careers in the manufacturing industry both at technician and professional levels. Reviews successes in implementation and in outcomes.

311 Pergom-Larsson, M. 1982. **Women and technology in the industrialized countries.** IN *Scientific-technological change and the role of women in development*. p.29-75. Edited by P.M.D'Onofrio-Flores and S.M.Pfafflin. Boulder, CO, Westview Press.

This Swedish study of women and technology in industrialized countries shuttles between two levels: the first being criticism of male technology, a critique that has evolved from the female consciousness formed by women's position in the production process as unsalaried producers in the home. A second level documents quite concretely the way in which women suffer from technological development. These two levels are intimately related. Out of specific experiences in work outside and inside the home with downgrading of labor, social control, stress, and isolation, women's protest grows against a technology that does not inquire after their fundamental needs. Against a technology that, increasingly, is threatening the life on earth and in our wombs, women today, increasingly, are saying no in order to safeguard their physiological integrity. The risk of congenital and genetic damage and cancer in the future for unborn children constitutes a direct threat to our lives and our children's lives. The drastic drop in the birth rate in all highly industrialized countries demonstrates the extent to which technology becomes manifest in women's consciousness in the form of a birth strike. It is remarkable how little inquiry has been made into women's needs from technology or the consequences to women and women's culture when new technology is introduced. The microelectronic revolution has hit women harder than men both in the form of unemployment and in the downgrading of the content of work. The pollution of earth, air, and water affect both women and men, but women seem more vulnerable emotionally than men as a result of their daily responsibility for child care and feeding. The technologization of everyday life has been harmful to women in terms of increased isolation and privatization. There is to understand more about the relationship between women and technology, or more specifically how women in particular are affected by technological developments; how women perceive technology and its consequences for society at various levels; and how, on this basis, women can constructively contribute to selecting the types of technology that would generate better life conditions for all women, men and their dependents.

312 Pfafflin, S.M. 1982. **Some reflections on women in science and technology after UNCSTD.** IN *Scientific-technological change and the role of women in development*. p.179-188. Edited by P.M.D'Onofrio-Flores and S.M.Pfafflin. Boulder, CO, Westview Press.

States that developing nations are still in the early stages of their scientific and technological work forces. They can take steps to insure that women are incorporated into their scientific and technological work force as these are developed. But failure to do so will almost inevitably result in structures that systematically discriminate against women. There should be no misunderstanding about the need for specific action if women are to be allowed to participate equally in science and technology in developing countries. Reasons put forward for women's participation are (a) it is a right

since women make up half the human race, they should participate fully in all aspects of their societies; (b) developing countries can ill afford to disregard the talents of half of their people. To fail to take advantage of many of their most able citizens is a waste of human resources that even most developed countries now recognize cannot continue to be tolerated; (c) the participation of women in science and technology is important and thus is because of their potential role in science policy-making. Active planning to provide women with the opportunities they need is vital. The view that one can simply bring in development without planning for the participation of women in science and technology, and find that they do, in fact, benefit, is either an expression of wishful thinking or of an indifference to the fate of women that reflects the traditional view of women as chattel, not human beings with rights and responsibilities. Planning for the integration of women into the scientific and technological work force is a sign of a knowledgeable and responsible developmental effort.

313 Powell, D. 1992. **Women in engineering: Canadian panel calls for more.** *Science*. Vol.256, No.5057, p.607.

A panel of educators, engineers and employers has come up with a report stating reasons why there are so few women on Canadian engineering faculties. The lack of role models for girls who want to become engineers, gender stereotyping by parents and teachers and systemic discrimination in universities and in the workplace were all cited as factors explaining why there are so few women on the engineering faculties.

314 **Resource organizations.** 1988. *Engineering Education*. Vol. 78, No. 8, p.781.

This listing provides the names, addresses, and brief descriptions of 11 major national groups concerned with minorities and women in engineering.

315 Ross, S.S. 1985. **Progress report.** *Graduating Engineer (Women's Issue)*. Feb, p.29-31.

Reports on a Society of Women Engineers survey which documents strides for women engineers. Respondents are categorized according to employer, degrees/specialization, and supervisory responsibilities. Data indicate progress with salaries and change in the number of engineering bachelor degrees awarded to women from 1972 (1 percent) to 1983 (13 percent).

316 Saigal, A. 1987. **Women engineers: an insight into their problems.** *Engineering Education*. Vol. 78, No. 3, p.194-195. Addresses the status of engineering education for women. Discusses the changes related to both the image of women and the engineering profession over the past 15 years. Assesses how computer-aided engineering has made engineering attractive to women today.

317 Sessar-Karpp, E. 1986. **The situation of women in technical professions in the Federal Republic of Germany.** *European Journal of Engineering Education*. Vol. 11, No. 3, p.315-320.

Reviews the employment situation of women in West Germany and states the initiatives that have been taken to increase the proportion of women in jobs traditionally undertaken by men, including technical jobs at all levels. Focuses on strategies for improving the position of women in engineering.

318 Shelley, S. 1989. **Women engineers: The playing field isn't level.** *Chemical Engineering*. Vol.96, No.12, p.47-48.

According to 2 recent surveys conducted by The Cooper Union for the Advancement of Science and Art, women are making strides in the engineering world but still have some way to go. Women engineers stated that they are satisfied with their jobs, are paid as well as their male peers, and play important roles in the profession. However, women engineers stress that they have to work harder

than male engineers to get the same recognition, are excluded from decision making, and will be penalized professionally if they take maternity leave. The goals of the 2 surveys - one of 4,000 women engineers and the other of 4,000 students - were to identify what type of women become engineers and the problems and rewards they face in this profession. The information generated could help dispel negative stereotypes of engineering and encourage more women to take up technical careers. Emerging from the studies was an overwhelming theme that engineering is not being adequately promoted among women in high schools and colleges.

319 Smith, E.T. and Freundlich, N. 1989. **The women who are scaling high tech's heights; making science more seductive to women on campus.** Business Week (Industrial/Technology Edition), No.3121, p. 86-89.

Women are chief executives of nearly 3 percent of the 25,000 small biotechnology, medical, pharmaceutical, and electronics companies, but the high-technology area is still male-dominated. Women have few female role models, mentors, or contacts in the industry. Studies show that, although men and women begin at comparable levels, women earn 25 percent less than men with similar experience after being out of school for 10 years. Women are also confronted with "glass ceilings" that prevent them from moving into general management as fast or nearly as often as men. Women entrepreneurs have circumvented some of the barriers by launching out on their own, despite the fact that venture capitalists are wary of giving money to women. Sweeping changes are needed. Some engineering schools are instituting special programs to encourage women to enter high-tech fields and stay there. Purdue University, for instance, now requires all women engineering students to attend a seminar designed to help them overcome their lack of confidence and create a support network. About 22 percent of all engineering graduates at Purdue are women.

320 Srinivasan, M. 1982. **The impact of science and technology and the role of women in science in Mexico.** IN Scientific-technological change and the role of women in development. p.113-148. Edited by P.M.D'Onofrio-Flores and S.M.Pfafflin. Boulder, CO, Westview Press.

This study was strictly limited to the investigation of the role of women in science and the impact of science and technology on women in Mexico. Concludes that finding jobs in modern industries for women depends on the size of the male labour force and the availability of child care facilities. But in Mexico's northern bordertown, women's employment has not depended on these factors because women are employed instead of men and the day care situation of the children is carefully avoided by industries that prefer to hire unmarried young women and constantly keep their labour force in a state of perpetual youth by changing workers quite often. Despite the general ill effects of the maquiladoras, direct investigation revealed that the women who are working in these plants are happy to have their jobs. The young women in these factories enjoy the money they get, which is considerably more than what most of the women are used to making. In traditional textile industries a woman often spends a whole month to make one item that is sold for less than 150 pesos-making that sum their monthly earning. The same woman has the opportunity to make as much as 3,000 pesos per month in a modern textile maquiladora. The peasant girls seem to like the new style of living, which caters to their fanciful spending on consumer goods. More importantly they like having jobs that are not homebased and therefore have a certain "status" attached to them. The image of working in a modern technology-based industry is greatly pleasing to them even though the job has all the trappings of a traditional industry without its benefits. The migration to the north as well as the preference by women for factory jobs in all centers in Mexico has had an important effect on the domestic service market. The few who remain to be maids are in a better bargaining position and their salaries have doubled in the last five years.

321 Swarbrick, A. 1986. **Women in technology: a scheme for women engineer returners.** European Journal of Engineering Education. Vol.11, No.3, p.339-349.

Explains the Women in Technology (WIT) program, which aims to help women engineers not currently in paid employment to prepare for a return to technological work. Provides evidence that the project is fulfilling its objectives at a modest cost.

322 Tadesse, Z. 1982. **Women and technology in peripheral countries: an overview.** IN Scientific-technological change and the role of women in development. p.77-111. Edited by P.M.D'Onofrio-Flores and S.M.Pfafflin. Boulder, CO, Westview Press.

From their inception in human history, technology and science have had contradictory impacts on society. They have been both labour-saving and labour-displacing, lifesavers and potential killers. In all societies, the impact of technology varies according to its social utilization. For those who control it and those who have access to it, the advantages are undoubtedly immense. On the other hand, the reverse is the case for those who not only have no access to it and do not control it but whose livelihood has been deteriorated because of the way technology is presently utilized. The degree of women's access to technology is a consistent index of a country's level of socioeconomic development. In most peripheral countries, today the majority of women are negatively affected by many of the technological changes. That this negative impact has now and will continue to have in the future serious repercussions should be the cornerstone of any discussion on women and technology. Yet one has to add that positive changes in the status of women. The transformation of a given country depend on the use of technology within a totally different socioeconomic framework.

323 Trescott, M.M. 1984. **Women engineers in history: profiles in holism and persistence.** IN Women in scientific and engineering professions. p.181-204. Edited by V.B.Haas and C.C.Perrucci. Ann Arbor, MI, The University of Michigan Press.

Women engineers who have made substantive intellectual contributions to the theory and practice of engineering, represent historically a highly select group of holistic thinkers. For we find combined in them these characteristics of (1) persistent, independent-thinking pioneer, (2) exceptionally bright intellect, (3) engineer, who, whether male or female, often deals with systems, and (4) woman, who may have evolved a more holistic approach to life, in general, than man. With such a possible orientation, to holism, women engineers in our history may be reassessed as having contributed much more to technological change and the advancement of engineering knowledge than we might otherwise suppose from their relatively small numbers. Within the field of engineering, women have undoubtedly been outstanding thinkers and faculty members, among other roles they have filled. Women such as Lillian Gilbreth, Edith Clarke, and various other thinkers, women engineers have contributed greatly to the intellectual history of engineering and science. Additionally, they have contributed impressively to the history of management, to business enterprise, and, of course, to women's history.

324 Valyo, J.A. 1985. **Factors which influence career choice of first year women engineering students.** Thesis (ED.D.), Columbia University Teachers College. 171p.

First year men and women engineering students at two engineering schools were surveyed. Participants were asked to complete an adapted version of the Lunneborg Non-Traditional Career Survey and the Bem Sex Role Survey. A socioeconomic scale, the Valyo Socio-economic Status Index (VSESI) which places special emphasis on parents' education and assigns people to the working, middle and professional classes, was developed. The largest percentage of women from each VSESI category were classified as androgynous. Women students in the working and middle classes indicated their parents were very supportive of the

daughter's decision to study engineering. Additionally, these women said they were very close to their parents. Several recommendations to increase the enrollment of women in engineering which capitalize on this closeness with parents were made. An overwhelming majority of working-class women stated that a high school science teacher was most influential in their decision to study engineering. The educational plans of men and women respondents differed significantly and birth order for the women in this study was not as significant as in previous studies of women in non-traditional careers.

325 Vetter, B.M. 1981. **Women scientist and engineers: trends of participation.** Science. Vol. 214, No.4527, p.1313-1321.

The proportion of doctorates in science and engineering awarded to women increased from 7 percent in 1965 to 23 percent in 1980. At the same time, the proportion unemployed continued to be higher among women, and their starting salaries lower. Further, the disparity in earnings tended to increase with degree levels and with years of experience.

326 Vetter, B.M. 1988. **Demographics of the engineering student pipeline.** Engineering Education. Vol 78, No. 8, p.735-740.

Reviews trends in the population of engineering students since 1975. Discusses fixed and flexible elements of the college-age population. Describes the current situation of women in engineering education. Compares freshmen and graduate data. Considers the possible future effects of current trends on American universities.

327 Whyte, J.B. 1986. **Starting early: girls and engineering.** European Journal of Engineering Education. Vol. 11, No. 3, p.271-279.

Describes an action research project, "Girls into Science and Technology" (GIST), which focuses on girls' subject choices in the first three years in their secondary schools in the north of England. Summarizes the initiatives taken by the GIST team and reviews research findings and project outcome.

328 Wilson, R. 1991. **Colleges start programs to encourage women who are interested in engineering careers.** Chronicle of Higher Education. Vol.37, No.39, p.A27,A29.

A second annual meeting sponsored by the Women Engineering Program Advocates Network (WEPAN) is discussed. WEPAN aims to increase the number of women who pursue careers in engineering by encouraging colleges to establish special support groups for them.

329 **Women in technology: proceedings of a conference at Loughborough University, January 1984.** Loughborough, UK: Centre for Extension Studies. Loughborough University of Technology. 134p.

Aeronautics

330 Bowen, B.D. 1990. **A trend analysis of women who hold Federal Aviation Administration certificates; relationship to the representation of women in Collegiate Aviation faculty ranks.** Wichita, KA, USA: Wichita State University. National Institute for Aviation Research. 18p. (IAR-90-3)

The report analyzes data on the number of women pilots and the number of women faculty in colleges and universities that offer a baccalaureate degree in aviation. Data were obtained from U.S. Civil Airmen Statistics, The Chronicle of Higher Education, and a survey of the 69 collegiate institutions that have aviation programs. The data verify that women are not proportionally represented in aviation career fields that require Federal Aviation Administration certification or in the aviation faculty ranks. Only six percent of all aviators are women, slightly decreased from 1978 to 1988. While

the number of women who have become Airline Transport Pilots has increased from 1978 to 1988, the number of women student pilots has decreased. Women hold 5.2 percent of full-time aviation faculty positions. Women hold 6.5 percent of the earned doctorates in the technologically related field of engineering. Five percent of Certified Flight Instructors are women. Several recommendations are offered to increase the representation of women in the collegiate aviation faculty.

331 Gilmartin, P.A. 1992. **Women pilots' performance in Desert Storm helps lift barriers in military, civilian market.** Aviation Week & Space Technology. Vol.136, No.2, p.62-63.

Although Congress lifted a statutory ban that prohibited the assignment of women to combat aircraft in the US Air Force, Navy, and Marine Corps, the Defense Department is not likely to change its rules in the near future. Nevertheless, the shift in policy could have a significant long-term impact on the future of women in aviation. Expanded participation by women will provide younger women with successful role models that their elders lacked. The performance of military women who were deployed during Operation Desert Storm was a major reason for Congress to change the law. A survey the world's airlines shows that women are slowly filtering into the ranks. The US currently has the greatest number of women pilots, many of whom are employed by regional carriers. With about 350, United Airlines has the greatest number of women pilots. There are still no women pilots at All Nippon Airways, Singapore Airlines, Japan Air Lines, and El Al Israel Airlines.

332 Lamboda, A. 1991. **For women only: Resnik Scholarship.** Flying. Vol.118, No.1, p.42-43.

American Flyers established an annual \$20,000 starter fund for scholarships to be awarded to women who hold at least a private pilot certificate and instrument rating.

333 Reynolds, S. 1989. **High flyers--women aviators in pre-war France.** History Today. Vol.39, Apr, p.36-41.

Women aviators in France in the 1920s are profiled. While women aviators proved their abilities were as good as men, they had little or no impact on the status of women as second-class citizens.

Chemical Engineering

334 Musella, M.A. 1990. **What women engineers want - what women engineers can do.** Chemical Engineering. Vol.97, No.10, p.207-212.

With few exceptions, the career goals and abilities of women engineers match those of men. The US Bureau of Labor Statistics reports that women compose 7.3 percent of the US' engineering work-force and an impressive 12 percent of chemical engineers. Some common themes concerning the situation of women engineers today are: (1) Encouragement is essential to foster confidence in new and old employees, (2) Delegating responsibilities is critical to getting important work done in a timely fashion, (3) The most important work is usually carried out by an informal network that crosses departmental or managerial levels, (4) Risk-taking should be encouraged, (5) Visibility is an important element in getting a promotion, (6) New members in an organization need to become familiar with the corporate culture. There are many issues that affect women engineers to a much greater degree than men, such as family care, maternity, and workplace safety.

335 Rollins, J.T. 1984. **Administration of high school competency requirements for chemical and petroleum engineers.** Thesis (ED.D.), Texas Tech University. 163p.

Increased instructional demands on engineering schools for

chemical and petroleum graduates, caused by variations in energy prices, has led to efforts to better define and assess the competencies of students entering these fields. The standard of measurement of these competencies is that of freshman grade point average. Required competencies include problem-solving ability, computer literacy, a knowledge of mathematics, and communications skills. Correlations of GPA with other readily available high school transcript data of high school rank and SAT scores is the traditional predictor of success or nonsuccess, or degree of competency, for these students. This study was concerned with different combinations of predictors than the traditional ones presently in use. Data from 307 students enrolled in chemical and petroleum engineering at Texas Tech University between 1972 and 1977 were subjected to statistical analysis using the procedure of multiple linear regression. The following variables were found to be meaningful predictors of freshman GPA: (1) SAT scores; (2) high school rank relative to class size; (3) advanced placement status; (4) grades in high school science courses; (5) grades in high school mathematics courses. From these variables, five equations were developed for use by the counselor or advisor in placing or advising entering students.

Civil Engineering

336 Chiosso, R. and Tizard, J. 1990. **Women and girls on engineering and construction courses in further education.** Vocational Aspect of Education. Vol. 42, No. 113, p.101-107.

Interviews with 10 female students in construction and engineering courses at Keighley College (Great Britain) found that they experienced problems with harassment from male students, isolation, and lecturers' attitudes. Recommendations were to increase the numbers of women students, encourage them to support each other, improve the induction process, change the college environment, and challenge sexist attitudes.

337 Hinckley, P. 1991. **Engineering women into the work-place.** Civil Engineering. Vol.61, No.11, p.66-67.

While men and women speak the same language, they often have different interpretations of what is said. Ideally, men and women should draw on the strengths of both "cultures". This solution is the key to integrating women into the engineering profession and workplace. Integration is a 2-dimensional process requiring both a technical change of recruitment and retention and a human, or social change. Social changes call for the dismantling of outdated barriers and the elimination of unfair stereotypes. The woman engineer is not necessarily fragile, nor is she afraid to get dirty. As these social changes evolve, a company's management can lead the way by initiating the technical aspects of integration - the long-term commitment to recruit, develop, advance, and retain women. Once women have been recruited, they must be integrated into a workplace that encourages their participation.

Engineering Design

338 Brasell, H. 1987. **Sex differences related to graphing skills in microcomputer-based labs.** Paper presented at the annual meeting of the National Association of Research in Science Teaching, 60th, Washington, D.C., April 23-25, 1987. 7p. (SE 047898, ED 280734)

As part of an investigation of the effectiveness of a microcomputer-based laboratory (MBL) activity in developing students' graphing skills, this study was specifically designed to examine the differences between females and males in both

performance on graphing tasks and on their attitudes to graphs and graph-based activities. Results based on a pretest of the participating secondary level students (N93) revealed that about one-fifth of the students were seriously restricted in their ability to understand graphs by an inadequate graph schema. Females who had poor graph schemas appeared to have been constrained by their comparatively low ability, whereas the males were more likely to have been constrained by lack of interest. After controlling for differences in ability, some sex differences in performance on graphing tasks remained. Females had lower scores for items involving speed or velocity graphs, but not for miscellaneous graphs of less abstract properties such as distance. Also discussed are two treatment groups that constructed distance and velocity graphs for one class period: (1) MBL group (N) used the microcomputer; (2) second control group (N18) used paper and pencil. The females who participated in the MBL treatment gained significantly higher scores on a posttest of distance graphs, than the males did, while the reverse was true for velocity items. There were no sex differences for students in the control treatment. It was concluded that the MBL experience was effective in improving students' graphing skills.

339 Curry, D.T. 1991. **Engineering schools under fire.** Machine Design. Vol.63, No.20, p.50-54.

According to Eleanor Baum, Dean of Engineering at Cooper Union for the Advancement of Science and Art, significant changes are needed. One is to introduce students early into design. The National Engineering Education Coalition, an 8-university group, has a goal of reshaping engineering education that includes making engineering more attractive and relevant to students, particularly women and minorities.

340 Woudhuysen, J. 1990. **Women who are on the verge of a design industry breakthrough.** Management Today. October, p.41.

Although there has never been a shortage of design talent among women, female designers are woefully absent from the milieu of product design. They are to be found in graphics, and, to a lesser degree, in interiors and architecture. They also play an important role in fashion, textiles, ceramics, and jewelry. Yet in transport, consumer electronics, and domestic appliances, male designers dominate. The disparities are most glaring in domestic appliances, which are used mostly by women. Moreover, repeated empirical studies have shown that the multiplication of labor-saving devices in the home has done nothing in this century to reduce the hours women spend there. If employers were prepared to cover the day care expenses of the children of women designers, the situation might change. Employers should recognize that a female design perspective on the products that surround cooking and child care would improve those products.

Electrical and Electronics Engineering

341 Basta, N. 1985. **Job Prospects for E/E Engineers.** Graduating Engineer (Women's Issue). Feb, p.154-155.

Employment opportunities remain high for electrical/electronic (EE) engineering; although leveling-off has occurred in the personal computer area, there is expansion potential in telecommunications. Specific skills sought by EE employers and data on women in EE fields are included.

- 342 Forbes, L.H. and Edosomwan, J.A. 1990. **The role of women, minorities and the handicapped in the engineering sector.** *Industrial Engineering*. Vol.22, No.9, p.47-49.

A shortage of engineers, particularly industrial engineers, is posing a threat to the future economic survival of the US. Bureau of Labor statistics indicate that, because of the emergence of high-technology industrial growth, both in the manufacturing and service sectors, the need for scientists and engineers will increase by 36 percent between 1986 and 2000. Conversely, because of the phasing out of the postwar baby boom, the college age population will drop to 24 million, compared with 30 million in 1980. The engineers and scientists of the future will increasingly come from the ranks of women and minorities. In 1990, the Institute of Industrial Engineers (IIE) formed a task force to study the shortage problem. Some of the initiatives now being implemented include: (1) developing the IIE role at the national, society, division, and chapter levels in addressing the problems of women, minorities, and the disabled in engineering, and (2) cooperating with industry, government, academia, and other professional societies in addressing these issues.

- 343 Peacock, S. 1986. **Engineering training and careers for women in Britain: an overview of the initiatives undertaken by the engineering industry training board.** *European Journal of Engineering Education*. Vol.11, No.3, p.281-294.

Outlines the initiatives taken by the Engineering Industry Training Board of the United Kingdom to increase the number of women in engineering careers in the manufacturing industry both at technician and professional levels. Reviews successes in implementation and in outcomes.

- 344 Syedain, H. 1991. **Women on their metal.** *Management Today (UK)*. Feb, p.56-60.

Of all the professions, engineering has the worst record for recruiting women. However, the consensus among most female engineers in the UK is that the existing obstacles are both surmountable and dwindling. Many believe that popular prejudice keeps women away from the field of engineering. The conditioning starts with the toys given to children and continues all the way through school. To combat this kind of prejudice, a number of initiatives have been set up in the UK to encourage young women to broaden their options. Initiatives like the Women into Science and Engineering campaign must be having some effect; the percentage of young women in the engineering intake at UK universities has risen from 3-4 percent in the 1970s to 12 percent today. Christine Smith, who owns and runs the Medical Technology Partnership consultancy, sees positive advantages in being a woman in a man's world; chief among these is being a high-profile person. There are still so few women engineers that those who are there tend to get noticed.

Environment

- 345 Center for Systems and Program Development. 1980. **The status of women in water related science and technology.** Submitted to Office of Water Research and Technology. U.S. Department of the Interior. Washington, D.C., USA: Center for Systems and Program Development. ii, 51 p.

- 346 Chiro, G. 1987. **Environmental education and the question of gender: a feminist critique.** IN *Environmental education: practice and possibility*. p.27-52. Edited by Ian Robottom. Victoria,

Australia: Deakin University. (ED 325383)

On a global scale, there is consensus that the earth and its inhabitants are in social and environmental peril. This is where the consensus ends, however, for there is equally widespread disagreement over the nature, causes and extent of the problems and the most appropriate and effective responses to them. This essay critically examines environmental education, one such 'appropriate response' to the global socio-environmental crisis. It advocates the adoption of a critical feminist perspective of environmental education to aid in the understanding and development of appropriate solutions to environmental problems. Presents a view of the problematic nature of environmental education. Found that there is no consensus about what it means to practice 'good' environmental education, nor about the processes and fundamental aims of environmental education. In the social world of education, environmental education practice is a political activity and is therefore subject to the conflicts of values, ideologies and decision-making processes concerning appropriate environmental education curricula and pedagogy. Environmental education, then, cannot disregard these contested areas, but must make use of its essential problematic quality to advance its aims of socio-environmental change through education. To this end, the author argued that environmental education should embrace a political perspective of the environment, a feminist critique, as well as a political perspective of education, a socially critical impulse and of educational development and change, an action research approach.

Geosciences

- 347 Claudy, N. 1991. **Geoscience employment.** *Geotimes*. Vol.36, No.2, p.57-58.

Geoscience hiring in 1990 is profiled. A nearly complete recovery from the downturn of 1989 is revealed. The outlook for employment in the field in 1991 is encouraging, though a great disparity between salaries of women and men still exists.

- 348 Schwarzer, T.F. 1979. **The changing status of women in the geosciences.** IN *Expanding the role of women in the sciences*. p. 48-64. Edited by A.M.Briscoe and S.M.Pfafflin. New York, NY, The New York Academy of Sciences. (Annals of the New York Academy of Sciences, vol. 323)

The current status of women in the geosciences is changing and improving rapidly. For example, (1) women are entering the geosciences in unprecedented numbers. In 1974, only four percent of working geoscientists were women. Currently, women constitute about 20 percent of all undergraduate geoscience students. (2) Women geoscientists are now actively recruited and hired by employers, particularly by energy companies, the single largest employer of earth scientists. (3) Starting salaries for men and women

geoscientists are comparable, although median salaries for women at all experience levels are about 75 percent of those for their male colleagues. (4) Women geoscientists are moving away from their historical concentration in academic jobs and into employment areas and work activities in industry and government where salaries are higher and overall career opportunities are greater. (5) The timing of these changes is coincident with a high-demand market for geoscientists generated by increasing energy needs and environmental concerns. As the status of women in geoscience is changing, stereotyped images are fading, not only in the minds of men, but those of the women themselves. Geology, like other so-called hard sciences, historically has been a male domain and has been considered an unfeminine discipline. The geosciences have indeed had a long-standing image of rugged masculinity, demanding conditions or the shipboard geophysicist handling heavy equipment

and living in cramped, impersonal quarters. The physical image of geoscience and misconceptions regarding a woman's ability or willingness to participate fully in virtually all aspects of geoscience explains why, until very recently, women entered the profession in small numbers and tended to advance relatively slowly when they did pursue a geoscience career. However, while employers generally consider their women geoscientists, many of them young, as competent as men, employers are concerned about the women's long-term career commitments and their apparent lack of well-defined career goals. Women professors at all ranks still represent only about two percent of geoscience faculty members. Since many younger women feel the need for successful role-models, especially at the educational level, this continuing under-representation of women professors is a serious concern. The increasing numbers of husband-wife teams have generated some complex and not so easily resolved problems.

349 Suiter, M. 1991. **Tomorrow's geoscientists: recruiting and keeping them.** *Geotimes*. Vol.36, No.1, p.12-14.

The need for increased efforts to attract and maintain the interest of women and minorities in the geosciences is discussed. A list of recommendations is presented.

350 Suiter, M.J. 1991. **Women and minorities in the geosciences.** *Geotimes*. Vol.36, No.2, p.58-59.

Little progress has been made in the improvement of participation of under-represented groups in the geosciences. One notable area of growth, however, for under-represented groups is in leadership positions in geoscience professional organizations.

351 Suiter, M.J. 1992. **1991: The Geosciences in review--women and minorities in the geosciences.** *Geotimes*. Vol.37, No.2, p.44.

Geoscience enrollment among women increased 18.6 percent in 1991 from 1990, and ethnic-minority enrollment increased 42.3 percent. Other significant changes in the role of women and minorities in the geosciences are discussed.

352 Suiter, M.J. 1992. **Women in geoscience: a resource to develop.** *Geotimes*. Vol.37, No.1, p.14-17.

Females face more problems in entering the field of geoscience because they experience science education in a negative learning environment that may result in diminished self-esteem and minimal opportunities for experiencing positive role-models. By reinforcing support in schools at an early age, much of this wasted human resource can be retained and contribute mightily to geological study.

Information Technology

353 Arnold, C.L. 1988. **Salary and occupation by gender among community college computer science graduates.** Thesis (Ph.D.), Stanford University. 435p.

A survey and follow-up interviews were conducted to obtain data on the educational and labor market experiences of 1981-86 graduates of a Silicon Valley community college computer science program. Multi-variate analyses of the survey data yielded estimates of the relative effects of human capital, discrimination, and structural factors on salary differences. Qualitative data were used to explore the interaction between the individuals' attempts to obtain jobs and promotions, and the factors in the educational program, family, and labor market that facilitated or constrained those attempts. There were 324 graduates in the survey sample. Two-thirds were women. The major gender/race groups were white women, Asian American/Pacific Island women, and white men. The AA/AS degree was the highest educational level for one-third of the sample; the rest had higher degrees as well. More than half were in programming or analyst jobs, and another third were in other computer-related

positions. Interviews with 10 of the graduates revealed that both low and high-earning graduates experienced difficulty in finding entry-level programming jobs with little experience, due in part to competition with BS or MS graduates in computer science. In addition, married women with children had family responsibilities that constrained their job choices. However, high-earning graduates were able to overcome both labor market and family constraints because they had access to structural supports such as experience, opportunities for entry-level programming jobs, job contacts that led to high-paying jobs, or graduate degrees. These results raised issues of how to develop structural supports for more students. It is possible that community college graduates may be getting squeezed out of computer programming and into "subprogramming" jobs, jobs that require programming knowledge but do not provide programming experience or pay.

354 Coale, K. 1992. **Women making gains in IS sphere.** *InfoWorld*. Vol.14, No.10, p.53,56.

As the personal computer has garnered increased attention in corporate America, it has brought opportunities to many who might not otherwise have found themselves in technological positions. Among this group are female information systems (IS) professionals who saw rewards for their interest in and mastery of technology. However, information technology has not been entirely immune to the problems found in other fields. Corporations are having to come to terms with a more diverse workforce - one that includes women and minorities at all levels. To open their environments to these changes, several major corporations are establishing internal support groups and forums for their employees. While women have reaped rewards, they have also encountered hurdles, some of which have yet to be cleared, such as breaking into the ranks of upper management. Judy Andrews of Texas Instruments noted that for women to advance and increase their ranks, they must concentrate on expanding their field of knowledge.

355 LaPlante, A. 1992. **Decentralizing systems is not the best solution for everyone.** *InfoWorld*. Vol.14, No.10, p.57.

In regard to women entering the IS field, Sharon Moses of Plochman Inc. believes that women who have the willingness, the experience, and are aggressive enough to pursue what they want will certainly be considered. Moses' advice for young women with IS ambitions is to get a technical degree.

356 LaPlante, A. 1992. **Women call for more role models in IS.** *InfoWorld*. Vol.14, No.12, p.S73.

For young women in the information systems (IS) field seeking female role models, there are several pioneers and mentors. One is Isabella Castillo, director of Management Information Systems (MIS) at HCA Wesley Medical Center in Wichita, Kansas. Castillo was the Center's first computer employee. Approximately 1/3 of Castillo's IS employees are women, a number that has remained fairly constant since the year after she became director. Judy Andrews, business development manager for the telecommunication systems business unit at Texas Instruments Inc. in Dallas, advocates looking for mentors in any profession. Andrews is encouraged by the increased participation of women in the Association of System Managers, of which she is a member and a recipient of the organization's top award.

357 Marengi, C. 1992. **There are cracks, but glass ceiling is still mostly intact.** *Computerworld*. Vol.26, No.5, p.85.

For women in information systems (IS), financial services, high technology, health care, and pharmaceuticals offer the brightest prospects, while manufacturing and retailing pose the biggest hurdles. Insurance has traditionally employed large numbers of women, and many are finding their way to the top levels. Women make up roughly 45 percent of John Hancock Mutual Life Insurance Co.'s IS staff. The high-tech area is viewed as a boon to women because technically oriented companies emphasize capability over

gender. Health care is another information-intensive business where IS talent is highly valued. Amid all this promise, however, a glass ceiling still exists for women. Even though women may run parts of IS, the top position is usually held by a man. Despite this fact, Patricia Wallington of Xerox Corp.'s US Marketing Group believes that the outlook for women IS managers in the 1990s will be bright due to their holistic style of management.

358 Murphy, P. 1989. **Time for women in information technology in Northern Ireland.** *Adults Learning (England)*. Vol.1, No.4, p.113-115.

The University of Ulster developed a one-year course for women leading to a certificate in Information Technology Studies. Course content focused on personal development, study skills, assertiveness, communication skills, career and life planning, management skills, and social and economic effects of new technology. Support services included child care, financial aid, women tutors, and guidance and counseling.

359 Weingand, D.E. 1985. **Women, technology, and education.** *Library Trends*. Vol.34, No.2, p.343-353.

Women face technological issues in information professions. Work is changing rapidly as technological changes are introduced. Women need to be willing to make positive contribution to technological development. They need to use continuing education experiences that can assist in developing knowledge and strategies that they need to respond to change.

Mathematics

360 Battista, M. T. 1990. **Spatial visualization and gender differences in high school geometry.** *Journal for Research in Mathematics Education*. Vol.21, No.1, p.47-60.

Investigated the role that spatial thinking plays in learning, problem solving, and gender differences in 75 male and 53 female high school geometry students. Spatial thought was examined along with its counterpart verbal-logical thought. Males and females differed in spatial visualization and in their performance in high school geometry, but not in logical reasoning ability or in their use of geometric problem solving strategies.

361 Becker, B.J. 1990. **Item characteristics and gender differences on the SAT-M for mathematically able youths.** *American Educational Research Journal*. Vol.27, No.1, p.65-87.

Studied item responses of 2,380 mathematically talented junior high school students to explore the significant advantages that have been reported for males on the math sections of the Scholastics Aptitude Test (SAT-M). Data sufficiency items were easier for all students than were multiple-choice items, and were much easier for the girls than for the boys. Girls found miscellaneous items to be much easier than did the boys, but they found the algebra items more difficult. A number of specific aspects of mathematical performance seemed to be measured by the SAT-M for these students. The patterns of response suggest weaknesses and strengths that might be a focus of math instruction for bright students.

362 Blackman, S. 1986. **The masculinity-femininity of women who study college mathematics.** *Sex Roles*. Vol.15, No.1-2, p.33-41.

Study compared women who enrolled in college mathematics courses at the level of introductory calculus and beyond with those who did not on the 2-dimensional plane of masculinity-femininity. Measures included the Bem Sex Role Inventory and a mathematics skills assessment test. Data were gathered from 179 female undergraduates. It was found that the mathematics group differed

from the non-mathematics group on a number of variables, including background and vocational interests. Data provide evidence for the importance of social and psychological factors in women's choice of mathematics courses at the college level.

363 Blum-Anderson, J. 1989. **Affect and mathematics: persistence in the mathematical environment.** Paper presented at the conference on women in mathematics and sciences, St. Cloud University, MN, November 10-11, 1989. 11p.

Considers the effects of mathematical affect and the use of intervention programs to increase the retention of women and minorities in higher-level mathematics courses. Mathematical affect plays a role in the development of long-term mathematical persistence behaviors, such as course-enrollment decisions. The most critical period in which to use interventions to influence mathematical affect is the middle/junior high school age level. More students will be able to develop the short-term persistence behaviors necessary to experience success within the mathematical environment when attention to affect begins to be included as a regular part of the mathematics curriculum. Once students possess short-term persistence behaviors, it will be easier to motivate them to continue to enroll in mathematics courses.

364 Bradberry, J.S. 1989. **Gender differences in mathematical attainment at 16+.** *Educational Studies*. Vol. 15, No. 3, p.301-314.

Examines the mathematical concepts that cause the widest discrepancy between the sexes. Found these concepts to be concerned with scale or ratio, spatial problems, space-time relationships or probability questions. Contends that these findings have implications for those making decisions affecting the promotion of the teaching of mathematics to British girls and boys.

365 Bridgeman, B. and Wendler, C. 1991. **Gender differences in predictors of college mathematics performance and in college mathematics course grades.** *Journal of Educational Psychology*. Vol.83, No.2, p.275-284.

The results of a study suggest that grade differences in mathematics courses favoring women and SAT-M score differences favoring men cannot be explained in terms of differential course selection patterns.

366 Brody, L and Fox, L.H. 1980. **An accelerative intervention program for mathematically gifted girls.** IN *Women and the mathematical mystique*. p.164-178. Edited by L.H. Fox, L. Brody and D. Tobin. Baltimore, Johns Hopkins University Press.

An intervention program designed to increase gifted girls' participation in mathematics was conducted at The Johns Hopkins University in the summer of 1973. The program consisted of a course in algebra I for twenty-six seventh-grade girls and included special attention to the social needs of the girls, female role models, some career awareness training, and an emphasis on the social applications of mathematics. Control groups of boys and girls who did not participate in the program were selected for purposes of comparison in assessing the program. In 1977, when the students had completed the eleventh grade, there were significant differences between the experimental girls and the control girls, but not between the experimental girls and the control boys. Differential values career interests, and encouragement are explored as possible contributing factors to sex in course-taking behavior.

367 Campbell, P.B. 1986. **What a nice girl like you doing in a math class?** *Phi Delta Kappan*. Vol. 67, No. 7, p.516-520.

Discusses the effect of race and sex bias on student achievement in science and mathematics. Evidence shows that differing expectations and treatment of students have an impact on achievement. Includes discussions of programs that have effectively increased certain groups' achievement levels.

368 Campbell, P.F. and Geller, S.C. 1984. **Early socialization:**

causes and cures of mathematics anxiety. IN *Women in scientific and engineering professions.* p.173-180. Edited by V.B.Haas and C.C.Perrucci. Ann Arbor, MI, The University of Michigan Press.

Defines math anxiety, and discusses the causes that contribute to it. Included may be a prior low level of conceptual understanding of mathematical topics; a poor attitude towards mathematics, ideological issues and inadequate or inappropriate teaching. States that the increase in math anxiety clinics and remedial programs attests to the popular claim of cures for math anxiety.

369 Casserly, P.L. 1980. **Factors affecting female participation in advanced placement programs in mathematics, chemistry and physics.** IN *Women and the mathematical mystique.* p.138-163. Edited by L.H. Fox, L. Brody and D. Tobin. Baltimore, MD, Johns Hopkins University Press.

In order to identify those factors that might encourage female participation in Advanced Placement (AP) high-school science and mathematics programs, as well as those that discourage it, a study was conducted examining the curriculum guidance policies, and student cultures of thirteen high schools. The high schools were selected both for their geographic and socioeconomic heterogeneity and also for the statistically strong proportion of girls among their AP candidates in college level calculus, chemistry, or physics. The conclusions of the study were as follows: (1) The AP courses provide girls with a stimulus toward careers; (2) AP teachers are excellent agents for recruiting girls to AP courses and later careers; (3) much effective college and career counseling takes place in AP classes, and (4) many guidance counselors are poor sources of encouragement, while older girls are good sources for girls interested in mathematics and the physical sciences.

370 Chipman, S.F. 1987. **Discussion: Equitable science and mathematics education.** IN *Women: their under-representation and career differentials in science and engineering.* Proceedings of a workshop, Washington, D.C., October 9, 1986. p.43-48. Edited by Linda S. Dix. Washington, D.C., USA: National Academy of Sciences. Office of Scientific and Engineering Personnel. (ED 285752)

In attempting to understand what causes the differences between men and women with respect to their participation in mathematics, science, and engineering, many points of difference between male and female students and the way that others treat them are described and documented.

371 Clency, J.E.S. 1985. **Influence of a sex equity and a science-mathematics career orientation intervention paradigm on middle school/junior high school students.** Thesis (ED.D.), Indiana University. 143p.

An instrument, pre and post was validated and administered to a sample of 166 students in the participating schools. The instrument has three dependent variables--sex equity, attitudes toward science and attitudes toward mathematics. Attitudinal change was compared in terms of sex. The "Statistical Package for the Social Sciences" (SPSS) was used in the analysis of the data collected. The statistical analysis used was the t-test. The demographic characteristics provided a profile of the participating students from the two school systems consisting of three schools. The t-test indicated differences related to sex of the participating students. Significant differences consistently occurred between males and females on the pre and post-tests with respect to their attitudes toward sex equity. However, males only exhibited significant changes in attitudes toward the sciences. The findings of the study reflected that there was a greater influence on females' attitudes than on males' attitudes toward sex equity, attitudes toward science, and attitudes toward mathematics.

372 Collis, B.A. 1987. **Sex differences in the association between secondary school students' attitudes toward mathematics and**

towards computers. *Journal for Research in Mathematics Education.* Vol.18, No.5, p.394-402.

Examined sex differences in the positive association between attitudes toward mathematics and computers in 479 female and 539 male 8th graders and 381 female and 419 male 12th graders. Female students were more likely than male students to associate negative attitudes toward mathematics with negative attitudes toward computers. Participation in an 8th grade mathematics course with a computer component was associated with positive attitudes toward computers for males but not for females. It is concluded that integration of computer experiences with mathematics instruction may require some caution to yield more positive attitudes toward mathematics and computers from secondary school females.

373 de-Corte, W. and Brusselmans, D.C. 1987. **Gender and mathematics.** *Scientia Paedagogica Experimentalis.* Vol.24, No.1, p.5-20.

This study used data from the Belgian participation in the International Education Association Second International Mathematics Study to investigate the relationship between gender and mathematics achievement. The impact of sex-role bias, curriculum, type of education, and education organization is examined. It was found that the difference in participation in more advanced mathematics programs is largely responsible for the sex and mathematics issue. Other findings emphasize the local importance of sex-role bias and co-educational schools.

374 Deitch, I.M. 1981. **Cognitive-behavioral treatment of mathematics anxiety in college women.** Thesis (Ph.D.), Yeshiva University. 244p.

Forty-five women experiencing mathematics anxiety and mathematics avoidance behavior were selected for this experiment. Fifteen subjects were randomly assigned to each of the treatment groups, and a waiting-list control group. Homogeneity of sample was determined by statistical analysis of demographic and preliminary testing data. Mathematics workshops led by trained "nonmathematically anxious" peers, met for two-hour sessions for a six-week period. Group observers and recorders monitored subjects' behavior. Effectiveness of treatment was measured by standardized tests, consisting of: Mathematics Anxiety Rating Scale and State-Trait Anxiety Inventory, attitude rating scales and autonomic measures. Observed tensional manifestations and pre- and post-treatment pulse rates were recorded for each session. Results indicated significant mathematics anxiety reduction for both treatment groups. The untreated control group remained unchanged in its level of mathematics anxiety. Cognitive restructuring, as an intervention, demonstrated greater effectiveness compared to systemic desensitization. A three-month, structured interview follow-up assessed the stability of changes and the self-reported workshop effects. Attitude changes and decreases in math avoidance behaviors were noted for subjects of both treatment groups. Coping strategies were generalized to math and non-math related situations. Increased self-confidence and self-esteem were acknowledged. The experimental results were discussed with regard to subject selection and the use of specific techniques in the reduction of math-anxiety. The relation of cognitive restructuring theory to math anxiety was considered.

375 Developing math learning skills. **A parallel support course for the math-anxious college student.** 1989. Washington, D.C., USA: Women's Educational Equity Act Program. 104p.

Anxiety toward mathematics is a persistent barrier to successful completion of a college degree for women and minorities. This program adapted materials and philosophies from other programs to meet the needs of students identified as impaired by mathematics anxiety in their pursuit of a college education. The program addresses both influencing students' attitudes and behavior and seeking to make changes in the standard learning environment.

376 Dowling, D.M. 1978. **The development of a mathematics confidence scale and its application in the study of confidence in women college students.** Thesis (Ph.D.), The Ohio State University. 334p.

The primary purpose of the study was the development of the Mathematics Confidence Scale (MCS). The scale provides a measure of confidence with respect to three types of mathematics problems namely arithmetic, algebra, geometry, representing three levels of cognitive demand i.e. computation, comprehension, application, and two problem contexts, real and abstract. A measure of the degree of agreement between the students' expressions of confidence and performance on similar problems was generated and upon this basis students were classified as under-confident, overconfident, or neither. At each stage during the development of the MCS, exploratory investigations were conducted into the relation between the MCS scores and other background and attitude variables for groups of men and women. Conclusions are based not on any one statistical test, but on an accumulation of evidence gathered throughout the study. Students in the six tested groups using seven forms of the MCS consistently expressed most confidence in their ability to do the arithmetic problems, then the algebra problems, and the geometry problems. Regarding cognitive levels of demand, students consistently expressed most confidence in their ability to do the computation problems and least for the application problems. No clear pattern of expression of confidence occurred with reference to problem contexts. Coefficients of correlation between expressions of confidence and performance ranged from .45 to .54 for three groups of college students. Correlations were stronger for computation problems than for application problems. The men who were tested consistently expressed more confidence than the women, but in most groups, this was not accompanied by higher performance. Evidence suggested the importance of considering the students' mathematics backgrounds when examining sex differences. Correlations between confidence and performance were generally higher for the women than the men, but not significantly so. For the women college students, expressions of greater degrees of confidence were associated with better backgrounds in mathematics, motivation, encouragement of teachers, lower levels of mathematics anxiety, and unsteretyped views about mathematics as a male domain.

377 Duckworth, D. and Entwistle, N.J. 1974. **The swing from science: a perspective from hindsight.** Educational Research. Vol. 17, No. 1, p.48-53.

Part of the study examined the attitudes towards maths and sciences of 600 second and fifth form grammar school students. Four dimensions were considered: interests, easiness- freedom, to use own ideas, and social benefit-solve world problems, useful in everyday life. Overall female-male comparisons found fairly similar ratings though boys gave chemistry a better rating and girls gave biology a somewhat better rating. boys and girls held similar attitudes towards physics except that fifth year boys saw more social benefits in it and second year boys felt more freedom in it and found it more interesting. Maths attitudes differed by age - in the second year girls were more favorable to it than boys, by the fifth year boys found it more interesting and felt more freedom. Few sex differences were detected on attitudes when arts, science and mixed choice, based on fifth year plans, students were examined separately, although considerable attitude differences were found across area-specialties.

378 Engelhard, G. 1990. **Math anxiety, mother's education, and the mathematics performance of adolescent boys and girls: Evidence from the United States and Thailand.** Journal of Psychology. Vol.124, No.3, p.289-298.

Examined the relationship of mathematics performance to math anxiety, mother's education, and gender in 4,091 thirteen year olds in the United States and 3,613 in Thailand. Separate analyses of variance (ANOVAs) were run in each country, using a 40-item math

performance test as the dependent variable. Math anxiety had an inverse relationship with math performance in the US and in Thailand. The relationship between math anxiety and math performance was significant in both countries after controlling for previous achievement, mother's education, and gender, although the data suggest a 3-way interaction between math anxiety, mother's education, and gender in Thailand.

379 Ernest, J. 1980. **Is mathematics a sexist discipline?** IN Women and the mathematical mystique. p.57-65. Edited by L.H. Fox, L. Brody and D. Tobin. Baltimore, MD, Johns Hopkins University Press.

A study of enrollment in mathematics courses at the University of California at Santa Barbara documented sex differences in mathematics course-taking at the college level. Evidence of differential participation and achievement in mathematics at the graduate and professional levels was also provided. Explores stereotypes and attitudes of high-school students and teachers that may contribute to these sex differences. The need for eliminating sexism in the classroom and in the job market is emphasized.

380 Fabricant, M. 1990. **Why women succeed in mathematics.** Mathematics Teacher. Vol. 83, No. 2, p.150-154.

Uses historical figures to examine variables influencing women's success in mathematics. The three characteristics stressed are supportive family background; early exposure to significant mathematics; and available female role models in mathematics. Discusses barriers to females' choice of mathematics as their careers and actions taken to increase females' participation.

381 Fabricant, M. and Adner, H. 1989. **Women in science and technology.** Paper presented at the annual convention of the American Mathematical Association of two-year colleges, 15th Baltimore, MD, October 26-29, 1989. 13p. (ED 325143)

In 1985-86 the "Women in the Technical Curricula" project was developed at Queensborough Community College to encourage more women to choose a technical curriculum and to provide support services to help them successfully complete the curriculum. The project activities were designed to eliminate the stereotype of mathematics and related careers as masculine domains. Female tutors and female computer laboratory technicians, peer tutoring, scheduled review sessions, and access to computer-assisted instructional materials were provided to help women develop confidence in their mathematics ability. The retention rate for women in technical curricula increased from 53 percent to 61.2 percent after exposure to the new program. In addition, the dropout rate for women in remedial mathematics decreased at the end of the experimental year compared to the previous 2 years. An expanded project emphasizing career education and targeting local high school seniors was implemented in the 1988-89 school year. This project focused on increasing the number of women who elect to take technical curricula, increasing the retention rates of women in technical curricula, and disseminating information about careers for women in nontraditional technical fields. Support services similar to those offered the previous year were provided. In conjunction with Gruman Aircraft Systems, IBM, and AT&T Bell Laboratories, a Career Day was held with presentations from women within these industries. The 1988-89 results were also successful, with retention rates for women increasing from 70.5 percent in 1987-88 to 89.2 percent in 1988-89.

382 Fennema, E. 1980. **Sex-related differences in mathematics achievement: where and why.** IN Women and the mathematical mystique. p.76-93. Edited by L.H. Fox, L. Brody and D. Tobin. Baltimore, MD, Johns Hopkins University Press.

Many studies that have reported male superiority in mathematics learning have compared achievement scores of males and females without controlling for differential mathematics course-taking. Since males have usually elected to study more mathematics than have

females, a better mathematically educated group (males) has been compared with a less mathematically educated group (females). When amount of course-taking is controlled, few sex-related differences in achievement are found. Cognitive, affective, and educational variables that may contribute to differential mathematics course-taking are explored in the chapter. The need for intervention programs that are designed to increase women's participation in mathematics and that include both male and female students, their teachers, and their counselors is stressed.

383 Fennema, E. and Peterson, P.L. 1985. **Autonomous learning behavior: a possible explanation of sex-related differences in mathematics.** *Educational Studies in Mathematics*. Vol. 16, No.3, p. 309-311.

Discusses a model which provides a partial explanation of why females are not achieving equity in mathematics education. The model consists of four phases and explores mediating factors of autonomous learning behaviors which exist between socialization influences and learning.

384 Fox, L.H and Cohn, S.J. 1980. **Sex differences in the development of precocious mathematical talent.** IN *Women and the mathematical mystique*. p.94-111. Edited by L.H. Fox, L. Brody and D. Tobin. Baltimore, MD, Johns Hopkins University Press.

In 1972 the Study of Mathematically Precocious Youth (SMPY) began its search to identify highly able mathematical reasoners. With some variations in the target population and the selection procedures, the talent searches have continued to the present. This chapter reviews the results of the 1972, 1973, 1974, 1976, 1978, and 1979 talent searches, with particular emphasis on sex differences. Follow-up data available on the 1972, 1973, and 1974 participants are analyzed, particularly as they relate to sex-role identity and willingness to accelerate. Attempts to foster precocious achievement in mathematics by means of special, accelerated classes for mixed-sex and same-sex groups are described.

385 Friedman, B. 1990. **Bringing knowledge of women mathematicians into the mathematics classroom.** *Mathematics and Computer Education*. Vol. 24, No. 3, p.250-253.

An activity that works to attract and retain more women in mathematics is described. Women who do mathematics and information about particularly noteworthy women mathematicians are brought into the mathematics classroom. A list of women mathematicians is included.

386 Garcia, J. 1990. **The portrayal of females and minorities in selected elementary mathematics series.** *School Science and Mathematics*. Vol. 90, No. 1, p.2-12.

Examines whether elementary textbooks enhance a socially active mathematics education program. Reports that young females and minorities are adequately portrayed in five mathematics textbook series; representation of careers, however, is less than adequate.

387 Gessner, J.K. 1977. **Sex and attitudes toward women as factors affecting attitudes toward mathematics of elementary school teachers in two districts of New Jersey.** Thesis (ED.D.), Rutgers The State University of New Jersey. 58p.

Investigated whether there was a relationship among sex, attitudes toward women, and attitudes toward mathematics of elementary school teachers. The questions under investigation were: has the attitudes of female elementary school teachers toward women's roles in our society influenced their attitudes toward mathematics? If a female elementary school teacher has a liberal or pro-feminist view of a women's role in society, will she tend to have a more positive attitude toward mathematics than if she has a more conservative view of a women's role? Using stratified cluster sampling, a questionnaire was distributed to certified elementary school teachers, grade K-6, in the East Brunswick and the Perth Amboy public schools during May, 1976. A statistical model was

developed using an analysis of coefficients. The null hypothesis that the coefficient of attitude toward women (CATW), was 0 was rejected. The alternative hypothesis that CATW was greater than 0 was accepted. If the variable sex was deleted from the model, attitude toward women was no longer significant.

388 **Girls and mathematics. Is there a problem?** 1990. *Australian Mathematics Teacher*. Vol. 46, No. 3, p.10-11.

The situation of the ability, participation, and achievement of girls in mathematics in Australia is discussed. Reasons for the concern of many educators about this situation are presented. A few research explanations are suggested.

389 Gray, M.W. 1991. **The Association for Women in Mathematics--A personal view.** *Mathematical Intelligencer*. Vol.13, No.4, p.6-11.

The Association for Women in Mathematics (AWM) is profiled. The strength of AWM has been its broad focus; it has had a speakers bureau for many years, and its members have been active in outreach to community groups as well as high schools and colleges.

390 Harris, M. 1987. **An example of traditional women's work as a mathematics resource for the learning of mathematics.** *International Journal of Mathematics Education*. Vol. 7, No. 3, p.26-28.

Offers examples of non-standard mathematical application problems. The applications come from a variety of areas including industry and other cultures.

391 Helson, R. 1980. **The creative woman mathematician.** IN *Women and the mathematical mystique*. p.23-54. Edited by L.H. Fox, L. Brody and D. Tobin. Baltimore, MD, Johns Hopkins University Press.

Research contributions of forty-four female Ph.D's in mathematics were rated on creativity by peers in appropriate fields of specialization. Women whose work was rated as more creative than the average research paper in mathematical journals were compared with the other members of the sample. Their personality characteristics and research style were further studied in comparisons of female with male mathematicians and of mathematicians of both sexes with writers of both sexes. Results show that the creative women mathematicians were flexible, individualistic, and introverted and had strong symbolic interests. Like creative writers, however, they lacked the social confidence and discipline that creative men mathematicians possessed and which seems advantageous for academic success. This difference in personality between creative men and women mathematicians seems attributable in part to their very different life circumstances. Subgroups of women mathematicians, constituted on the basis of research style, are shown to have differed markedly in personality, cognitive abilities, characteristics of parents, ethnicity and social integration of the family, and situational conditions at the time of assessment. Hypotheses are offered to explain these findings, and case studies illustrate how interest in mathematics developed in members of the different subgroups. One subgroup of creative women showed the "confident inventiveness" characteristic of creative men in mathematics. Comparisons among women point to social-developmental sources of this feature of research style. The fact that there were three subgroups about equal in creativity show that women with a variety of personality traits can do creative work in mathematics.

392 Hensel, R.A.M. 1989. **Mathematical achievement: equating the sexes.** *School Science and Mathematics*. Vol. 89, No. 8, p.646-653.

The literature concerning the development of sex stereotypical behaviors of boys and girls in mathematics is reviewed. Early socialization in the home and in school are discussed. Suggestions

for creating an unbiased atmosphere at school are suggested.

393 Hewitt, G.C. 1979. **The status of women in mathematics.** IN *Expanding the role of women in the sciences*, p.100-109. Edited by A.M.Briscoe and S.M.Pfafflin. New York, NY, The New York Academy of Sciences. (Annals of the New York Academy of Sciences, vol. 323)

Less than a decade ago the phrase "the absence of women in mathematics" was heard despite the fact that women had not been altogether absent. Positive changes have occurred within the mathematical professional organizations. For example, the Association for Women in Mathematics provided a medium through which their concerns and ideas could be discussed. Women now serve as editors, officers, and members of the Council, and are on various committees of the American Mathematical Society, the professional organization of research mathematicians. They also serve as editors, officers, and members of the Board of Governors and on various committees of the Mathematical Association of America. States that efforts directed toward developing the mathematical talents of women have yielded more fruit than efforts directed toward the utilization of these talents. Yet, the percentages of women mathematicians is not a true picture of their representation in the population nor are the employment percentages an accurate indication of their representation among mathematicians. The author used statistics to refute the claims of some that women now have equal rights and that affirmative action has solved the problems.

394 Holden, C. 1987. **Female math anxiety on the wane.** Science. Vol. 236, No. 4802, p.660-661.

Reviews recent research findings related to sex differences in math and science achievement. Specifically discusses results which point to an apparent decline of math anxiety.

395 Hunt, G.E. 1985. **Math anxiety - where do we go from here?** Focus on Learning Problems in Mathematics. Vol. 7, No. 2, p.29-40.

Provides a review of the literature related to math anxiety, indicating that society needs to eradicate the myth that females are more anxious about mathematics than males. Several options for eliminating math avoidance and math anxiety are considered.

396 Jacobs, J. E. 1991. **Influence of gender stereotypes on parent and child mathematics attitudes.** Journal of Educational Psychology. Vol.83, No.4, p.518-527.

Tested the hypothesis that parents' gender stereotypes about mathematical ability interact with the sex of their child to directly influence their beliefs about the child's mathematical ability and likelihood of future success in mathematics and to indirectly influence the child's self-perceptions and mathematics performance. Approximately 400 parents and their 6th - 11th grade children responded to questionnaires concerning their beliefs about the child's mathematics achievement and their stereotypes about males' and females' relative abilities in mathematics. Path analyses revealed that parents' gender stereotypes have no direct effect on children's self-perceptions. Instead, parents' stereotypes interact with the sex of their child to directly influence the parents' beliefs about the child's abilities. In turn, parents' beliefs about their child directly influence their child's self-perceptions, and both the parents' stereotypes and the child's self-perceptions influence the child's performance.

397 Kaeley, G.S. 1988. **Sex differences in the learning of post-secondary mathematics in a neo-literate society.** Educational Studies in Mathematics. Vol. 19, No. 4, p.435-457.

The enrollment disparities and sex differences in the learning of post-secondary mathematics course are investigated. Reports a disparity in the enrollment of females, however no significant difference in the mathematics achievement of males and females was seen.

398 Lacampagne, C.B. 1979. **An evaluation of the Women and**

Mathematics (WAM) Program and associated sex-related differences in the teaching, learning and counseling of mathematics. Thesis (ED.D.), Columbia University Teachers College. 231p.

This study investigated the Women and Mathematics (WAM) lectureship program. The program brings young women with interesting careers into the high schools to speak about their careers and about the importance of mathematics to their careers. It is hoped that these women will serve as role models, encouraging high school women to persevere in the study of mathematics. The WAM program also addresses mathematics teachers and guidance counselors. In addition to investigating the WAM program, this study also considers sex-related differences in the teaching, learning, and counseling of mathematics. The subjects selected for this study were students, mathematics teachers, and guidance counselors drawn from four urban and four suburban public high schools in New Jersey and one academically superior public high school in New York. In all, 1,510 tenth-grade students, 60 mathematics teachers, and 33 guidance counselors participated in the study. Data were collected from six instruments, designed to test the effect of the WAM program and possible sex-related differences in the teaching, learning, and counseling of mathematics. The following conclusions were reached concerning the WAM program: (1) the program had some effect on encouraging urban students to continue with the study of mathematics. No such effect was found for students in the suburban or special school; (2) students who had participated in the program were more likely to be aware of the usefulness of mathematics to various careers than those who had not participated. The program had little effect on student attitudes toward mathematics and on mathematics teacher attitudes. (3) Male students ranked mathematics significantly higher among favorite subjects than did female students, and (4) guidance counselors perceived different counseling needs of female and male students.

399 Lappan, G. 1988. **Research into practice: gender and race equity in primary and middle school mathematics classrooms.** Arithmetic Teacher. Vol. 35, No. 8, p.46-48.

Summarizes recent research relevant to the differential achievement of females in mathematics. Suggests ways for teachers to deal with the issue of equity.

400 Leith, D.M. 1988. **Active learning in an adult basic math class.** Journal of Experiential Education. Vol. 11, No. 2, p.28-31.

Describes use experiential education for teaching mathematics as component of job training for single, unemployed women in Washington, D.C. Stresses value of practice-oriented curriculum, group work, and self-paced study. Concludes that student involvement fosters student reasoning and self reliance.

401 Lent, R. W., Lopez, F. G. and Bieschke, K. J. 1991. **Mathematics self-efficacy: sources and relation to science-based career choice.** Journal of Counseling Psychology. Vol.38, No.4, p. 424-430.

Explored personal performance accomplishments, vicarious learning, persuasion, and emotional arousal to mathematics self-efficacy percepts and the relations among self-efficacy, outcome expectations, interest in mathematics-related college courses, and choice of science-based careers. Results indicated that the efficacy informational sources were significantly predictive of and helped explain gender differences in mathematics self-efficacy, that outcome expectations complemented self-efficacy in predicting interest and choice indexes, and that the effects of self-efficacy on science-related career choice were mediated by interests.

402 Lips, H.M. 1984. **Math/Science self-schemas and curriculum choices among university women.** Paper presented at the Annual Convention of the American Psychological Association, 92nd, Toronto, Canada, August 24-28, 1984. 22p. (ED 250194)

Four hundred forty six female university students who had

completed at least five courses were tested for self-schemas in math/science ability. One hundred eighty-four of the women had taken or were taking more than the required one basic math or science course. It was found that 35.0 percent of the women in the sample could be classified as having a positive self-schema for math/science ability, while only 14.1 percent could be classified as having a negative self-schema for this ability. Women were more likely to be positive schematic for math/science ability if they had taken or were taking math or science courses. Both the finding of such a small proportion of women classified as negative schematic and the subjects' responses to open-ended questions about the reasons for their course choices suggest that many university women avoid math and science courses not because of a sense of inferiority with respect to their abilities in these areas, but simply because of a lack of interest. The problem of women's avoidance of math and science courses may well lie less with the women themselves than with the presentation of math and science to them.

403 Luchins, E.H and Luchins, A.S. 1980. **Female mathematicians: a contemporary appraisal.** IN *Women and the mathematical mystique*. p. 7-22. Edited by L.H. Fox, L. Brody and D. Tobin. Baltimore, MD, Johns Hopkins University Press.

In 1975 a questionnaire was sent to members of the Association for Women in Mathematics. The replies from 350 female members (40 percent of the membership) provide a picture of contemporary women in mathematics and of what has encouraged and/or discouraged them in their studies and careers. The responses were compared with those of a small sample of male mathematicians who answered the questionnaire. Interviews were also conducted with mathematicians and college mathematics majors. Based on the response patterns, recommendations are offered which would dispel the mystique about women in mathematics. In addition, a multiplicity of approaches is suggested for removing educational and career barriers to women in the mathematical sciences.

404 MacDonald, C.T. 1980. **An experiment in mathematics education at the college level.** IN *Women and the mathematical mystique*. p. 115-137. Edited by L.H. Fox, L. Brody and D. Tobin. Baltimore, MD, Johns Hopkins University Press.

Women's career choices traditionally have been limited, in part because of women's inadequate mathematics background. In an attempt to reverse this trend, an intervention project was conducted at the University of Missouri-Kansas City during the 1974-75 academic year. The project, which was centered around a special introductory mathematics course for female students only, was designed to open career options for women by helping them acquire basic mathematics skills and by assisting them in overcoming various social and cultural barriers to their success. There were several areas in which the project was successful. Participants in the special program earned higher grades, had more positive attitudes about mathematics, and were less likely to withdraw from the introductory mathematics class and more likely to continue to the next-level mathematics class than were non-participants.

405 Maines, D.R. 1985. **Preliminary notes on a theory of informal barriers for women in mathematics.** *Educational Studies in Mathematics*. Vol. 16, No. 3, p.314-317.

Examines the nature of informal barriers for women who enter and attempt to forge careers in mathematics, proposing a theory on the subject, drawn from interactionist sociology and anthropology and which is grounded in a dialectical and interpretative ontological view of society.

406 McLeod, M.A. 1991. **Correlates of coping responses to failure in mathematics in college women.** Thesis (Ph.D.). University of Minnesota. 183p.

One hundred thirty-seven students at a private women's college completed the study, which involved responding to a questionnaire comprising two standardized instruments: the Personal Attributes

Questionnaire (PAQ) and the Ways of Coping Questionnaire (WOCQ) plus a thirty-five item questionnaire developed by the author to assess attitudes and provide demographic data. Students in the sample were divided into three groups based on the degree of direct action they took to remediate the failure through official college procedures within one academic year. The three levels of response were ascertained from college records and involved registration for study options and retaking the exam. One way analyses of variance were computed to test for differences among the three coping groups on the personality, coping strategy, environmental and attitudinal variables. In addition, ANOVAs were run to test for hypothesized relationships between PAQ scores on instrumentality and the WOCQ coping strategy scales. Results showed that students in the most active coping group had obtained significantly higher proficiency exam scores than the moderately active group and also used significantly more problem solving coping strategies than either of the other groups. The most active group also used more coping strategies involving seeking social support than did the more moderate group. The three coping groups did not differ significantly on the personality variable of instrumentality, contrary to expectations. Subjects high on instrumentality reported using relatively more social support and positive reappraisal and less escape than subjects low in instrumentality.

407 Norman, C. 1988. **Math education: a mixed picture.** *Science*. Vol. 241, No. 4864, p.408-409.

Reviews the findings of a Maryland study concerning the effects of gender and race on mathematics achievement. Cites parental and teacher attitudes as major factors in student achievement. Discusses the differences between girls' and boys' performance on standardized tests.

408 Olszewski-Kubilius, P., Kulieke, M. J., Shaw, B. and Willis, G.B. 1990. **Predictors of achievement in mathematics for gifted males and females.** *Gifted Child Quarterly*. Vol.34, No.2, p. 64-71.

Examined factors that may predict achievement in fast-paced mathematics classes for 63 high-ability male and 45 high-ability female adolescents aged 11-15 yrs. The predictive value of 3 categories was explored: ability, previous experience (PE) and exposure to the content area, and individual student characteristics. PE variables were the most important in accounting for entry-level knowledge and in predicting learning outcomes. For girls, parental teaching and tutoring of others related to learning, whereas for boys, participation in math clubs was the important PE variable. Ability measures explained a significant proportion of the variance in learning rate for boys only.

409 Prillwitz, B.E. 1983. **The correlates of success among women in mathematics and mathematics-related fields: implications in educational program development.** Thesis (ED.D.). University of Southern California. v,107p.

Ninety-five women in mathematics and mathematics-related fields, who were members of the technical staff of the Aerospace Corporation in Southern California, were volunteer participants. They were given the MBTI and the LHV to complete and return by mail to the researcher. Five questions were formulated to test for commonalities in personality and life history of these women. These women were found to: (1) be from middle class urban families with professional fathers and working mothers; (2) have a recognized superior ability and inclination for mathematics by middle school; (3) have common personality characteristics of introversion and judgement (71 percent) on the MBTI; (4) share ISTJ (introverted, sensing, thinking judging) and INTJ (introverted, intuitive, thinking judging) as personality types on the MBTI; (5) found satisfaction in their careers. It was concluded that the women mathematicians in this study are characterized as: (1) coming from middle class families with working parents; (2) have early knowledge and ability in math; (3) were supported by parents, teachers, counselors; (4) preferred to think logically and look to themselves for solutions to

problems; (5) comfortable with theoretical and analytic aspects of their work; (6) introversion and judgement were common personality characteristics; and (7) were satisfied in career choice.

410 Randhawa, B. S. 1991. **Gender differences in academic achievement: A closer look at mathematics.** Alberta Journal of Educational Research. Vol.37, No.3, p.241-257.

Examined gender-related differences in language and mathematics achievement in 5,088 male and 4,909 female students in Grades 4, 7, and 10. Results suggest that in Grade 4, females increased their achievement advantage on capitalization and math concepts subtests between 1978 and 1985. The female achievement advantage observed in Grade 7 in 1978 was significantly reduced by 1985 in vocabulary, capitalization, and math concepts subtests. In Grade 10, males outperformed females in math while females outperformed males in language/reading. These Grade 10 male/female advantages did not significantly change between 1978 and 1985. In math components, Grade 10 results were consistent and systematic, indicating consistent male advantage in computation, concepts, and problem solving. These differences could not be attributed to differences in perceived classroom behaviors of males and females by their teachers nor to differences in cognitive structure.

411 Sangster, S. 1988. **Effect of sex segregated mathematics classes in student attitudes, achievement and enrollment in Mathematics.** A.Y. Jackson Secondary School, Year III. Willowdale, Ontario, Canada: North York Board of Education. 82p.

To improve female students' attitudes toward mathematics and to increase the enrollment of females in upper level mathematics courses, students enrolled in grade 10, 11, and 12 at A.Y. Jackson Secondary School were placed in sex-segregated math classes. This study focused on four main areas: attitudes, achievement, enrollment, and perceptions of the program. The longitudinal analysis of the attitudes for students provided very little evidence that segregated classes had a beneficial effect on female students' attitudes. The pattern of changes in final mathematics grades differed for the sex-segregated and the comparison groups of students. The possible reasons are discussed. The degree of enjoyment and challenge in math and perceptions of the usefulness of math declined over time to a significantly greater degree for A.Y. Jackson students than for students at the comparison school. Although a sizeable proportion of all A.Y. Jackson students felt that the program had no effect on their attitudes toward, or achievement in mathematics, males were more likely than females to believe that segregated classes had a negative effect on attitudes and achievement; females were more likely than males to believe that segregation had a positive or no influence on their attitudes and achievement.

412 Sangster, S. and Crawford, P. 1986. **Effect of sex-segregated mathematics classes on student attitudes, achievement and enrollment in Mathematics.** A.Y. Jackson Secondary School, year II. Willowdale, Ontario, Canada: North York Board of Education. 82p.

Focused on four main areas: attitudes, achievement, enrollment, and perceptions of the program. The longitudinal analysis of attitudes toward mathematics for students who were grade 11 in 1985-1986 provided some evidence that segregated classes had a beneficial effect on female students' attitudes. The analyses of data regarding student achievement and enrollment in mathematics are discussed. The majority of teachers thought that segregation created a more relaxed and open atmosphere. Comments made by parents reflected that attitudes and achievement were not affected by segregated classes, but that student ability or motivation and teacher's competence were important factors. Students surveyed felt more comfortable and relaxed and less intimidated in segregated classes. Appendices include student and parent questionnaires, interview materials, statistical tables, and responses to the

questionnaires.

413 Schaalma, D. 1989. **Gender differences in mathematics achievement: Do they exist? If so, what are their causes?** 45p. (ED 309958)

Gender differences in mathematics achievement were investigated. Educators need to be aware that gender differences may exist and encourage all students in the study of mathematics. Annotations of 38 articles and a glossary are included. It was concluded that affective factors are responsible for differences when they do occur. These may include student, parent, and teacher attitudes, and experiences outside of the classroom. Recommendations are provided.

414 Scherer, M.E. 1990. **Factors contributing to women's success in mathematics: selected teacher and family background variables.** Thesis (Ph.D.), Claremont Graduate School. 623p.

Female graduates (1950-1985) with mathematics or math-related majors, and a random sample of non-math honors graduates from two liberal arts colleges were surveyed to identify family and school experiences which influenced choice or rejection of math-related studies. Questions included fixed-response and open-ended items. Based on major and selected questionnaire responses, three math groups were identified: positive mathgroup--mathematics or math-related majors; negative mathgroup--women who disliked/feared math; neutral mathgroup. Data were also analyzed by graduation year: 1950-1961, 1962-1973, and 1974-1985. Positive mathgroup women were differentiated by the frequency with which they cited positive role models and peer support as incentives to pursue mathematics. Enjoyment of math, confidence in math ability, the knowledge that math was important for careers, and support of parents particularly father, were factors which encouraged math study. Teacher attitudes and encouragement were significant for the choice of major/career fields. Women's attitude differences toward mathematics began early in elementary school, and were reinforced by differential subject area encouragement from teachers. Positive mathgroup women reported more support from mathematics teachers than did other women, and recalled more encouragement in this subject than in others. Path analysis suggested that teachers, more than family or peers influenced women's decisions to continue/discontinue high school mathematics. Negative mathgroup women reported more negative math experiences, held lower opinions of their math ability, tended to stereotype mathematics and mathematicians, and perceived their math teachers as less competent. They were more likely to state that their parents considered math less important than other school studies, and that problems with teachers and peer math attitudes dissuaded them from taking math. Few math group differences in childhood and adolescent activities were observed. However, there was evidence of greater participation in spatial play and "logic" games on the part of Positive Mathgroup women. Responses of graduates from 1962-73 indicated that the Russian Sputnik success increased teacher and parent expectations for women's participation in math/science and decreased gender role stereotyping for math.

415 Segal, S.L. 1987. **Is female math anxiety real?** Science. vol.237, No.4813, p.350.

Reports that female mathematics anxiety is on the wane. Cites research that indicates no significant gender differences on a mathematics anxiety rating scale. Suggests that such things as misassignment of females to lower level mathematics classes and misinterpreted research results contribute to the popular impression of the existence of gender-specific mathematics anxiety.

416 Sells, L.W. 1980. **The mathematics filter and the education of women and minorities.** IN Women and the mathematical mystique. p. 66-75. Edited by L.H. Fox, L. Brody and D. Tobin. Baltimore, MD, Johns Hopkins University Press.

A student's level of high-school mathematics achievement acts as a critical filter for undergraduate college admission for blacks and limits choices of an undergraduate major for women in general once they are admitted to college. This effectively limits the opportunities of both these groups in the world of work. The data suggest solutions to the problems, particularly the dissemination of these facts to students, parents, teachers, counselors, and administrators in the educational system and to political decision-makers on the local, state and federal levels.

417 Selvin, P. 1992. **Profile of a field: mathematics.** *Science*. Vol.255, No.5050, p.1382-1383.

While up-front sexism is on its way out in most areas of science, it survives in mathematics with less overt forms of discrimination. The discrimination faced by several women in the field of mathematics is described.

418 Sheehan, K.R. 1989. **The relationship of gender bias and standardized tests to the mathematics competency of university men and women.** Thesis (Ph.D.), The American University. 136p.

Subjects participating in this study were university students during the years 1984-1988 who chose to take a mathematics competency exam rather than a course in mathematics as stipulated by the university as a requirement to graduate. T-tests grouped by gender, citizenship, and major were done on the results of each of three levels of mathematics skills. Multiple regressions were used to identify which of the selected variables impacted most heavily on each achievement test. The results indicate there are no significant differences between men and women in arithmetic skills and elementary algebra skills when all other variables are controlled. When SAT scores, GPA, gender, citizenship, and major were controlled, women outscored men on the highest level intermediate algebra test. Additional findings suggest that women enter college with significantly lower SAT scores than men, earn significantly higher college GPAs than men, choose majors where in the mean GPA does not differ significantly from the mean GPA of other majors, and do at least as well as men on standardized tests of mathematics achievement. The widely-held belief in a gender gap in mathematics achievement among university women and men is not supported by this study, at least at the pre-calculus level for this sample. Further, achievement tests show promise of more equitably predicting college performance than aptitude tests for men and women.

419 Sjöberg, S. 1988. **Gender and the image of science.** *Scandinavian Journal of Educational Research*. Vol.32, No.2, p.49-60.

Quantitative data from a large survey, 1,386 11 year olds; 1,490 16 year olds, and 3,314 19 year olds in Norway are used to demonstrate a wide range of differences between males and females in test scores and orientation toward science. It is argued that the perceived traits of the scientist are in conflict with the values and priorities held by females.

420 Spence, P. 1990. **Girls and mathematics. Women and mathematics and girls.** *Australian Mathematics Teacher*. Vol. 46, No. 2, p.26-28.

The experience of several different female mathematicians in the male domain of mathematics is discussed. The implications of the barriers experienced by these mathematicians for girls in mathematics are discussed.

421 Sprinthall, N.A. and Scott, J.R. 1989. **Promoting psychological development, math achievement, and success attribution of female students through deliberate psychological education.** *Journal of Counseling Psychology*. Vol.36, No.4, p.440-446.

The effects of a math tutoring program are examined. The pairing of female high school tutors with female elementary school students proved successful in improving national math achievement test scores.

422 Stenmark, J.K. 1989. **One point of view: What is Mathematics equity?** *Arithmetic Teacher*. Vol. 36, No. 5, p.3.

The status quo in mathematics is not equitable, especially for female and minority students. Some criteria for an equitable mathematics program are given.

423 Sipek, D. J. and Gralinski, J. H. 1991. **Gender differences in children's achievement-related beliefs and emotional responses to success and failure in mathematics.** *Journal of Educational Psychology*. Vol.83, No. 3, p.361-371.

A sample of 194 third graders and 279 junior high school students completed questionnaires measuring achievement-related beliefs before and after they took a regularly scheduled mathematics exam. Girls rated their ability lower, expected to do less well, were less likely than boys to attribute success to high ability and to failure luck, and were more likely to attribute failure to low ability. Girls also reported less pride in their success and a stronger desire to hide their paper after failure and were less likely to believe that success could be achieved through effort.

424 Stokes, A. 1990. **Relationships among level of cognitive development, gender, chronological age, and mathematics achievement.** *Journal of Negro Education*. Vol.59, No.3, p.299-315.

Forty-one male and 33 female African-American children, ranging aged 5 years 1 month to 7 years 11 months, completed the concept Assessment Kit-Conservation, a concept formation test, and a diagnostic inventory of essential mathematics. Results show performance in math as a function of quality of thinking. Age was more important to success with problems of addition, subtraction, and algorithms, and less important to success with measurement and word problems. The opposite was true for cognitive level. There was no significant effect of gender on learning math. Findings suggest that the most productive teaching should be targeted to the cognitive developmental level.

425 Thomas, G.E. 1986. **Cultivating the interest of women and minorities in high school mathematics.** *Science Education*. Vol. 70, No. 1, p.31-43.

Identified factors associated with college students' interest in science and mathematics and evaluated whether these factors differed for men and women or for blacks and whites. Results are based on a 78-item questionnaire completed by 2,046 junior/senior students who participated voluntarily in the study.

426 Tobin, D. and Fox, L.H. 1980. **Career interests and career education: a key to change.** IN *Women and the mathematical mystique*. p.179-191. Edited by L.H. Fox, L. Brody and D. Tobin. Baltimore, MD, Johns Hopkins University Press.

Sex differences in career goals and the relationship between those goals and the study of mathematics are reviewed using two intervention programs related to career awareness and mathematics. The first program was developed for a mixed-sex group of mathematically able youngsters between ten and thirteen years of age. Topics included the relationship of mathematical concepts studied in school to skills required in certain jobs, as well as a broad overview of the world of work and an understanding of different occupations. The second program was designed specifically to encourage mathematically gifted girls to continue to study mathematics and to understand the uses of mathematics in a wide range of career fields. Recommendations are given for increasing female interest in mathematics related subjects and careers.

427 Tocci, C. M. and Engelhard, G. 1991. **Achievement, parental support, and gender differences in attitudes toward mathematics.** *Journal of Educational Research*. Vol.84, No.5, p.280-286.

Investigated the relationships of attitudes toward mathematics with math achievement, parental support, and gender among 2,059 girls and 1,787 boys from the US and 1,700 girls and 1,828 boys

from Thailand. The majority of students were age 13.00 to 13.11 yrs. A multi-variate general linear model was used to analyze the data within each country. Four attitude scales (Mathematics and Myself, Mathematics and Society, Mathematics as Male domain, and Mathematics Anxiety) were used as the criterion variables. Math achievement, parental support, and gender were used as the predictor variables. In both countries, achievement, parental support, and gender were significant predictors of attitudes toward math. There were gender differences in attitudes toward math for 13-yr-olds in the US and Thailand, particularly on the Mathematics as Male Domain scale.

- 428 Tracy, D.M. and Davis, S.M. 1989. **Females in Mathematics: erasing a gender-related math myth.** *Arithmetic Teacher*. Vol 37, No. 4, p.8-11.

Discusses ways to correct a gender-related mathematics myth. Describes three tasks acquainting students with female-mathematician role models, including interviews, displays, and biographical sketches.

- 429 Troiano, L. 1989. **Mind/body news: fear of failing.** *American Health*. Vol.8, No.1, p.54.

Many American women manage math anxiety by avoiding the subject, which makes matters worse. The key to eliminating math anxiety is to try different approaches.

- 430 Turner, J.A. 1989. **In math ability, differences between sexes disappearing.** *Chronicle of Higher Education*. Vol.35, No.23, p.A10.

Researchers Marcia C. Linn and Janet S. Hyde have reported that differences in the mathematical ability of men and women are disappearing.

- 431 Turner, J.A. 1989. **More women are earning doctorates in mathematics, but few are being hired by top universities.** *Chronicle of Higher Education*. Vol.36, No.14, p.A13-A15.

Although the proportion of doctoral degrees in mathematical sciences awarded to women jumped in 1989, only 16 percent of the new doctors hired by doctoral-granting mathematical departments were women.

- 432 Turner, S.V. 1982. **Encouraging women's participation in high school mathematics: an intervention study.** Thesis (Ph.D.). University of South Florida. 262p.

Forty females and twenty seven males in college preparatory mathematics classes in two urban high schools were identified by their teachers, counselors, or themselves as math avoiders or at-risk students and pre-registered for the program. Eight weekly after-school sessions, team-led by a counselor and a mathematics teacher, provided group counseling related to the students' fear and avoidance of mathematics, career information emphasizing the usefulness of mathematics, and group tutoring related to the students' current mathematics coursework. The program also included the participants' parents, mathematics teachers, and counselors. Subjects were used as their own control in a pretest/posttest design using the Confidence, Usefulness, and Male Domain Scales of the Fennema-Sherman Mathematics Attitude Scales; the Syracuse Mathematics Anxiety Scale; and the Fennema-Sherman Mathematics Attribution Scale. In addition, interview, questionnaire, and observation data were gathered from students, their parents, and the leaders to refine the intervention protocol. Students who attended the after-school sessions regularly were more likely than non-attenders to continue with college preparatory mathematics and maintain satisfactory grades in the course. Significant pre- and posttest differences were found, but not in the hypothesized direction, in the students' perception of mathematics as a male domain, in their educational goals, and in their attribution of failure to lack of ability. There was no significant change in the students' confidence or anxiety about mathematics, in their perception of the usefulness of mathematics, or in their career

interests. In general, the program did not differentially affect females and males. Both students and parents evaluated the intervention positively and rated tutoring as the most beneficial component.

- 433 Useem, E.L. 1990. **Getting on the fast track in mathematics: school organizations influences on math track assignment.** Paper presented at the annual meeting of the American Educational Research Association, Boston, MA, April 16-20, 1990. 32p.

Examines the ways in which students' assignment to ability groups in middle and secondary school mathematics are influenced by the organizational features and placement policies of the schools themselves. Specifically, examines the fast track in mathematics which includes only 16 to 17 percent of U.S. students and is critical for qualification for college mathematics and physical science programs. The views of college admissions officers, variations by district in accelerated mathematics courses, explanations for variations in enrollment patterns, organizational factors influencing group assignment, and several case studies are discussed. Findings indicate that there are substantial variations in ability grouping that lead to inequities and arbitrary elements in student placement and that the range of abilities found in higher level tracks among different school systems can be explained by individual characteristics, and attitudes among school administrators. Implications for women and minorities are suggested.

- 434 Wallace, J. 1989. **What the world needs now: more women in mathematics and science.** *Educational Leadership*. Vol 46, No. 6, p. 46.

The aims of the conference on "Expanding your horizons in science and mathematics" conferences in Berkeley, California, was to nurture girls' interest in science and math courses and encourage them to consider nontraditional career options.

- 435 Weiner, N.C. and Robinson, S.E. 1986. **Cognitive abilities, personality and gender differences in math achievement of gifted adolescents.** *Gifted Child Quarterly*. Vol.30, No.2, p.83-87.

Examined whether 77 mathematically gifted male and 62 mathematically gifted female 7th-8th graders would differ significantly in cognitive abilities and personality factors. Students were administered the verbal and mathematical subtests of the Scholastic Aptitude Test, the Group Embedded Figures Test, and the California Psychological Inventory. They received mathematics achievement ratings depending on the number of summer courses completed. Results indicate that boys not only had higher mathematical reasoning abilities than did girls, but also that this ability was the single best predictor of their mathematical achievement. For both boys and girls, neither spatial reasoning ability nor personality factors significantly predicted mathematical achievement.

- 436 Wentzel, K.R. 1988. **Gender differences in math and english achievement: a longitudinal study.** *Sex Roles*. Vol.18, No.11-12, p. 691-699.

Investigated gender related developmental trends in mathematics and english achievement as measured by classroom grades and standardized test scores, using 30 males and 30 females followed from 6th through 12th grade. It was hypothesized that female classroom grades would remain stable over time, but that achievement test scores in the 2 subject areas would decline. For males, it was hypothesized that performance in both assessment contexts would remain stable. Results confirm the hypotheses. Results suggest that school-related responsibility was related to performance in both assessment contexts for females but not for males. The need to consider personal goals when assessing differences in ability and performance is discussed.

- 437 Wheat, J., Tunnell, J. and Munday, R. 1991. **Predicting success in college algebra: Student attitude and prior achievement.** *College Student Journal*. Vol.25, No.2, p.240-244.

Attitudes toward mathematics and prior math achievement on four hundred and seventy-five college algebra students' performance in college algebra were determined. Instructors in three Texas community colleges administered three instruments during the 1st three weeks of the fall semester. These instruments identified students' attitudes towards math, their knowledge of math, and their personal characteristics. Conclude that prior achievement, self-concept in math, perceptions of the math teacher, age, high school grades in trigonometry with elementary analysis, and gender were predictors of success in college algebra.

438 Wilson, K.L. and Boldizar, J.P. 1990. **Gender segregation in higher education: effects of aspirations, mathematics achievement and income.** *Sociology of Education*. Vol. 63, No. 1, p.62-74.

Analyzes the relationships among mathematics achievement levels, income potential, high school aspirations, and the gender segregation of bachelor's degrees. Investigates how gender segregation changed between 1973 and 1983. Concludes that gender segregation is present at the high school and bachelor's levels. Maintains that psychological barriers to women's mathematics achievement must be addressed.

Medical and Allied Sciences

439 Barinaga, M. 1992. **Profile of a Field: Neuroscience.** *Science*. Vol.255, No.5050, p.1366-1367.

A survey by Linda Spear, a psychopharmacologist at the State University of New York at Binghamton, showed that even though the pipeline supplying the field of neuroscience begins with many women, several women are lost along the way. The reasons for this occurrence are examined.

440 Bearn, A.G. 1979. **Expanding the role of women in the biomedical sciences.** IN *Expanding the role of women in the sciences*. p. 134-145. Edited by A.M.Briscoe and S.M.Pfafflin. New York, NY, The New York Academy of Sciences. (Annals of the New York Academy of Sciences, vol. 323)

States that there are many instances of outstanding leaders in all areas of human endeavor. This is hardly surprising. Societal attitude, however have sharply limited women's potential. Present statistics on annual salaries to total and women's science/engineering labor force in 1974, employment status during 1971-1975, selected institutions that were above average in proportion of doctorates granted to women 1973-1976, and those institutions that have a high percentage of women faculty.

441 Jones, A.B. and Shapiro, E.C. 1979. **The peak of the pyramid: Women in dentistry, medicine and veterinary medicine.** IN *Expanding the role of women in the sciences*. p.79-93. Edited by A.M.Briscoe and S.M.Pfafflin. New York, NY, The New York Academy of Sciences. (Annals of the New York Academy of Sciences, vol. 323)

Discusses the women at the peak of the pyramid in dentistry, medicine, and veterinary medicine. Used as points of reference two critical issues: first, that increases in the numbers of women dentists, physicians, and veterinarians do not guarantee these individuals either the authority or the power to influence the quality or the quantity of health-care delivery; and second, that there is the potential for a powerful alliance among relatively small number of women at the top of the health-industry pyramid, the large number of women workers who form its base, and health-care consumers the majority of whom are female, and there is also the potential for great conflict, particularly between the women health-care workers at the top and at the bottom of the pyramid. This paradox encapsulates an important dilemma facing women health-care providers today.

Selected aspects of the current status of women at the top of the hierarchies in the three health professions of dentistry, medicine, and veterinary medicine are reviewed. Discusses some of the effects of the changing structure of the health-care system on the present and future roles of the women in each of these professions, particularly in terms of the increasing demand for managerial and administrative skills for health-care professionals.

442 Rosenfeld, F.A. 1984. **Academic career mobility for women and men psychologist.** IN *Women in scientific and engineering professions*. p.89-127. Edited by V.B.Haas and C.C.Perrucci. Ann Arbor, MI, The University of Michigan Press.

Provides insights in the differences of career outcomes and in the ways in which men and women differ at each stage. Uses data collected on a sample of male and female academic psychologists.

443 Weber, J. 1990. **"I am intense, aggressive, and hard-charging".** *Business Week (Industrial/Technology Edition)*. No.3157, p.58.

In her 10 years at Merck & Co. Inc., Judy C. Lewent has continuously moved up the corporate ladder. In late March 1990, she was named the drug giant's vice-president for finance and its chief financial officer (CFO). Lewent is the first woman CFO at a company the size of Merck, where the CFO's job is especially vital. With mergers and acquisitions reshaping the drug business, and with Merck determined to stay independent, a number of strategic alliances will have to be forged with other drugmakers. Colleagues praise Lewent for her work ethic and her inventiveness. While scientists were shepherding breakthroughs in the laboratories, Lewent was showing how advanced finance practices could bolster the bottom line. Among Lewent's innovations is a computerized foreign-currency options program for hedging, important in Merck's increasingly global operations.

Physics

444 1985. **Science education notes.** *School Science Review*. Vol. 66, No. 237, p.767-778.

Two separate reports are presented. The first report describes an activity-based science program for students who have English as a second language. Results of an investigation into the educational experiences and attitudes of girls studying physical science are discussed in the second report.

445 Blin-Stoyle, R. 1983. **Girls and physics.** *Physics Education*. Vol. 18, No. 5, p.225-228.

Lack of women participating in physics programs/study from introductory high school courses through doctoral programs is addressed. Attitudes developed by perceiving science as masculine and lack of female role models are cited as two causative factors. Recommendations for improvement at classroom, science department, secondary, primary, and national levels are considered.

446 Chitayat, D. 1981. **Project seismic.** IN *Girls and science and technology (GASAT). Contributions to the conference, 1st, Eindhoven, The Netherlands, November 9-13, 1981*. Vol. 2, p.29-70. Edited by Jan H. Raat. Netherlands, Eindhoven University of Technology. (ED 262996)

Project SEISMIC is designed to encourage secondary school personnel to increase sex equity in the educational system and to promote practices free of sex bias within the community. Project components include a staff development program, curriculum methods and materials, and community outreach strategies. Teachers, counselors, and administrators can use these components in a comprehensive effort towards increasing equal treatment of the

sexes in educational and vocational settings. The ultimate goal of Project SEISMIC is to open up career options for females as well as males beyond those dictated by tradition. In order to do so three groups need to be educated: the faculty, the students and the employers. Thus Project SEISMIC provides interactive educational experiences targeted for each group. This article provides the rationale and a sample of the materials and activities for two of these groups: the teachers, and the students.

447 Duxbury, J. 1984. **Girls and physics - the role of a head of physics.** *School Science Review*. Vol. 65, No. 233, p.648-654.

Discusses the main features of the department head's role in determining the success of girls in physics. Areas examined include the presentation of material, classroom management techniques, option choices, and issues related to segregating boys and girls for several subject areas.

448 Ehindero, O.J. 1986. **Correlates of physics achievement: the role of gender and non-induced student expectations.** *Journal of Experimental Education*. Vol.54, No.4, p.189-192.

Investigated achievements in physics and related Piagetian tasks as a function of noninduced student expectations and assessed the effects on achievement in physics and related Piagetian tasks of sex and sex-role stereotyped expectations as well as individual achievement expectations. Thirty-five male and thirty-five female West African high school students responded to a two-item questionnaire on achievement expectation in physics. In addition, all the students were presented a 60-item multiple-choice physics test and a battery of three Piagetian formal operational tasks. Results show that students' achievement expectations were significantly related to their achievement. Significant relationships and interaction effects were recorded between achievement and sex-role stereotyped expectations.

449 Flam, F. 1991. **Still a "chilly climate" for women?** *Science*. Vol.252, No.5013, p.1604-1606.

Women physicists make up only 6.5 percent of the American Physical Society and women astronomers only 11.4 percent of the American Astronomical Society. Several explanations for the lack of women physicists and astronomers are presented.

450 Griffiths, D. 1989. **Group A. recruitment and teaching of women and minorities in Physics.** IN *Physics for the 1990s*. AAPT conference of department chairs in Physics, February 19-20, 1988. p. 44-45. Edited by Mark N. McDermott and Jack M. Wilson. College Park, MD, USA: American Association of Physics Teachers. (ED 307119).

This report summarized discussions of the conference. In the discussion there were two major recurring themes: (1) the need for role models, and (2) the importance of "critical mass" in sustaining participation by women and minorities. Speakers identified a number of Points of Attrition at which large numbers of such students are lost. A number of suggestions were made, based on what department chairs could do to alleviate the problem, actively recruit women and minority faculty members, bring and invite minority and women speakers to the campus, promote the idea that physics is not just for white males, encourage students to apply to summer programs specifically targeted for women and minorities, encourage admissions officers, graduate and undergraduate, to be more flexible in their criteria - looking for promise as well as actual experience, get involved in pre-college science education, for example, (a) talking to elementary school classes, (b) assisting in teacher training and support, and (c) approaching school administrators.

451 Hall, N. 1990. **Physics appeal.** *New Scientist*. Vol.127, No.1728, p.64-65.

A recent British conference designed to find ways to interest girls in studying physics is described.

452 Harding, J. 1977. **Sex differences in examination performance at 16+.** *Physics Education*. Vol. 4, No. 5, p.280-288.

Sex differences in entry to and performance in 16+ exams (1974-1976) were examined with comparisons made among school context and modes of assessment. More boys than girls took maths, chemistry and physics, while more girls than boys took biology. And while the proportion of boys taking biology is increasing, this is not so for girls and the physical sciences. Somewhat more boys than girls passed in maths and the sciences, while considerably more girls than boys passed English Language. However, boys' lower performance in language does not appear to constrain future achievement nor is it attributed to lesser ability, while girls' under-representation and poorer performance in maths and science is often accepted as demonstrated lower ability and is seen to account for their low involvement in the sciences later. Maths/science exam performances differed by type of school and method of assessment. Boys surpassed girls in mixed-sex, comprehensive and grammar schools. Girls surpassed boys in single-sex schools, weakly supported, while boys from mixed-sex schools did better than boys from single-sex schools, weakly supported, girls did better in single-sex than in mixed-sex schools. As to mode of assessment, boys did better than girls on multiple choice questions, girls were superior to boys on essay questions, and no sex differences were found on structured papers. These contextual differences in exam performance suggest that female-male achievement differences do not reflect sex differences in ability.

453 Harvey, T.J. 1979. **Mixed ability teaching in physical science.** *Educational Research*. Vol. 22, No. 1, p.60-61.

Verbal reasoning test scores were compared with science attainment, on four objective tests, for 240 first year comprehensive students in mixed ability classes. Of the more able students, boys did significantly better than girls while the reverse was true for the less able students. However, both boys and girls underperformed with able girls seriously underperforming.

454 Hearn, M. 1979. **Girls for physical science: a school-based strategy for encouraging girls to opt for the physical sciences.** *Education in Science*. April, p.14-16.

A comprehensive school teacher briefly discusses this school's strategies used to promote the physical sciences for girls - constant concern rather than extensive time input was the emphasis. Pupil-based efforts included in-class discussions, with third year students, on the paucity of girls in physical science classes, the increasing numbers of women choosing careers, and the importance of the physical sciences even if studying biology. Strategies for dealing with parents included a special evening program for third year pupils' parents to discuss issues as the selection of subjects, their influence on career prospects, and specifically on girls and science, and a demonstration of facilities and types of work in various subjects. Non-science staff such as the careers officer, the director of studies and third year personal tutors were involved and specifically discussed with students topics such as criteria to use for subject choices, their influence on career possibilities, and girls' restricted range of choices. Exhibits/films were shown to pupils and parents, using female scientists/demonstrators, focusing on sex equality in science ability, possible science careers and the necessity of physical science courses for a variety of careers, even in biology. Science teachers in particular watched for girls' understanding of the material and keeping up with the work.

455 Jackson, S.A. 1979. **From clerk-typist to research physicist.** IN *Expanding the role of women in the sciences*. p.296-299. Edited by A.M.Briscoe and S.M.Pfafflin. New York, NY, The New York Academy of Sciences. (Annals of the New York Academy of Sciences, vol. 323)

Refers to the evaluation of self-aspiration as a result of expanding opportunities and awareness and to the fact that the careers which black women have achieved are still running counter

to prevailing expectations. The evolution of aspiration for three black women is considered in light of the (1) family, community and school encouragement as sources of continued motivation to pursue and the fact that there were no sexual distinctions of roles although there were no direct female role models, (2) fact that for each student there was no focussed career in mind at the time of college entrance, and (3) problems encountered are as a result of ambition, awareness, sensitivity and direct treatment which became most apparent in college, graduate school and on the job.

456 Jones, A.T. and Kirk, C.M. 1990. **Gender differences in students' interests in applications of school physics.** *Physics Education*. Vol.25, No.6, p.308-313.

The type of physics applications that students are interested in learning more about in school are examined. Gender differences within that choice are explored. Interview methodology and the results of the interviews are discussed.

457 Jones, L.P. 1986. **Science education notes. Problems with problem solving?** *School Science Review*. Vol.68, No.242, p.137-157.

Contains six articles on various aspects of British science education. Deals with problem solving, the common examining system and the science curriculum, a comparison of girls and physics in Australia and the United Kingdom, energy education, the use of observations in science and science teaching and science software.

458 Kistiakowsky, V. 1979. **Women in physics and astronomy.** IN *Expanding the role of women in the sciences*. p.35-47. Edited by A.M.Briscoe and S.M.Pfafflin. New York, NY, The New York Academy of Sciences. (Annals of the New York Academy of Sciences, vol. 323).

Traces the history of women in science in the United States to the present. The early 1970s were marked by the beginning of affirmative action and shows statistics that emerge after this. Thus, the overall impression is that statistically the situation of women physicists and astronomers has not changed very much since the beginning of this century or during the last seven years, but this is not quite true. The increased percentages of physics doctorates awarded to women now correspond to respectable numbers, and it will not be long before they become commonplace enough in physics so that most physicists will know a competent woman as a colleague. Furthermore, affirmative action has caused a reversal on the acceptable reasons for discriminating against women, which once were readily and even righteously voiced. Equally important are the changes in the societal views of appropriate roles for women.

459 McCammon, S., Golden, J. and Wuensch, K.L. 1988. **Predicting course performance in freshman and sophomore physics courses: women are more predictable than men.** *Journal of Research in Science Teaching*. Vol.25, No.6, p.501-510.

Investigated the extent to which thinking skills and mathematical competency would predict the course performance of 115 male and 91 female undergraduate science majors enrolled in physics courses. Multiple-regression equations revealed that algebra and critical thinking skills as measured by the Elementary Algebra Skills Test and the Watson-Glaser Critical Thinking Appraisal, respectively were the best overall predictors across several physics courses. Although arithmetic skills, math anxiety, and primary mental abilities scores also correlated with performance, they were redundant with the algebra and critical thinking. Predictor variables were successful in predicting course performance for women but not for men.

460 McDonald, K.A. 1991. **Many female astronomers say they face sex harassment and bias.** *Chronicle of Higher Education*. Vol.37, No.22, p.A11.A15.

A significant proportion of female physicists and astronomers say

they continue to face sexual harassment and discrimination by male colleagues.

461 Mottier, I. 1981. **Girls and physics textbooks in Handover-project.** IN *Girls and science and technology (GASAT). Contributions to the conference, 1st, Eindhoven, The Netherlands, November 9-13, 1981.* Vol. 2, p.151-159. Edited by Jan H. Raat. Netherlands, Eindhoven University of Technology. (ED 262996)

The HANDOVER - project looks at the textbooks in order to find out if they form a negative factor for girls and to see how they can be improved. The origin of the project lays in an initiative of the Dutch minister of education. He published in the summer of 1979, together with the state secretary for emancipation, a sketch of a policy for emancipation in education and research, in which several measures were announced to promote educational opportunities for girls. Problems for girls are different in the various subjects, causes may vary, so possible solutions may vary too. In order to verify this hypothesis, case studies were undertaken in three different fields: languages, social sciences, and natural sciences. Concludes that physics textbooks must not only deal with abstract theories, models or facts, but must show the relationship with the interests of human persons; physics textbooks must show the positive social implications of science; physics textbooks must take examples not only from the professional world but from daily life too; and physics textbooks must represent women in professional scientific position as well.

462 Ormerod, M.B. 1979. **Girls and physics education.** *Physics Education*. Vol. 14, No. 5.

The research reported here has been concerned with attitudes to science or the sciences, measured either with specially constructed scales, by much simpler ratings of liking for a subject or its teachers, on five or three-point scales, and the crudest but most critical measure of all -- take or drop the subject. The concentration of research in the field of attitudes and simple preferences can be justified by the fact, ineluctable to anyone with much experience of teaching, that the learners, whatever their intellectual equipment, have an absolute veto over whether they learn anything at all or not. In the author's view many of the present undesirable aspects of science education result from the neglect, or ignorance, of factors favorably influencing pupils' attitudes and interest. Discusses the effects of single sex and co-education; girls' physics preferences and choices; effects of difficulty, effect of social implications of science, science interests in primary schools, and middle school science. Provides profiles of girl physicists.

463 Pirkle, S.F. and Pallrand, G.J. 1989. **Gender differences: novice problem solving attributes.** Paper presented at the annual meeting of the National Association for Research in Science Teaching, 62nd, San Francisco, CA, March 30 - April 1, 1989. 19p. (ED 305266) This research compared the performance of ninth grade females and males on flight protocol, with particular attention to interpretation of the graphs of paths of falling bodies, rolling objects, and projectiles. These subjects were chosen because they had received no formal instruction in projectile motion, yet through typical life experience, had encountered the phenomena associated with the concept and therefore could assume to be novices. The results suggested that there was no significant difference in the performance of ninth grade female and male groups on the flight protocol.

464 Price, J. and Talbot, B. 1984. **Girls and physical science at Ellis Guilford school.** *School Science Review*. Vol. 66, No. 234, p. 7-11.

For the past three years there has been a decrease in the number of third year girls opting to continue studying physical science at Ellis Guilford school. Various methods to resolve this trend at the school are discussed. They include creating single-sex teaching groups for physics/chemistry and revising physics/chemistry

465 Roth, L.M. and O'Fallon, N.M. 1981. **Women in Physics**. New York, N.Y., USA: American Physical Society. 35p. (ED 237335)

This booklet presents information about career opportunities for women in physics. Included are summaries of research areas in physics (optical physics, solid-state physics, materials science, nuclear physics, high-energy physics, astrophysics, cryogenics, plasma physics, biophysics, atmospheric physics) and differences between theory and experiment and between basic and applied research. Also included are discussions of job opportunities, focusing on those related to level of training, how to prepare for a career in physics, the current job situation, job discrimination, marriage and a career are also included.

466 Rubin, V. 1986. **Women's Work**. Science 86, Vol.7, No.6, p.58-65.

Provides an historic overview of the conditions and obstacles encountered by women in pursuing careers in astronomy. Highlights the accomplishments and contributions made by successful women in the field. Reviews the current status and climate associated with women in astronomy and the sciences in general.

467 Scott, L.U. and Heller, P. 1991. **Team work works! Strategies for integrating women and minorities into the physical sciences**. Science Teacher, Vol.58, No.1, p.24-28.

A way to modify the classroom environment so that females and minorities are more encouraged to participate in activities is described. The use of cooperative skills are emphasized such as active listening and checking for understanding.

468 Taylor, J. 1979. **Sexist bias in physics textbooks**. Physics Education, Vol. 14, No. 5, p.277-280.

From this very brief 'analysis' of three textbooks it has been shown that, in all three, references to females were few, references to active females were even fewer and references to females in scientific activities were virtually nonexistent. If this pattern, and this must of necessity be speculation, is apparent in all physics textbooks, then there may be a pointer to one possible cause of the lack of participation of girls in the physical sciences. It would be interesting and perhaps worthwhile to examine physics textbooks from, say, Eastern Europe and to see if the same phenomenon occurs. It must be pointed out that, particularly in CSE Physics, the references to any person at all, either by diagram, photograph or in the written word, occupy only a minute part of the literature. It may be, given the different socialization of males and females, that this impersonality of the physics textbooks exerts a different pressure on the female and perhaps in a negative influence. Without a thorough study, one cannot state categorically that this is so but it may be a likely area for research. Suggests that publishers review much more carefully material submitted to them and consider ways in which physics books can be made more attractive and interesting to girls. The McGraw-Hill guidelines (1974) for equal treatment of sexes in literature contain many suggestions which are applicable to all scientific literature. Females should be shown in a wide variety of professions and trades, as active individuals and as scientists. Above all they should be shown to be so in as great a number as men. They should appear as logical thinkers, problem solvers and decision makers. Only then can we be sure that textbooks do not play a part in the under-representation of girls in physics.

469 Van Harlingen, D.L. 1981. **Cognitive factors and gender related differences as predictors of performance in an introductory level college physics course**. Thesis (ED.D.). Rutgers The State University of New Jersey New Brunswick. 210p.

Pretests were given to over 500 students enrolling in the first semester mechanics and thermodynamics, of an introductory calculus-based college physics sequence at a large eastern state university. Most students were sophomores majoring in science: 40

percent were female. The pretests included algebra (ALG), trigonometry and geometry (TRIGEO), calculus and functional relationships (CALFUN), propositional logic (conjunction equals CJ, disjunction equals DISJ, biconditional equals BIC, and conditional equals COND), deductive reasoning (VD), inductive reasoning (FC), spatial rotation (CC) and spatial visualization (SD and PF). SAT scores (SATQ and SATV) and college grade point averages (GPA) were also obtained for most students. Pretest performance was compared to student performance on 80 multiple choice physics tests items given in three examinations during the term. These items comprised 80 percent of the course letter grade. Multiple regressions and factor analysis were used to compare pretest performance to PA. For the entire group, 31 percent of the variance in PA was explainable by TRIGEO, SATQ, COND, PF, and CC (in descending order of beta coefficients). When GPA was included, the multiple R^2 equals 0.35. When GPA was added, R^2 increased to 0.50. In the factor analysis, three factors were extracted: logical/verbal, spatial, and mathematical. These explained 29 percent of PA variance, with the largest beta weights from the first and third factors. An oblique rotation indicated that the factors one and three were highly correlated but less related to factor two. For females alone, the factor structure was similar but less distinct. SAT scores loaded across two factors which could otherwise been described as logical and mathematical. The mathematics factor was most important in predicting PA, and the beta weight for the regression was not significant. GPA when added again dominated the regression; age had a high negative beta weight. Students dropping the course differed from those completing it on all mathematics tests, conjunctive and disjunctive reasoning. Those dropping were no different on any pretest variable than those receiving a grade below "C". High ability in all areas of mathematics appears required for physics success. Conditional reasoning also contributes, but spatial skills are of minimal importance. For women, only mathematics is important, while men bring several factors to bear on physics. Women enter the course with lower abilities in TRIGEO and CC and higher abilities in SATV. Even when these differences are controlled statistically, a difference in PA remains favoring males and corresponding to about 1/6 letter grade. Half of the variance in PA remains unexplained, emphasizing the importance of individual factors. These results suggest that multiple learning options are a necessary part of the course, and that women especially can benefit from techniques designed to enhance their abilities to utilize other cognitive skills in doing physics problems. It also appears that an overall sophistication in mathematics is a virtual necessity for course success.

Science Teaching

470 Ato, T. and Wilkinson, W.J. 1986. **Relationships between the availability and use of science equipment and attitudes to both science and sources of scientific information in Benue State, Nigeria**. Research in Science and Technological Education, Vol.4, No.1, p.19-28.

Examines the influence of both teacher and pupil use of science equipment on Nigerian students' attitudes to science. Test results from students in 36 secondary schools indicated that schools making considerable use of science equipment, particularly with girls, were associated with more positive attitudes to many aspects of science.

471 Chiarelott, L. and Czerniak, C. 1987. **Science anxiety: implications for science curriculum and teaching**. Clearing House, Vol.60, No.5, p.202-205.

Study of 532 elementary and secondary school students that tested science anxiety. Suggests that females are more anxious about studying science than males at every grade level. Links among achievement, attitudes, and science anxiety appear to be

strong and should give researchers a solid base upon which to build while enhancing the quality of the elementary school science curriculum.

- 472 Doherty, M. 1987. **Science education for girls a case study.** *School Science Review*. Vol.69, No.246, p.28-33.

A science program being developed at a high school in Great Britain to cater to the particular needs of females is described. Curriculum was modified in third, fourth, and fifth examination years to emphasize social nature of science and relevance of science to pupils' lives. Some of the problems encountered with program and selected parts of curriculum are discussed.

- 473 Donawerth, J. 1990. **Teaching science fiction by women.** *English Journal*. Vol.79, No.3, p.39-46.

Science fiction writing is not confined to the male population. Women have participated vigorously in the writing of science fiction in the course of its two-hundred-year history, and many women have written for a young audience.

- 474 Edwards, K. **Seeking feminist transformation of the science and the teaching of science.** IN *Feminist pedagogy and the learning climate. Proceedings of the annual GLCA women's studies conference*, 9th, November 4-6, 1983. p.18-28. Edited by K. Loring, C. Lamb, K. Schwartz and D. Wilcox. Ann Arbor, MI, USA: Great Lakes College Association. Women's Studies Program. (ED 252493)

Discusses what is lacking in the traditional teaching mandate for the sciences; what feminist pedagogical methods or approaches would transform the learning of science and eventually the relationship of science to capital and society; and what would a course for science majors be like if feminist pedagogy and goals were applied extensively.

- 475 Jones, A.C. 1988. **Technical illiteracy: treat the cause, not the symptom.** *Engineering Education*. Vol. 78, No. 8, p.741-743.

Emphasizes the importance of K-12 education in a technically literate society. Cites several major studies in a discussion of the reasons for the apparent unpreparedness of K-12 teachers to teach mathematics and science. Makes recommendations as to how engineering colleges can help to improve K-12 teachers' technical abilities.

- 476 Jones, M.G. 1987. **Gender differences in student-teacher interactions in physical science and chemistry classes.** Thesis (Ph.D.), North Carolina University. 142p.

The study examined classroom factors that may affect the underrepresentation of women in high school and college physics and calculus courses, and physical science and engineering professions. Specifically, gender differences in student-teacher interactions, classroom atmosphere and classroom behaviors were examined. Thirty physical science and thirty chemistry classes containing a total of 1332 students were observed using the Brophy-Good Teacher-Child Dyadic Interaction System. The quantitative coding process allows for examination of patterns of interactions for individuals and groups of pupils. Qualitative data on classroom atmosphere, class demonstrations and teacher verbal patterns were also recorded. An analysis of variance of the data yielded a significant main effect for teacher praise, call outs, procedural questions and behavioral warnings based on the sex of the student. Significant two-way interactions were found for the behavioral warning variable for teacher sex by student sex and subject by student sex. The qualitative data on classroom conditions and student-teacher behavior revealed that male students were more likely to participate in science classroom activities and they were more likely to be asked by teachers to carry out science demonstrations. There was evidence that teachers continue to sex type science occupations and reinforce the traditional role of the woman as the homemaker. Only a very few female scientists were depicted in classroom posters or displays and the majority of these were of black female scientists.

- 477 Lockheed, M.E. and Harris, A.M. 1982. **Classroom interaction and opportunities for cross-sex peer learning in science.** Paper presented at the American Educational Research Association, New York, N.Y., March 18-23, 1982. 18p. (ED 216869)

To investigate factors which could explain the unequal participation and performance of males and females in science, the limited opportunity for females to acquire scientific literacy from their male peers in school was examined. It was assumed that males are more scientifically literate than females, even at elementary school age, that most peer learning results from same-sex as opposed to cross-sex interaction, and that cross-sex group work for science projects would increase female scientific literacy. Fourth- and fifth-grade students from 29 classrooms in California and Connecticut completed three pretests in the fall of 1980: classroom sociometric, attitude survey, and problem solving task completed once individually and once by a four person mixed-sex group. Post-tests were administered the following spring. Researchers observed each classroom eight times, focusing each time on three boys and three girls randomly selected. Test results and observations were used to assess classroom organization, extent of cross-sex cooperation, willingness to participate in cross-sex interaction, and sex bias/sex stereotyping. Findings indicated that opportunities for peer learning in general and cross-sex peer learning in particular were few, students were not receptive to cross-sex grouping, and that more peer learning opportunities existed in collaborative than in non-collaborative classrooms.

- 478 McDowell, E.E. and McDowell, C.E. 1986. **A study of high school students' expectations of the teaching style of male, female, english and science instructors.** Paper presented at the annual meeting of the International Communication Association, 36th, Chicago, IL, May 22-26, 1986. 28p. (ED 278074)

A study investigated high school students' expectations of the teaching styles of english, science, male, and female instructors. A sample of 164 high school students completed the Expectation of Teacher Affective Communication Questionnaire (ETACQ). The same three factors emerged in rating male and english instructors: open, friendly, and dramatic. Female teachers were predominantly labelled attentive, friendly, and dominant. Science teachers were labelled attentive, dramatic, and open. Female high school students rated the friendly dimension significantly higher than did male students for both male and female instructors and rated the open dimension higher for english and science teachers. Male high school students, however, rated the dramatic dimension higher for male, english, and science teachers. Overall, the results of this study reveal that female high school students have higher expectations of teachers from the different categories than male students do. Females expect teachers to be more attentive, show greater sensitivity, show a greater interest in them, and establish closer interpersonal relationships with students. A greater percentage of males, on the other hand, expect a more dramatic communication style, expect to be criticized negatively, and expect the instructor to be impersonal and distant.

- 479 Rennie, L.J. and Parker, L.H. 1987. **Detecting and accounting for gender differences in mixed sex and single sex groupings in science lessons.** *Educational Review*. Vol.39, No.1, p.65-73.

Examined possible sexist attitudes in the teaching of physical sciences. Observations were obtained in 20 Australian year 5 classrooms in which students were working on an electricity topic. The teachers involved were selected as 10 pairs, matched for sex, educational background, and teaching experience. Half the teachers were alerted to the possibilities of sexism in the physical sciences. In classes of the experimental group teachers, the same pattern of activity was found for boys and girls in mixed-sex and single-sex groups, a pattern also found in single-sex groups in the control group classes. Mixed-sex groups in the control group classes involved lower participation rates for girls than for boys. Concludes that single-sex grouping may be beneficial to girls' science education in certain

circumstances.

480 Smail, B. 1984. **Girl friendly science: avoiding sex bias in the curriculum.** Developing the curriculum for a changing world. Schools Council Programme 3. Yorkshire, UK: Longman Resources Unit. 83p.

Based on experiences gained during the Girls into Science and Technology (GIST) project, this report reviews practical suggestions for teaching science to mixed classes in ways that encourage girls to become more involved in the sciences. Chapter 1 provides data about sex differences in examination entries and women's representation in professional and managerial occupations. Results of an attitude survey of 11-year-olds in Great Britain are discussed in Chapter 2. The causes of girls' under-achievement in the physical sciences are explored. The other three chapters focus on needed changes in the laboratory/classroom, curriculum, and in written materials. Chapter 6 suggests ways of counteracting the concept that science and technology are exclusively male preserves. A list of references and suggestions for further reading are also included. Appendices consist of: (1) a list and descriptions of the career areas of women visitors to science classes; (2) examples of the GIST project workcards; (3) two worksheets on women scientists; (4) brief biographies of women scientists; and (5) model illustrations of girls performing standard lab operations.

481 Smail, B. 1985. **An attempt to move mountains: the "girls into science and technology" (GIST) project.** Journal of Curriculum Studies. Vol. 17, No. 3.

Describes the results of a four-year action research project that investigated the reasons for girls' under-achievement in science and technology and tested teacher-developed change strategies. Boys participating continued to be much more interested in science than the girls. Changes in option choice behavior were very small for both sexes.

482 Tobin, K. 1988. **Differential engagement of males and females in high school science.** International Journal of Science Education. Vol. 10, No. 3, p.239-252.

Synthesized the results of five qualitative investigations of high school science classrooms in Western Australia and in the state of Georgia. Gender differences were observed in each study and teachers were not aware of their occurrence.

483 Wetherall, H.J. 1989. **The context of science classrooms: Relationships among expectations, attitudes, student-teacher interactions and student gender.** Thesis (ED.D.). Peabody College for Teachers of Vanderbilt University. 213p.

Data were collected from five elective science classes in four public high schools to determine if there are significant differences in the dependent variables for males and females in each of the two academic settings. The effect of time on student attitudes and classroom interactions was assessed to detect trends in these variables. The SCI science classroom observation system was developed to record student-teacher interactions, student engagement ratings, and classroom climate. Target students were utilized to determine the influence of teacher-expectations of students on interactions. The Subject Area Preference Survey was administered at the beginning and end of the study to detect possible changes in student attitudes toward mathematics, English, and science. Students were interviewed to assess their perceptions of the role of women in science, the relevance of science in their everyday lives, and the role that science may play in their futures. Teacher interviews were conducted for insight into the problems faced by practicing science teachers. Analysis of variance and chi-square were used to statistically analyze data. Results indicated that males substantially control science classroom discourse, in both required and elective classes, by calling out and/or volunteering answers to teacher academic questions. Target student data suggest no significant differences in teacher-initiated interactions with

students perceived as low, average, or high-achievers. However, top students initiate fewer interactions than their low and average peers. Results of students attitudes toward mathematics, English, and science do not generally show sex differences; however, time was shown to exert an influence on student attitudes.

Science Education

484 Alesandrini, K.L. 1981. **Pictorial-verbal and analytic-holistic learning strategies in science learning.** Journal of Educational Psychology. Vol. 73, No. 3, p.358-368.

This study investigated the effects of learner-generated pictures on science learning relative to both a verbal strategy and a control condition, and to determine the role of individual differences. Results revealed weak effects favoring a drawing strategy for males and females, and a holistic strategy for females only.

485 Bakken, M.P. 1981. **An examination of the factors which aid and impede women in completing an associate of science degree program.** Thesis (ED.D.). Boston University School of Education. 366p.

Fifteen women who did complete the degree requirements and fifteen women who did not were interviewed. The women were students at Wheelock College in the five-year period from 1974-1979. The data was collected in single interviews in which an interview guide was used. The interview focussed on the woman's experiences as a student in the Associate of Science degree program and woman's experiences as a family member and preschool teacher while she was a student. The results of the analysis of the data suggest that relationships with the faculty and the other students were critical institutional factors which aid women in pursuit of the degree. The relational nature of these aids to completion is not inconsistent with recent findings about developmental patterns in adult women. The support of family members or the lack of strain in families when the women went to school, the relationship between the woman's job as a preschool teacher and the early childhood college curriculum, and the woman's own growth as a person were important personal factors in aiding the women. Factors which were consistent impediments included transportation difficulties and the lack of babysitting.

486 Bolt, R.H. 1965. **The present situation of women scientists and engineers in industry and government.** IN Women and the scientific professions, the M.I.T. symposium on american women in science and engineering. p.139-162. Edited by J.A.Mattfeld and C.G.Van Aken. Cambridge, MA, M.I.T. Press.

Sketches briefly a statistical profile of "woman power" as it is deployed in science and engineering today. The profile gives estimated numbers of women in different categories, relative distributions of these women among fields, employers, and kinds of work, and related ratios of men to women. Some data on salaries fill in another dimension. Considers some of today's forces that are shaping the deployment of women scientists and engineers of tomorrow. These forces include actions the federal government recently have taken, especially in connection with studies made by the President's Commission on the Status of Women.

487 Camp, C.A. 1981. **Problem solving patterns in science: Gender, and spatial ability during early adolescence.** Thesis (ED.D.). University of Massachusetts. 219p.

The clinical interview was selected for this study in order to uncover dimensions of the cognitive processes not observable by most standardized methods of measurement. It allows the researcher and opportunity to pursue lines of inquiry that emerge during each session and to probe into fundamental and underlying concepts, thoughts and ideas. The population selected for this study

consisted of 9th grade students who were enrolled in four physical science classes. These students were divided into six groups, based on performance on a spatial relations test. The middle scorers were then eliminated from the study in order to create groups consisting of students at extreme levels of spatial ability. Four pools of students were thus created; high scoring males (HSM); low scoring males, (LSM); high scoring females, (HSF); and low scoring females, (LSF). From each of these four groups, ten students were randomly selected. During two interview sessions the students were asked to solve two items from the spatial relations test, a volume displacement puzzle, and two science problems, one involving the earth-sun-moon system and one involving relative motion. A brief selected outline of some of the findings are: more females than males folded the item incorrectly. More than half of the LSF had a geocentric model of the universe. High scorers, low scorers, both male and females thought that the earth's shadow caused the phases of the moon. All of the males did the volume displacement puzzle correctly, less than half of the females correctly interpreted the puzzle. The HSMs were able to shift planes when diagramming the moon and earth from a point on moon's orbit while very few females, high and low spatial, were able to correctly diagram this same arrangement. The females were confused about the meaning of miles per hour. The greatest and most consistent differences occurred between the high scoring males and low scoring females. These differences need to be reached continually in order that we may best meet the needs of high and low spatial students and we must deliberately address the differences between males and females.

488 Collea, F.P. 1990. **Increasing minorities in science and engineering: a critical look at two programs.** *Journal of College Science Teaching*. Vol. 20, No. 1, p.31-34.

The under-representation of minorities and women pursuing graduate and undergraduate degrees in science and engineering is discussed. Two intervention programs are described in detail—Minority Access to Research Careers and the Minority Engineering Program.

489 Deboer, G.E. 1986. **Perceived science ability as a factor in the course selections of men and women in college.** *Journal of Research in Science Teaching*. Vol.23, No.4, p.343-352.

Hypothesized that high school students develop beliefs about their abilities in science that are based in part on their participation and performance in certain science courses, and that those who believe they have ability in science are more likely to choose a science curriculum than those who do not. 140 female and 109 male juniors and seniors at a highly selective university in the Southeast completed a questionnaire about science and mathematics courses they had taken, grades received, and perceptions of their ability in these courses. As many female students took high school biology and chemistry as male students, but significantly fewer females took physics. Similarly, whereas 74 percent of both males and females took one college science course, only 28 percent of the females took 3 science courses, compared to 45 percent of the males. Females performed better in biology and chemistry classes than males but rated their ability in science lower.

490 Granstam, I. 1986. **Technology for girls in Sweden.** *European Journal of Engineering Education*. Vol.11, No.3, p.261-270.

Suggests practical activities which can be introduced into the training of Swedish nursery school and compulsory school teachers for the purpose of improving the organization of technology classes. Explains how simple inexpensive materials can be used in imaginative ways to intrigue and involve children, especially girls, in technical activities.

491 Harding, J. 1981. **Report of science examinations and type of school.** IN *Girls and science and technology (GASAT)*. Contributions to the conference, 1st, Eindhoven, The Netherlands,

November 9-13, 1981. Vol. 2, p.105-122. Edited by Jan H. Raat. Netherlands, Eindhoven University of Technology. (ED 262996)

States that in the girls' schools, where facilities to study science were often barely adequate, the girls would choose physics and chemistry in numbers comparable to those choosing arts subjects if it was made clear to them that the sciences were acceptable subjects for them to study. However, in the larger, mixed grammar school, which had well-equipped laboratories, very few girls were to be found in physics and chemistry classes after the age of 14 years. After the introduction of Nuffield science courses into secondary schools in the 1960's, these new courses were used more extensively for boys than for girls and claimed that girls had more problems with "the Nuffield approach" than did boys. These teachers had clearly-defined assumptions about different characteristics and abilities possessed by the two sexes. The author follows this up by studying the performance of boys and girls in the special Nuffield science examinations at GCE 'O' level, and compared them with more traditional courses and examinations. No significant differences between boys' and girls' overall successes in any of the six examinations included in the study were found.

492 Harding, J. 1985. **Girls and women in secondary and higher education: science for only a few.** *Prospects: Quarterly Review of Education*. Vol.15, No.4, p.553-564.

Reviews data from around the world documenting differences in educational attainment of males and females with emphasis on scientific subjects. Considers social and cultural factors which account for these differences and offers concrete ideas for creating a less sex-differentiated science and technology.

493 Hoffman, L. 1981. **Consequences for science education based on results of girl's learning interest.** IN *Girls and science and technology (GASAT)*. Contributions to the conference, 1st, Eindhoven, The Netherlands, November 9-13, 1981. Vol. 2, p.123-144. Edited by Jan H. Raat. Netherlands, Eindhoven University of Technology. (ED 262996)

In the Federal Republic of Germany, as well as in other countries, science and technology are domains predominately reserved for men. To provide a framework for efforts to reduce girls being disadvantaged in the field of science (especially physics) and technology education, to achieve the sought for equality of opportunity for girls concerning occupational choice, firstly considers the current situation of education in the Federal Republic of Germany and identify sources which may be responsible for this disadvantaged situation of girls.

494 Kahle, J.B. 1984. **Girls in school/women in science: a synopsis.** Paper presented at the Annual Women's Studies Conference, 8th, Greeley, CO, January 1984. 16p. (ED 243785)

Research from sociology, science education, mathematics education, and psychology, as well as data from the National Assessment of Educational Progress (NAEP) indicate some of the causes of and potential solutions for sex inequities in science education. NAEP has indicated that 13- and 17-year-old girls have strong negative attitudes toward science and have little belief that the discipline can be useful to them. Research suggests that social factors, role models and sex stereotypes, educational factors such as enrollment patterns, adult expectations, and class activities, and personal factors (spatial visualization) all contribute to this negative attitude. Possible remedies include adaptation of teaching strategies to female student needs, use of experiments that would enhance girls' spatial abilities, and incorporation of structured lab work. A national study has identified 10 teaching factors that affect retention of girls in science, including attractive classrooms, nonsexist teacher-developed materials, teacher awareness of sexism, and teacher encouragement of extra-curricular activities.

495 Kauermann, W. and Jacqueline. 1990. **Formal equality and discrete discrimination.** *Western European Education*. Vol. 22, No.

1, p.66-79.

Describes results from 1985 interviews, asking college women how the type of school, co-educational or women's, influenced their choice of study or occupation in the hard sciences or engineering. Argues co-educational schools reinforce discrimination against and disadvantage females. Commends feminists' demands for greater sensitivity in detecting sex-discriminating structure and forms of interaction.

496 Kravetz, N. 1984. Looking at the special needs of gifted girls. Paper presented at the Annual Institute for the Gifted, 2nd, Los Angeles, CA, November 2, 1984. 19p. (ED 252039)

The educational experiences and special needs of gifted girls at elementary and secondary levels are discussed. It is noted that enrollment of women in college science and mathematics courses remains disproportionately low. It is felt that girls in grades 7 and up are not encouraged to participate fully in math and science courses. Special sections of math and science courses offered for girls only, with a supportive female role model as teacher, are suggested as a more positive environment for growth that would attract gifted female students. Additional topics discussed include acceleration within subjects, skipping a grade, narrow academic specialization, identification of gifted students, and enrichment activities.

497 Manthorpe, C. 1987. Reflections on the scientific education of girls. *School Science Review*. Vol.68, No.244, p.422-431.

Presents perspectives on the access of females to science education and on the content of that education. Reviews efforts of the Association of Women Science Teachers and addresses concerns related to the attainment of a balanced science education for all.

498 Matyas, M.L. 1992. Promoting undergraduate studies in science and engineering. IN *Science and engineering programs on target for women?* p.43-65. Edited by M.L.Matyas and L.S. Dix. Washington, D.C., National Academy Press.

By closely monitoring student progress through the undergraduate educational system, institutions can pinpoint whether under-represented groups are or are not being recruited into science and engineering studies from secondary schools, having academic and/or social success in the first year of studies, and/or persisting in science and engineering studies after the initial semesters. Reasons for attrition from science and engineering and subsequent solutions differ at each of these levels, and these issues must be examined by specific science and engineering fields. In summary, few undergraduate science and engineering programs are today directed at the recruitment and retention of women, and the most effectively targeted models are not necessarily the most likely to be employed. Although previous work has provided a number of excellent program models that include the components of successful interventions, few of these model programs are targeted specifically at women. Suggest a number of future steps for increasing the participation of women in science and engineering at the undergraduate level.

499 Meissner, D.W. 1988. A study of the relationship between science anxiety and grade level, gender, and students' and parents' perceptions of science, scientists and science teachers. Thesis (Ph.D.), The University of Southern Mississippi. 116p.

The sample consisted of 308 students selected from the fourth, sixth, eighth, tenth, and twelfth grades of three school districts in Lake County, Illinois. Each student was administered either the State-Trait Anxiety Inventory or the State-Trait Anxiety Inventory for Children (depending on grade level), and a Semantic Differential Instrument for determining perceptions of science, scientists and science teachers. There were 162 parents of this student sample who responded and returned the Semantic Differential Instrument. Findings from this study included: (1) There was no significant relationship between science anxiety and grade level. (2) There was

a significant relationship between science anxiety gender, (girls had a higher science anxiety); and students' perceptions of science. It was also noted that from grades four through ten, negative perceptions of science increased, particularly from grade six to grade eight.

500 Narchi, A. 1990. Influence of parents, past science experiences, locus-of-control, self-actualization, and gender on high school students' attitude toward science, science achievement, and commitment to college majoring in science and non-science. Thesis (Ph.D.), University of Florida. 183p.

Three hundred twenty-one eleventh and twelfth graders who were enrolled in three different levels of physics and chemistry courses (standard, honor, and advanced placement) were selected from three public high schools in Alachua County, Florida. Four scales were used to measure variables of interest: Children's Nowicki-Strickland Locus of Control Scale (CNSIE), the Personal Orientation Inventory Scale (POI), and the Test of Science-Related Attitudes Scale (TOSRA). A questionnaire to measure past science experience and demographic information was developed by the researcher. The Test of Science-Related Attitudes was used as a repeated measure at the beginning of semester term and at the end of the same semester. The results indicated that students' past science experiences from elementary and middle school, number of science and mathematics courses taken in high school, and gender significantly impacted students' current attitude toward science and their commitment to the choice of science and non-science college majors. The findings revealed gender differences, in favor of male students, in variables of students' past science experiences, number of science and mathematics courses taken in high school, and attitude toward science. The female students demonstrated that they attained more self-actualization traits than did males.

501 Science Council of Canada. 1982. The science education of women in Canada: a statement of concern. Ottawa, Ontario: Science Council of Canada. 15p.

Since fewer girls than boys study science and mathematics in Canadian schools and no immediate change in this pattern is apparent in the near future, the science education of women will be one of the issues examined by a study of science education in Canada to be conducted by the Science Council of Canada. Several reasons are identified why the Council considers the absence of women in science classes an important issue. Among these are: results in an absence of women in professional science, impacts on women's equality, daily decision making skills, deprives Canada of valuable personnel for the labor market, and increases future risk of unemployment for women.

502 Sherry, J and Dix, L.S. 1992. Promoting graduate and postdoctoral studies in science and engineering. IN *Science and engineering programs of target for women?* p.67-98. Edited by M.L.Matyas and L.S. Dix. Washington, D.C., National Academy Press.

The model programs described provide new ways of addressing the issues and suggest ways that elements of these programs can be replicated in other places and other situations. An important fact about them is that the models almost always include three elements identified as characteristic of successful programs: (1) specific identification of needs, (2) a total or holistic approach, with multiple linkages between graduate education and other populations, and (3) substantial faculty or mentor commitment as well as support from the head of the sponsoring organization. This support includes commitments of both staff and money to initiate and maintain the program. An additional aspect of effective programs is opportunities for networking.

503 Tippins, D.J. 1989. The relationship of science self-efficacy and gender to ninth-grade students' intentions to enroll in elective science courses. Thesis (Ph.D.), Texas A&M University.

In this study, the Test of Science Self-Efficacy was developed and administered to ninth grade students in eight Texas high schools. The instrument was designed to assess science self-efficacy for technical skills, tasks, problems and science-related course work. Students were asked to complete this test and a more general academic Student Self-Efficacy Scale. The data were analyzed using correlational procedures. Science self-efficacy was found to be only slightly related to general student self-efficacy, providing support for the proposed domain-specific nature of efficacy beliefs in scientific fields. A small, but statistically significant difference was found between males and females in science self-efficacy, with males scoring higher. In addition, small, but statistically significant, gender differences in intentionality were also found, indicating that males intended to take more science classes than females.

504 Walford, G. 1983. *Science education and sexism in the Soviet Union*. School Science Review. Vol. 65, No. 231, p.213-224.

Provides general background material on science education in the USSR, assessing equipment, facilities, teaching style, discipline, class size, and enrollment by sex. Analyzes reasons for sex differences in enrollments, textbook bias, classroom interaction, and jobs, both job type and pay by considering society, family, and factors stemming from the educational organization/process.

505 Welborn, T.T. 1990. *Gender differences in science education: A case study*. Thesis (Ph.D.), University of South Carolina. 142p.

This case study investigated how male and female students in two junior high school classrooms differed in their verbal interactions with their science teachers, their attitude toward science as a school subject and as a possible career choice. Techniques of data collection included direct classroom observation, surveys, and interviews with teachers and students of different genders. Other findings pointed to a lack of information about science careers for students from in-school or out-of-school sources. Additionally, most instruction occurred at the lower levels of Bloom's taxonomy of cognitive skills, even for students taught in an "academic" or "college preparatory" track. Suggestions are offered as to how science educators can better instruct female students to encourage their interests in science, as well as how to achieve more effective science instruction for students of both genders.

506 Whyte, J. 1986. *Girls into science and technology: the story of a project*. London, Routledge and Kegan Paul. xi, 281p.

Girls into Science and Technology (GIST) was an innovative action research program with the twin aims of investigating the causes of female under-achievement in science and technology, whilst simultaneously trying to change the situation. The project was based at Manchester Polytechnic, but was a joint university-polytechnic venture. This study used data collected during the project to describe the hidden curriculum of teacher and pupil expectation, and the atmosphere in school labs and workshops which subtly and inexorably leads the majority of girls to opt out of subject areas which seem to present so many formidable though invisible barriers. Presents a description and interpretation of some of the findings from cognitive and attitude testing on the GIST children and links the most important findings to the behavior and response of the GIST cohort in the schools. Examines the GIST experience of single-sex clubs and groups within formal classes. The issue of mixed or single-sex school is still alive and controversial. This evidence contributes food for thought about what can be achieved in coeducational schools and shows that, without attentive awareness from teachers and others, mixed schools are in danger of becoming boy's schools with girls in them.

Sciences

General

507 Al-Methen, A.E. and Wilkinson, W.J. 1988. *In support of a sociological explanation of sex differences in science and mathematics achievement: evidence from a Kuwait study of secondary school certificate examinations*. Research in Science and Technological Education. Vol. 6, No. 1, p.91-101.

Explored the relationships between gender and achievement as measured by the Secondary School Certificate Examination in Kuwait. Found that girls attained significantly superior results compared with boys in all science subjects and lower results in mathematics. Also reports comparisons of urban-rural and Kuwaiti-non-Kuwaiti students.

508 Arrick, E.K. 1983. *Persistence of women and men science majors at an urban state university*. Thesis (ED.D.), University of San Francisco. 351p.

Women and men completing science majors were compared in terms of effects of background characteristics and university experiences on their persistence to graduation and on future educational, personal, and career goals. Vincent Tinto's model of dropout behavior was the source for the background and institutional variables measured. Sandra L. Bem's research on gender identity provided the basis for determining whether differences between women and men in gender-related attributes and socialization experiences were related to persistence factors. From a total population of 189 science baccalaureate degree recipients, 100 subjects were selected randomly. Respondents, 34 women and 39 men, completed the NCHEMS Program-Completer and Graduating-Student Questionnaire and the Bem Sex-Role Inventory. Additional questions tested Tinto model variables and examined gender-related phenomena. Results indicated that women and men completing traditionally male-dominated majors were more alike than different in persistence factors. Shared academic experiences in the School of Science appeared to dominate over stereotypical differences, fostering similar cognitive and affective outcomes for women and men. These findings validated Tinto's academic integration and educational goal constructs. The most significant differences between women and men were demonstrated by the character of their responses to the Bem Inventory and to questions about families and careers. The belief that social norms are changing for women was not verified. Rather, the women graduates appeared to have retained traditional gender-role expectations regarding educational and career aspirations as well as family plans.

509 Baker, D.R. 1982. *Differences in personality, attitude, and cognitive abilities found among biological, physical science, and non-science students*. Thesis (ED.D.), Rutgers The State University of New Jersey. 137p.

Analysis of variance and discriminant analysis indicated that the personality of males and females differed in terms of their decision-making preferences. Males preferred to make decisions based on logical analysis, and females preferred to make decisions based on personal values. Science majors had higher mathematics scores than non-science majors. This is attributable to the higher mathematics scores of the physical science majors. There was no difference in the mathematics scores of biological and non-science majors. All science majors had the expected scientific personality and a positive attitude toward science. Non-science majors had the expected non-scientific personality and a negative attitude toward science. Male science and non-science majors and female physical science majors rated themselves as having stereotypical masculine characteristics. Female non-science majors rated themselves as having stereotypical feminine characteristics. Female biology majors were predominantly feminine in their self ratings (80 percent). Males

did not perform better than females on the test of spatial ability, but science majors did perform better than non-science majors on the spatial test. However, this difference was not as important as the factors of personality, mathematical ability, attitude toward science, and stereotypical masculinity and femininity in discriminating between science and non-science majors. It appears that mathematics as a factor of success in science is more important for the physical sciences than the biological sciences. The same is true for stereotypical masculinity and femininity, especially for women.

510 Baker, D.R. 1987. **Sex differences in classroom interactions in secondary science.** *Journal of Classroom Interaction*. Vol.22, No.2, p.6-12.

Observed 196 high school students in 2 classrooms each during biology, chemistry, and physics classes, using a modified form of the observation instrument of T. Good and J. Brophy (1970). One set of classrooms used a lecture format with little laboratory activity; the other set of classrooms used a self-paced laboratory format. Males were asked more academic and procedural questions than females and were more disciplined. Feedback was minimal, but males received more feedback than females, and feedback terminated the interaction rather than sustained it. Females had more social interactions with their teachers than males and initiated more academic questions than males.

511 Becker, B.J. 1989. **Gender and science achievement: A reanalysis of studies from two meta-analyses.** *Journal of Research in Science Teaching*. Vol.26, No.2, p.141-169.

Synthesized data from 30 studies on gender differences (GDs) in science achievement. Analyses of effect sizes (standardized mean differences) and vote-counting estimation procedures revealed that males showed significant advantages in studies of biology, general science, and physics; significant differences were not found for studies of mixed science content and geology and earth sciences, or in a single study of chemistry. In all cases, the numbers of effects examining each subject-matter area were small.

512 Benbow, C.P. and Minor, L.L. 1986. **Mathematically talented males and females and achievement in the high school sciences.** *American Educational Research Journal*. Vol.23, No.3, p.425-436.

Determined if possible sex differences (SDs) in science achievement are related to SDs in mathematical reasoning ability, using data from a study of 2,188 mathematically precocious 7th and 8th graders conducted in 1972, 1973, and 1974. 61 percent of students were males. Analysis of variance (ANOVA) showed no overall SDs in course-taking or course-grades in the sciences. Indications of SDs favoring males, however, were found in participation in high school physics, the taking of and performance on high school and college level science achievement tests, and intention to major in the more quantitatively oriented fields of physics and engineering. No substantial SDs in attitudes toward the sciences, except possibly physics, were detected. Overall attitude toward science related to participation in science. Moreover, SDs in mathematical reasoning ability may explain some of the SDs in science participation and achievement.

513 Bernstein, S. 1984. **The social determination of science: some implications for women's studies.** IN *Feminist pedagogy and the learning climate: Proceedings of the annual GLCA Women's Studies Conference*, 9th, November 4-6, 1983, p.41-45. Edited by K. Loring; C. Lamb; K. Schwartz and D. Wilcox. Ann Arbor, MI, USA: Great Lakes College Association. Women's Studies Program. (ED 252493)

Briefly discusses the invention of science by men, and ask if women might have done it differently. Explores the assertion that science is value-free; for if this is true, we are faced with the serious problem of trying to explain how social values can impinge on a value-free endeavor. Presents a brief discussion of the seventeenth-century scientific revolution dealing with the creation of

a new institution in the midst of powerful existing institutions. Parallels are drawn with the creation of the new feminist scholarship.

514 Carroll, S. 1991. **A comparison by gender of science achievement as measured by the 1988 Massachusetts Assessment Test.** Thesis (Ph.D.), Boston College. 193p.

The purpose of this study was to determine whether there exist significant gender differences in science achievement. This was accomplished using data based on the 1988 Massachusetts Assessment Test. This test was administered April, 1988, to all students enrolled in Massachusetts schools at the fourth, eighth, and twelfth grade levels. Hypotheses were developed to consider differences: (a) at three grade levels: fourth, eighth, and twelfth, (b) in four content areas: Scientific Inquiry, Life Science, Earth/Space Science, and Physical Science, and (c) at two process levels: Knowledge and Comprehension, and Application and Higher Order. The test was designed to furnish information to improve curriculum and instruction and to provide a basis for comparison of achievement, not to generate individual test scores. For this reason, matrix sampling, in which each student completes a sampling of test questions, was employed to administer the test. Test results were reported in such a way that group comparisons could be made. For the purpose of this study, a random sample of 1/100 of the population of boys and 1/100 of the population of girls on each grade level was taken. The data was analyzed using a t-test for independent means, with the level of significance set at the .05 level. Significant gender differences were found for two subgroups at the fourth grade level, five subgroups at the eighth grade level, and six subgroups at the twelfth grade level. Gender differences were greatest in the areas of earth/space science and physical science.

515 Cole, J.R. 1980. **Meritocracy and marginality: women in science today and tomorrow.** IN *Choices for science*. Symposium proceedings. Bunting Institute working Paper. p.4-26. Cambridge, MA, USA: Mary Ingraham Bunting Institute of Radcliffe College. (ED 235006)

Argues that it might be useful for us not only to consider the question of where in science women stand today, and what their futures look like, but also to take a glance backwards in order to gain some perspective on where they have come from. This paper looks at where women are, a very brief look at some problematics, and puzzles that remain to be addressed and to be solved. In the process, the author focuses on problems of marginality and meritocracy in the scientific community, and indicate not only what we have limited knowledge of, but also what we simply know little about.

516 Davidson, D.D. 1982. **A survey of women studying science in the Los Angeles Community College District.** Thesis (ED.D.). University of California, Los Angeles. 105p.

Hypotheses were posed in order to test the assumption that (1) differences in sex, age, grades, and perception of academic skills are related to women's decisions to study science, (2) the community college has an impact on women's choices to study sciences. This research was conducted by the Center for the Study of Community Colleges and sponsored by the National Science Foundation in the fall of 1980. The sample consisted of 3,098 female and 3,246 male respondents. The hypotheses were tested by frequency counts and cross-tabulations. Females were compared to males on all the above variables in order to determine whether gender differences exist. The statistical analyses revealed that sex differences do exist and that high school participation in the sciences has an impact on future science studies. Female students are older and complete fewer science courses in high school and college. They report lower overall grade point averages but higher grades in science courses. They express less confidence in their abilities and skills, especially mathematical skills. In a second analysis, community college females and males identified as high and low science participants in

high school were compared. The high science females were found to be less likely to continue their science studies and less confident in their abilities but earned higher science grades than high science males. Not surprisingly, college women who were high science participants in high school were more likely to complete a science course than college women who were low science participants in high school. The high science college women were older than the low science college women. The study demonstrated that the low science high school females who became high science college women tended to show more confidence, request more counseling, and use more support services than women who moved away from the sciences in college.

517 Denmark, F.L. 1979. **Women in psychology in the United States.** IN *Expanding the role of women in the sciences.* p.65-77. Edited by A.M.Briscoe and S.M.Pfafflin. New York, NY, The New York Academy of Sciences. (Annals of the New York Academy of Sciences, vol. 323)

Considers the number and distribution of women in psychology. Examines their participation activities in the American Psychological Association. Their employment and salary are reviewed together with barriers faced by women in obtaining doctorate degrees.

518 Ditchfield, C. and Scott, L. (Comp.). 1987. **Better science: for both girls and boys.** Curriculum guide 6. Cambridge, UK: Association for Science Education. 34p. (ED 305228)

Section one of this guide discusses gender-related issues raised by examining the interests, attitudes, aspirations and behavior that young people bring with them into science classes. Section two considers some of the attitudes and experiences which are present in the environment of young children and help to shape their image of the world. Section three considers daily interactions with students, identifies implications, and includes two checklists for teachers. Section four looks at sex-linked choices currently made by students while the future and the changes required if the goal of equal opportunities in science education are to be realized is discussed in section five.

519 Dobson, C. B. **Study inventory responses and "A" level grades.** Educational Studies. Vol.5, No. 2, p.127-134.

Arts and science students were compared as to whether study habits and study attitudes were related to A-level achievement. High correlations between each scale and performance were found for the 290 sixth form students. For science students, study attitudes were better predictors of performances, for arts students study habits were better predictors. All four study orientations were strongly associated with achievement for females but had little overall relationship for males. Educational acceptance was the most important for females in general. Teacher approval was particularly important for female science students.

520 Doherty, J and Dawe, J. 1985. **The relationship between development maturity and attitude to school science: an exploratory study.** Educational Studies. Vol. 11, No. 2, p.93-107.

Between the second and fifth years of their secondary schooling, British students' attitudes toward school science became more negative. This applied to both boys and girls, but it was more marked in the case of girls. Early maturing girls showed significantly more negative attitudes to school science.

521 Donovan, E.P. 1982. **The influence of the eighth grade science teacher's gender, classroom laboratory emphasis, level of understanding of science and career interest on eighth grade girls' science and engineering career interests.** Thesis (Ph.D). Florida Institute of Technology. 229p.

This study sought to determine: (1) whether eighth-grade science teachers serve as sex role models and therefore enhance eighth-grade students' science and engineering (SE) career interests; and

(2) if the SE career interests of eighth-grade girls are related to the sex and selected teacher effectiveness characteristics of their eighth-grade science teachers. Subjects were 30 eighth-grade science teachers (14 men and 16 women) and 1,937 eighth-grade students (945 boys and 922 girls) in Brevard County, Florida. All students were given an author-developed career interest survey at the beginning and near the end of the eighth-grade school year. Two major conclusions were reached based on analyses designed to test interaction of teacher and student sex on student SE career interest. The first conclusion is that as sex role models, the eighth-grade science teachers were not found to enhance the SE career interests of their students. The second conclusion is that eighth-grade girls' SE career interests were not influenced by the teacher's sex or effectiveness as measured by such variables as observed classroom laboratory emphasis, understanding of science, and career interest.

522 Driver, G. 1980. **How West Indians do better at school (especially the girls).** New Society. Vol. 51, No. 902, p.111-114.

This study looked at the 16+ exam results of 2300 intercity school leavers from five multiracial schools. Girls and boys from West Indian, Asian and English backgrounds were compared on achievement in maths, science and English language. West Indian girls and boys outperformed English students in all three areas, with Asian students doing the best, except in English language. Although English boys did better than English girls overall, the reverse was true for West Indian pupils - resulting in an overall ranking of West Indian girls, English boys, West Indian Boys then English girls. Because of differential drop out rates, higher for English students and for girls, the results were weighted by the percent of course enrollment in the last compulsory year appearing on the 16+ exam. The superiority of West Indians, particularly girls, remained. Explanations for the different directions of the two groups' sex differences focused on the impact of family structure on aspirations for females and employment patterns. For example, English working class families are less likely to encourage their daughters in school, while West Indian women must often be the family provider, due to discrimination against West Indian males and family structure.

523 Erickson, G. and Farkas, S. 1991. **Prior experience and gender differences in science achievement.** Alberta Journal of Educational Research. Vol.37, No.3, p.225-239.

A set of 23 multiple-choice items that displayed significant gender differences on a previous Canadian science assessment test were administered to 238 grade 12 students. Eight male and 7 female students were selected for a follow-up interview to identify any previous experiences they might have had that might have enabled them to respond to an item. Four categories were generated from their explanations. These were school-based experiences, informal experiences, common knowledge, and a final miscellaneous category. Results indicate that females consistently appealed to school-based experiences much more than did the males. Also, many of the items elicited spontaneous negative reactions from many of the females but virtually none from the males.

524 Ethington, C.A. 1988. **Differences among women intending to major in quantitative fields of study.** Journal of Educational Research. Vol.81, No.6, p.354-359.

Found patterns of differences in quantitative performances across seven groups of 10,000 intended undergraduate majors for students who had completed their undergraduate study. Women intending to major in engineering and the physical sciences on the average scored higher on the Scholastic Aptitude Test (SAT-M) than anticipated as compared with women intending to major in mathematics, statistics, physics, and computer science. However, the difference in mean SAT-M performance disappeared when other measures were controlled for, and effects of these measures were the same for both groups. Self-rating relative to others with respect to mathematics and science ability was the primary influential variable.

525 Fausto-Sterling, A. and English, L.L. 1985. **Women and minorities in science: an interdisciplinary course.** Wellesley, MA, USA: Wellesley College, Center for Research on Women. 48p. (Working Paper, No. 5; ED 281752)

"Women and Minorities in Science" was developed as a course that would bridge the gap between traditional women's studies and Afro-American studies courses. This paper provides a descriptive account of how the course was developed and discusses its content and instructional approach. The class schedule is provided and includes a listing of the topics covered, the format employed, and the readings required. Resource materials and sources are identified and listed in the categories of: (1) bibliographies; (2) books (separate sections for Black Studies and Women's Studies); (3) science as a social process; (4) women and minorities in science; (5) other minorities; (6) journal articles; (7) visual aids; (8) journals; and (9) reference works.

526 Ferguson, J. 1981. **The science education of girls in Canada: a strategy for change.** IN *Girls and science and technology (GASAT). Contributions to the conference, 1st, Eindhoven, The Netherlands, November 9-13, 1981. Vol. 2, p.71-90.* Edited by Jan H. Raat. Netherlands, Eindhoven University of Technology. (ED 262996).

Outlines the role of the Science Council of Canada and the nature and origin of its Science and Education study, within which the problem of girls and science is but one issue. The "nobody cares" problem was singled out as the first and most urgent area of concern. Change in any area of the education system is difficult to achieve, especially when that change involves modifying long accepted ideas and attitudes. Secondly, is the need to adopt a pluralistic approach to the problem. The complexity of the problem requires that action at a number of levels of the education system be undertaken simultaneously, if real and enduring changes are to be accomplished. And finally, the idea that the difficulty that is often experienced by researchers trying to pinpoint exact causes of the situation may result from the fact that this separation of girls from science grows out of what is lacking in their education and their daily lives, rather than from easily identified concrete obstacles. The lack of public concern about this issue is being approached by the Science Council through a number of doors. The Council is planning to issue a formal statement of concern about the situation. This statement is intended to act as an alarm bell, to draw attention to the situation and to its potentially serious consequences for women and for Canada as a nation. The workshop on the science education of women in Canada was sponsored in an attempt to provide a documented basis for the further deliberation of this issue.

527 Fink, L. 1981. **To attract and hold young women's interest in the physical sciences (so that they can achieve success equal to that of young men).** IN *Girls and science and technology (GASAT).*

Contributions to the conference, 1st, Eindhoven, The Netherlands, November 9-13, 1981. Vol. 2, p.91-103. Edited by Jan H. Raat. Netherlands, Eindhoven University of Technology. (ED 262996)

Researchers working with very young children of both sexes find them to be very interested in and curious about the world around them and in number puzzles and games. These are certainly traits needed for success as a scientist. Since these traits are found in very young children it is necessary to examine closely what happens to make them disappear in many young adolescent women. Psychological and sociological studies have shown that the family, the school and society at large put constraints on girls which tell them overtly and covertly that science and mathematics are really masculine subjects. They are told further that to be a successful "lady" one doesn't need to be or even want to be interested in or successful at these subjects.

528 Freundlich, N. 1989. **Making science more seductive to women on campus.** *Business Week.* No.3121, p.89.

Reasons why women chose not to pursue high-tech careers are discussed. Remedies to attract more women to engineering and other high-tech professions are described.

529 Gibbons, A. 1992. **Creative solutions: foundations lend a hand.** *Science.* Vol.255, No.5050, p.1387.

Fellowships from the National Science Foundation are among the new programs designed to help women get over the tenure hump and help them gain visibility outside their own departments.

530 Gibbons, A. 1992. **Key issue: mentoring.** *Science.* Vol.255, No.5050, p.1368.

While mentoring is an important part of the maturation of young scientists into senior researchers, most women have a difficult time getting this guidance. The ultimate solution is to increase the number of senior women in science who can be mentors to younger female colleagues.

531 Haggerty, S. M. 1991. **Gender and school science: Achievement and participation in Canada.** *Alberta Journal of Educational Research.* Vol.37, No.3, p.195-208.

Reviews recent studies of gender differences in science achievement and participation. Studies suggest that for females more than for males, success in school science is attained by learning right answers. The result of this approach to learning is that girls more than boys frequently do not understand the science they learn. This approach to learning may contribute to females' lower level of achievement on standardized tests. The failure to understand the science that is being learned leads females to feel that science, particularly physics, is not for them. Consequently, they are less likely to participate in elective physical science courses. If this disadvantage with respect to both participation and achievement is to be overcome, it will be necessary for middle school/junior high school science to be taught in a more meaningful and relevant way, involving girls as well as boys.

532 Harding, J. 1980. **Sex differences in performance in science examinations.** IN *Schooling for women's work.* p.86-97. Edited by R. Deem. London, England: Routledge and Kegan Paul.

The 1974 GCE exam scores for a stratified sample of 1000 students were used to compare girls' and boys' performance in the sciences for Nuffield versus conventional approaches, mixed versus single-sex schools, and grammar versus comprehensive schools. While no overall sex difference in pass rates was found, differences emerged for various school types, controlling for selectivity and sex composition of school. In mixed-sex schools, boys clearly outperformed girls, while in single-sex schools girls outperformed boys slightly. Boys also clearly outperformed girls in comprehensive schools, but not in grammar schools, with girls actually being superior in direct-grant and independent schools. Girls pass rates were extremely high in these two. Girls clearly did better in girls' schools than in co-ed schools while the reverse was somewhat true for boys. Comparison between Nuffield and conventional approaches yielded mixed results. Girls studying science seem to be most disadvantaged in mixed-sex, comprehensive schools, the dominant trend today. Overall, fewer girls than boys select science courses and careers. Two important factors seem to influence girls' choice of school subjects and their performance in them: the masculine/feminine image of the area and the level of commitment to a career outside the home. The masculine image of science can be clearly observed in the relative numbers of each sex represented in science courses, teaching staffs, scientists shown in the media, and text books and in the masculine examples used.

533 Harding, J. 1988. **Recent international concerns in gender and science/technology.** *Educational Review.* Vol.40, No.2, p.185-193.

Topics addressed at the 1987 Girls and Science and Technology Conference are reviewed. The author argues that involvement of

females in science/technology depends on the interactions of societal expectations of males and females, the image and practice of science and technology, and objectives and organization of education.

534 Harding, S. 1991. **Whose science? Whose knowledge? thinking from women's lives.** Ithaca, N.Y., Cornell University Press. xiii, 319p.

Focuses on issues of special interest to natural scientists and researchers working in the social studies of the natural sciences. It raises some new critical issues about the sciences and is designed to make the later discussions of these topics more accessible to readers who are new to feminist critiques of science and epistemology. Pursues some of the issues that the 'standpoint theories of knowledge' raises about traditional epistemologies, critically examines the assumptions and logical consequences of the theories, and compares this kind of epistemology with post-modern theories of knowledge. The logic of taking standpoint epistemologies as a directive to begin our thinking from the standpoint of the lives of groups that have not been central to Western feminist discussions of science and epistemology. Reconsiders the relationship between experience and knowledge and asks what the liberatory movements can do to hasten the "birthing" of new agents of history and knowledge. The concluding chapter argues that within the transformed logic of feminism and of science it makes sense to think that distinctively feminist sciences have already appeared.

535 Harvey, T.J. and Stables, A. 1986. **Gender differences in attitudes to science for third-year pupils: an argument for single-sex teaching groups in mixed schools.** *Research in Science and Technological Education*. Vol.4, No.2, p.163-170.

Examines the attitudes to science, physics, chemistry, biology, and to school of students in mixed and single-sex secondary schools from England. Results are used to support an argument for separating students by sex for studying some subjects in mixed schools.

536 Healy, B. 1992. **The astonishing thing is that young women pursue careers in science and medicine at all!** *Chronicle of Higher Education*. Vol.38, No.29, p.B5.

A study shows that women in science classes receive more negative treatment than their male colleagues. Attitudes towards women pursuing careers in science and medicine must be changed.

537 Hilska, U. 1990. **Recruitment of students to universities of technology in Finland.** *European Journal of Engineering Education*. Vol. 15, No. 4, p.361-368.

The student selection procedure is described for higher education in technical sciences in Finland. The outlook, problems, and opportunities for development of universities of technology in the 1990s are examined. The inadequate preparation of students in math and science and the lack of women who chose technological studies are discussed.

538 Holden, C. 1989. **Radical reform for science education.** *Science*. Vol.243, No.4895, p.1133.

A group of scientists and educators has called for the teaching of science, especially to women and minorities, who lag behind white males in math and science skills, to be a priority for education policy. The report, "Science for All Americans," is part of a long-term project by the American Association for the Advancement of Science.

539 House, J. D. and Wohlt, V. 1989. **The effect of student and tutor gender on achievement of academically underprepared students in mathematics and science.** *Journal of Instructional Psychology*. Vol.16, No.4, p.192-198.

Examined the effect of the sex of 220 female and 113 male college students and the sex of their graduate or undergraduate student tutors on achievement in introductory-level science and math

courses. An analysis of variance (ANOVA) indicated that students did better when they worked with a tutor of the same sex. It is possible that same-sex tutors interact differently with their tutees, are better able to put information into an understandable context, are more able to reduce tutees' anxiety, and communicate different expectations than different-sex tutors.

540 Howe, A. C. and Doody, W. 1989. **Spatial visualization and sex-related differences in science achievement.** *Science Education*. Vol.73, No.6, p.703-709.

Examined whether sex differences in science learning were linked to superior spatial visualization abilities in males. Twenty-eight male and twenty-eight female 10th graders were administered the Group Embedded Figures Test (GEFT) and the Piagetian tasks for perceptual fidelity, simple and complex imagery, pseudoconservation, and cognitive regulation. Gender differences in GEFT scores were nonsignificant. Only performance on complex imagery and cognitive regulation accounted for significant portions of the variance in GEFT scores. Findings suggest that disembedding ability is cognitive not a spatial ability and that it is a type of problem solving or fluid intelligence. Evidence does not support the idea that girls do not do as well as boys in science because they are less analytical or more field dependent.

541 Huetinck, L. 1990. **Gender differences on science exams with respect to item type, format, and student interests and experience.** Thesis (Ph.D.), University of California, Los Angeles. 199p.

The study based on a general physical science exam given to tenth grade biology students, consisted of a series of four investigations conducted within one experimental setting. The first investigation examined gender differences on a multiple choice exam taken by the traditional right/wrong method versus the results obtained using a confidence weighted method. The second and third sections of this investigation examined the knowledge base of science students by using certain types of content and process items and think-aloud protocols. Lastly, students' interests and experience responses to a survey were analyzed. The results indicate that girls are outperformed by the boys on content items but not on scientific process items. From this study it appears that the girls' test scores are not adversely affected by the right/wrong mode of response required by traditional multiple choice questions nor advantaged by the use of a confidence weighted test format. There was little gender difference in modes of responding to the questions as determined by number of times no response was indicated, number of times "I don't know" was marked, and the number of times an initial answer was changed. The examination of the interest and experience survey, test score, and eighth grade physical science final grade, indicates that interest in science is most closely related to an understanding of science information for the boys but that the grade in the previous physical science course is most closely related to the understanding of science information for girls.

542 Hughes, R. 1980. **Status of women in the physical sciences, mathematics and engineering.** IN *Choices for science. Symposium proceedings.* Bunting Institute working Paper. p.27-32. Cambridge, MA, USA: Mary Ingraham Bunting Institute of Radcliffe College. (ED 235006)

The number of women holding academic positions in scientific fields remains discouragingly low. Because mathematics is a critical prerequisite for any career in the sciences, possible causes for the current situation by examining those factors which contributes to the high attrition rate for women from mathematics at every level of their intellectual development. Other factors which may contribute to the disparity between the interest and achievement of girls and boys which appears at this level are societal expectations and peer pressure. The sexual stereotype of the woman scientist as a rather formidable individual is as persistent as it is inaccurate. Moreover, the current popularization of math anxiety may lead girls to believe

they suffer from an inevitable female disorder and may ironically reinforce existing stereotypes of women as being inept at math and sciences. Another factor is the misleading impression young women have about the degree of mathematical facility needed for their particular career aspirations. The young woman whose enthusiasm has survived until college faces a new set of obstacles. Encountering for the first time the predominantly male scientific establishment, she may find that the shortage of women faculty members creates a less than supportive atmosphere. The woman who chooses to do graduate work in mathematics may be affected to an even greater extent by the paucity of role models.

543 Hutt, C. **Why do girls underachieve?** Trends in Education 4, winter, p.24-28.

A survey of the sex role attitudes of 200 thirteen to sixteen year olds was conducted, comparing students in single-sex and mixed-sex schools. Several findings directly concerned maths and science. Both sexes thought maths was an important subject for boys, but not for girls. The reported 'worst' vs. 'best' subject were maths vs. English for girls in co-ed schools, foreign language vs history for girls in girls' schools as well as boys in co-ed schools, and the natural sciences, both worst and best, for boys in boys' schools. This supports other studies which find that mixed-sex schools polarize students' performance and subject preference along sex role lines, particularly for girls. Sex-stereotyping of jobs, roles and abilities in general was more evident in mixed-sex than single-sex schools.

544 Illovsy, M.E. 1991. **A comparison of the physical and mental health of doctoral level women scientists.** Journal of College Student Psychotherapy. Vol.5, No.3, p.99-110.

200 biological and physical scientists from universities were surveyed to compare the mental and physical health of males and females in the sample. The 43 females had more problems with suicidal ideation, depression, headaches, tension, and crying. They also had more stomach, back, and neck problems. No sex differences were obtained on measures of amount of sickness, smoking, alcohol consumption, and quarreling. Compared to males, females tended to engage in less sports activity and more in other exercise. Females tended to be under-represented both as doctoral and postdoctoral students and as faculty. Female faculty members and doctoral students were younger than their respective cohorts.

545 Kahle, J.B. 1983. **Factors affecting the retention of girls in science courses and careers: case studies of selected secondary schools.** Washington, D.C., USA: National Science Foundation: National Science Board Commission on Precollege Education in Mathematics, Science and Technology. 40p.

Describes a 9-month, nationwide project which investigated the teaching strategies and teacher attitudes that successfully encouraged girls in science. Subjects included 205 females and 147 males from seven high schools. In addition to analyzing instructional techniques, classroom climates, and teacher-student interactions, a selected sample of former and current students received a variety of instruments which assessed attitudinal, cognitive, and socio-cultural variables. Results obtained from the case studies and survey instruments indicate that teachers who successfully encourage girls in science maintain well-equipped, organized, and perceptually stimulating classrooms, are supported in their teaching activities by parents of their students, are respected by current and former students, use non-sexist language and examples, include information on women scientists, use a variety of instructional strategies, stress creativity and basic skills, and provide career information. Factors which discourage girls in science include high school counselors who do not insist on further courses in science and mathematics; lack of information about science-related career opportunities and the prerequisites for them; sex-stereotyped views of science and scientists fostered by textbooks, media, and many adults; lack of development of spatial ability skills; and fewer experiences with science activities and equipment that are

stereotyped as masculine.

546 Kyle, S.A.P. 1980. **Curriculum resources: Women in science, medicine, and technology.** Thesis (ED.D.), Wayne State University. 162p.

This historical study of women was limited to five women in medical science since an indepth study of women in all fields of science or medicine proved to be impossible for one individual. Also reviews the literature on elementary and secondary science textbooks to see how women have been treated by publishing companies, and prepares a unit of study which could be used in the later elementary and/or middle school grades. It contains: (1) biographies of a select group of women in medicine for teachers who would use this unit of study, (2) a model biography for a booklet that students could use of one of the women selected in working with this unit of study, (3) a few scientific experiments and/or demonstrations that can be used with this unit of study, and (4) bibliographies and subject headings which would allow teachers and students to work on this or future units of study.

547 Lane, M.J. 1990. **Women and minorities in science and engineering.** Washington, D.C., USA: Division of Science Resources Studies. 174p.

Examined: (1) the population of women scientists and engineers including employment characteristics; (2) the experiences of women in science and mathematics at all educational levels; (3) the differing experiences and characteristics of Blacks, Asians, Native Americans, and Hispanics in the U.S. science and engineering population; (4) minority experience in U.S. educational institutions; and (5) the employment characteristics of persons with physical disabilities in the U.S. science and engineering population. Appendices include technical notes and statistical tables.

548 Lawrenz, F.P. and Welch, W.W. 1983. **Student perceptions of science classes taught by males and females.** Journal of Research in Science Teaching. Vol. 20, No. 7, p.655-662.

Investigated whether students perceive science classroom environment in significantly different ways depending on their science teacher's sex. Reported differences such as perceiving classes taught by males as more difficult, and possible relationships between these differences and changes in girl's preference for science are discussed.

549 Levin, T., Sabar, N. and Libman, Z. 1991. **Achievements and attitudinal patterns of boys and girls in science.** Journal of Research in Science Teaching. Vol.28, No.4, p.315-328.

Examined the gender-related differences and their determinants in learning of science, using data from the 1983-1984 Israeli International Association for the Evaluation of Education Achievements study. The sample included 900 male and 1,034 female 9th graders. Involved several measures of science learning, 10 attitudinal measures, and item and error classification. Differences between boys and girls were observed in some measures of science performance, particularly in the physical sciences, in items with lower estimates of opportunity to learn, and in specific kinds of errors. Gender-related differences were also observed in the predictive model of achievement, using science-specific affective measures.

550 Livingston, M. M., Maxfield, M. W. and Attevery, B. J. 1990. **Who takes science: Preliminary findings regarding changing perceptions of computers.** Psychological Reports. Vol.67, No.3, Pt1, p.1057-1058.

Analysis of responses of 369 undergraduate students, 59 percent from a predominantly white university and 41 percent from a predominantly black university to questionnaires indicated computing was rated as one of the most popular, interesting courses and one in which students expected the best grades. Students who had internal locus of control, low anxiety toward mathematics, awareness

of the relevance of knowledge of computers for their work, and experienced positive influences from their fathers and high school teachers were more likely to select science courses. Men were more likely to take science courses than women.

551 Lord, T.R. 1987. **A look at spatial abilities in undergraduate women science majors.** *Journal of Research in Science Teaching*. Vol.24, No.8, p.757-767.

This study was conducted to determine if women in the sciences were as accurate in spatial abilities as male counterparts. An experiment was also conducted to find if an intervention would improve the visually spatial awareness of women as rapidly as men. Data indicated that while women tended to start at a lower level, they were able to learn quickly.

552 Manthorpe, C. 1982. **Men's science, women's science or science? Some issues related to the study of girls' science education.** IN *Studies in science education*. Vol. 9, p.65-80. Edited by David Layton. Leeds, UK: Leeds University. (ED 266941)

Examines the three distinct, though not unrelated, perceptions of the problem of why male students outnumbered female students in science. One, which may be called the State or managerial view, sees the intellectual potential of girls as a significant untapped resource for scientific and technological labor power. The second interprets the problem as one of equality of opportunity and seeks to identify and reform those factors believed to be working against the achievement of girls in science. The third view recognizes the incidence of the under-representation of girls and women in science as a comment of the nature of science itself, upon the male-female relation, and believes science, as it is now practiced, to be oppressive to women. This perception is not one which entails a rejection of science, merely of a specific form of science. As such, the concern represents something of an organizational and even a methodological challenge to contemporary Western science.

553 Mason, C.L. and Kahle, J.B. 1989. **Student attitudes toward science and science-related careers: a program designed to promote a stimulating gender-free learning environment.** *Journal of Research in Science Teaching*. Vol.26, No.1, p.25-39.

Describes a teacher intervention program modifying classroom techniques and environments for fostering the participation of girls in high-school science classes. Reports that students who were taught by trained teachers, compared to students who were not, have higher scores on tests of attitudes toward science, perceptions of science, and science experience.

554 McDade, L.A. 1988. **Knowing the right stuff: Attrition, gender, and scientific literacy.** *Anthropology and Education Quarterly*. Vol.19, No.2, p.93-114.

Examined patterns of attrition and retention behaviors in science and mathematics among undergraduates, and the sense students made of the event. Of 379 chemistry and math freshmen at a university, 200 dropped out or left the disciplines, 56 percent of them women. Although enrolled in higher numbers, women dropped from the major in higher numbers than men. A critical analysis of gender orientations to attrition and scientific literacy is provided. The competent self, the male counterpoint in attrition, positivist knowledge, and powerlessness are discussed.

555 Olesen, D. 1988. **Popularization of science in Denmark in relation to women.** *Impact of Science on Society*. Vol.38, No.4, p.373-382.

Describes the diversity of channels through which the cause of science is being promoted and the special efforts being made to involve females in science and technology. Topics include the background of science popularization, tradition, innovation, television programs, science museums, the role of universities, youth activities, computers, and magazines.

556 Rand, D. and Gibb, L.H. 1989. **A model program for gifted girls in science.** *Journal for the Education of the Gifted*. Vol.12, No.2, p.142-155.

"Action Science" was developed to increase gifted girls' involvement in science. The program, for girls in grades one-nine, emphasizes enjoyment of science activities, parental involvement, female role models, and hands-on investigations. The article includes a rationale for a "girls only" program and program evaluation results.

557 Reyes, L.H. and Padilla, M.J. 1985. **Science, math and gender.** *Science Teacher*. Vol. 52, No. 6, p.46-48.

Examines recent data on sex-related differences in science and mathematics achievement, discussing meta-analyses findings on attitudes, career choice, life/physical science preferences, and motivation. Indicates that spatial visualization appears to be very important and that girls more often attribute success to luck rather than skill.

558 Rudy, M.J.K. 1981. **Gender, sex-role stereotypes, interest in science, and responses to science/technology role models in the television science series "3-2-1 Contact".** Thesis (Ph.D.). New York University. 203p.

The 149 sixth grade boys and girls responded, pre and post to two sex-role stereotypes scales, Spence's Extended Intermediate Personal Attributes Questionnaire and Spence's Trait Stereotype Measure, and to an Interest in Science Scale. They viewed 13 "3-2-1 Contact" color videotapes and commented on Appeal, Attention, and Attitude to selected role models. A multi-variate analysis of variance compared gender and time of testing to the sex-role stereotype and interest in science variables. Boys saw themselves as more stereotypically masculine than did girls. Boys also liked the mechanical aspects of science more than girls did. Boys and girls described themselves as more stereotypically masculine and rated feminine traits less stereotypically on the post-test than on the pretest. Examination of open-ended appeal and attention responses revealed that positive appeal was related to a combination of liking behavior/activity, personality, and verbalizations of role models. Attention mostly focused on appearance and behavior/activity. Overall, as appeal and attention diminished, especially to females, comments decreased. Girls, in particular, commented negatively about behavior/activity they did not enjoy, unclear verbalizations, and unattractive personality and appearance. In conclusion, boys and girls already interested in investigative science responded positively to the role models. Girls who exhibited masculine traits and perceived masculine traits less stereotypically were more receptive to female role models. Although boys and girls liked same-sex models, appeal of and attitude toward female models diminished from beginning to end, questioning the effectiveness of these selected role models. Reasons were related to appealing or non-appealing aspects of personality, verbalizations, appearance, and behavior/activity. Therefore, if role models are to be the vehicles to interest more girls in science, careful attention needs to be focused on personal qualities of the role models. Furthermore, understanding more about the target population of boys and girls, their initial interest in investigative science, sex-role stereotypes, and other attributes would lend to greater effectiveness of female role models.

559 Schwartz, W. 1988. **Teaching science and mathematics to at-risk students.** *Equity and Choice*. Vol.4, No.2, p.39-45.

Cognitive, social, and organizational problems put some groups at a disadvantage in learning mathematics, science, and technology. Recent programs and policies have begun to improve these inequalities. Minorities and women can benefit from long-term programs that help them to recontextualize information, reduce their anxiety, and spend more time on tasks.

560 **Science in the U.S. -- With one hand tied behind us.**

1988-1989. Hood on the Issues. No.1, p.3-14.

The status and experiences of women in science and engineering are discussed. Specifically highlighted is the situation at Hood College, Maryland, a school with a majority of female students. Strategies for encouraging female students to enter and continue in science majors and careers are suggested.

561 Skolnick J., Langbort, C. and Day L. 1982. **How to encourage girls in math & science: strategies for parents and educators.** Englewood Cliffs, N.J., Prentice Hall. xi, 192p.

Why do many girls avoid math and science? What can parents and educators do to change this? And how can we inspire girls who do like math and science to pursue their interests? This book provides theoretical and practical answers. Examining the effect of sex role socialization on skills and confidence, the book traces the pattern of girls' involvement with math and science from early childhood through adolescence. It shows how attitudes, parenting and teaching practices, stereotyped play activities and books, peer pressure, and career and family expectations cause girls to question their ability and render them unfamiliar with the math and science skills and concepts they will need. On the basis of this analysis, this book presents a variety of educational strategies and 69 math and science activities designed to encourage girls.

562 Sposito, G. 1992. **Promoting science and engineering careers in academe.** IN Science and engineering programs on target for women? p.101-118. Edited by M.L. Matyas and L.S. Dix. Washington, D.C., National Academy Press.

Career-related statistics for women in academe can vary greatly across scientific and engineering fields. Some of this variability is related directly to issues that are of a particular nature: the public image of a specific field; its visibility to science and engineering majors as a career opportunity; the demand for it in the private sector; and its distribution among the academic programs of doctorate-granting universities. These issues are perhaps of lesser importance than the broad, generic issues that affect most, if not all, career patterns of women scientists and engineers who choose to work in higher education. It is the generic issues that interventions are expected to address first and foremost. Interventions are necessary to increase the low percentage of science and engineering faculty who are women. Women are not being appointed at expected rates or promoted to expected levels. Among the reasons given for the slow and low rates of women's advancement up the academic career ladder in science and engineering are the following: geographic constraints, dual-career families, narrowness of searches to fill faculty openings, fears that the department will not be getting its due because of family commitments, and lack of "top-down" support within the institutions.

563 Tamir, P. 1991. **Factors associated with the acquisition of functional knowledge and understanding of science.** Research in Science and Technological Education. Vol.9, No.1, p.17-37.

Explored the relationships and possible effects of various personal home and school variables on the acquisition of functional scientific knowledge by 544 10th grade students in Israel. A questionnaire on personal characteristics and a self-report knowledge inventory was completed. It was found that for functional knowledge in biology, the most influential variable was intention for further study, followed by attitudes toward science, reading outside school on science topics, and career aspirations. For physics, gender was most influential, followed by attitudes toward science, intentions for further study, and the school environment. Chemistry occupied a middle position between biology and physics with one additional variable, namely, parents' occupation related to science.

564 Tobin, K. and Garnett, P. 1987. **Gender related differences in science activities.** Science Education. Vol.71, No.1, p.91-103.

Discusses a study which examined gender related differences in participation in science activities. Based on interpretive

observations and formal interviews, gender related differences in engagement patterns were evident with the high school students. Presents six assertions and provides supporting examples of gender differences.

565 Vaughn, J.C. and Rosenzweig, R.M. 1990-1991. **Heading off a Ph.D shortage.** Issues in Science and Technology. Vol. 7, No. 2, p.66-73.

The projected shortage of Ph.Ds in the natural sciences and engineering by the turn of the century is discussed. Reasons for the shortage and three ways to reduce the projected shortages are provided. Topics discussed include a complete federal strategy, attracting more minorities and women, and institutional reform.

566 Versey, J. 1990. **Taking action on gender issues in science education.** School Science Review. Vol.71, No.256, p.9-14.

Positive steps are recommended that teachers can take to enhance access and motivation for students. Stressed the idea that paying attention to the needs of girls as individuals with differing interests and expectations, and valuing their contributions should enhance instruction for all students.

567 Vetter, B.M. 1985. **A statistical picture of women in science.** Journal of College Science Teaching. Vol. 15, No. 2, p.138-140.

Presents degree and employment statistics on women scientists and engineers, outlining variations through the years and by fields. Several factors contributing to the difference between women's proportion of degrees and their proportion of the labor force are discussed. Also presents starting salary differences and types of employers.

568 Vetter, B.M. 1989. **Women in science: progress and problems.** Occasional Paper 89-1, Adapted from a paper presented at the Annual Meeting of the American Association for the Advancement of Science, San Francisco, CA, January 15, 1989. 27p. (ED 313217)

The current status of women in science and engineering careers are reported. Statistical data comparing women with men in various subject areas are presented, with graphs at these various levels. The obstacles on the way to a science career are explored, using the presented data. Encouraging women to participate in science and engineering areas, equal treatment in school and the workplace, shared responsibility for home and family, and a change in societal attitudes towards girls and women are recommended.

569 Warran, C.R. 1990. **An exploration of factors influencing the career preferences of Junior High Students.** Paper presented at the annual meeting of the National Science Teachers Association, Atlanta, GA, April 1990. 33p. (ED 319632)

The purpose of this study was to investigate the relationship between images of science careers and junior high school students' attitudes toward science occupations. Eight classes of students in grades 6 to 8 were shown sex-biased collages of images. Four classes were shown pictures with a male bias, and the other four the opposite condition over 4 weeks in their science classes. Following treatment, students completed a questionnaire, a Draw-A-Scientist test, and a Q-sort of science occupations. It was shown that: (1) student background characteristics were significant predictors of Q-sort scores; (2) there were significant differences between the treatment groups; and (3) the treatment was more effective for the girls in the sample than for the boys. A questionnaire, a sample collage, and protocols for the Draw-A-Scientist Test and the Q-sort are included.

570 Bouillon, J. 1987. **Research productivity and rewards in academe: Gender and field differences.** Thesis (Ph.D.), University of California, Los Angeles. 208p.

This study examines the gender differentials in research productivity, rank, and salary within and between fields. For the analysis, only Ph.D.'s and Ed.D.'s from universities and four-year institutions were selected from a recently surveyed (1980) sample of faculty. Four field categories were identified by discriminant analysis: natural sciences (biological sciences, biochemistry, chemistry, earth sciences, and physics), social sciences (psychology, anthropology, archaeology, political science, and sociology), humanities (English language and literature, foreign language and literature, history, philosophy, and religion), and education. To determine the influence of sex on total number of published articles, total number of published books, rank, and salary, stepwise multiple regression analyses were performed separately for each field category. It was found that gender differences are statistically significant in only a few cases. Women in the social sciences publish significantly fewer books than men. Female humanists publish significantly fewer articles and books than male humanists. Women in the natural sciences hold significantly lower ranks than men. Stepwise multiple regression analyses were performed separately for each sex within the four field categories to determine which demographic, educational, professional, and institutional variables associated with research productivity, rank, and salary differed from men and women. Multi-group discriminant analysis was used to examine similarities and differences between field categories and gender. Although several studies have found gender differences to be less in the natural sciences, the results of the multiple regression analysis indicate that in fact this is not the case. Furthermore, the discriminant analysis shows that men and women are less similar with respect to the variables associated with research productivity and rewards in the natural sciences than in the social sciences and education.

571 Bruer, J.T. 1984. **Women in science: toward equitable participation.** Science, Technology and Human Values. Vol. 9, No. 3, p.3-7.

Summarizes activities of the Macy Foundation (including a symposium and a meeting) which focused on various issues related to women in science. Included are discussions of major symposium topics such as the differential in research productivity between male and female scientists as well as symposium recommendations.

572 Cole, J. and Zuckerman, H. 1987. **Marriage, motherhood, and research performance in science.** Scientific American. Vol.256, No.2, p.119-125.

The authors tested the claims made in previous studies that marriage and motherhood have no effect on women's research performance. This was done by interviewing 120 scientists, 73 women, and 47 men and assessing the dynamic relation of family life and women's research throughout their careers. The study concluded that science and womanhood do mix. Women publish less than men, but marriage and family obligations do not generally account for the gender difference. Married women with children publish as much as their single colleagues do. However, managing the simultaneous demands of research careers, marriage, and motherhood is not easy. It requires organization and an elaborate set of personal adaptations.

573 **Enhancing the research and publication productivity of faculty women at minority colleges.** 1982. Journal of Educational Equity and Leadership. Vol. 2, No. 4, p.231-237.

Describes a project designed to teach women science faculty at small, minority colleges those research skills that lead to increased publication activity and concomitant professional advancement. Discusses barriers to research and publication by women faculty members in colleges with limited science facilities and heavy teaching demands.

574 Lovett, S.L. 1968. **Personality characteristics and antecedents of vocational choice of graduate women students in science research.** Thesis (ED.D.), University of California, Berkeley. 106p.

This was an investigation of the personality traits and life history factors which characterize women who choose careers in science research. Particular attention was given to person orientation as related to nurturance, manipulation and curiosity. The Adjective Check List, Person Interest Inventory and the Identification Scale were used in combination with a questionnaire to obtain the data for the study. The questionnaire explored such areas as discipline, early social experience, intellectual stimulation, parental characteristics and behavior, and family experiences. These were examined for possible relevance to the present person orientation and occupational choice of the subject. Two groups of women were used. The first was the science group who were all graduate students indicating contentment with choice and commitment to research. The comparison group was chosen to be as opposite as possible in person orientation and consisted of graduate women students in social welfare who indicated satisfaction with their choice and a commitment to casework. All of the women completed the four instruments. The data indicated that person orientation was a consistent differentiating trait for these two groups of women with scientists consistently the more nonperson oriented. There were no differences between the groups with regard to feminine role, although there was more tendency for the science women to be more identified with their fathers. Childhood activities reflected person orientation. Greater interpersonal distance and less stress in childhood were reported by scientists, and social workers reported experiences which focused their attention on behavior and interpersonal relations. Parental discipline of science women tended to be based on rules and impersonal factors and to be consistent and predictable.

575 Markert, L.R. 1981. **Women researchers in science and technology: why so few?** Man/Society/Technology. Vol. 41, No. 1, p.12-14.

Discusses three major reasons why more women do not pursue research positions in science and technology: (1) lack of awareness of female role models; (2) social rejection in graduate schools and sexual pressures on the job; and (3) lack of technological literacy. Makes recommendations to solve these problems.

576 Mitchell, J.M. 1987. **The association of the old boy network with productivity and career satisfaction of women academicians, and antecedents to the old boy network.** Thesis (Ph.D.), University of California, Los Angeles. 119p.

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 structure of opportunity variables included marital status, having an academic spouse, doctoral university prestige, research topic visibility, having had a mentor or a post-doctoral fellowship, and time spent in research activities. 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.

577 NSF's research opportunities for women program: an assessment of the first three years. 1990. Washington, D.C., USA: National Science Foundation. 35p. (NSF report 90-13; ED 322851)

Summarizes a study of the effectiveness of the National Science Foundation's Research Opportunities for Women (ROW) program in encouraging female scientists and engineers to initiate research careers. Study findings are based on telephone interviews conducted with 657 ROW-eligible women: 255 who applied through the ROW program, 302 who applied through regular National Science Foundation (NSF) disciplinary programs, and 100 who had never applied. The program provides an alternative entry point for proposals to NSF from women seeking their first Federal research grant or from women whose research career has been interrupted for two of the previous five years. The report outlines the survey and sampling strategy and discusses results in terms of program attraction, impact of proposal decision, differences among applicant groups and non-applicants, support from non-NSF sources, proposal preparation assistance, perceptions of ROW and NSF, career development, and suggestions for improving NSF support of female scientists and engineers. The study found that the program was successful in attracting women who had not previously submitted research proposals to NSF, and that ROW principally benefits young female researchers who are substantively ready to conduct sponsored research but relatively unsophisticated about the process of obtaining a Federal grant. An appendix contains a copy of the survey form.

578 Subotnik, R.F. 1988. The motivation to experiment: a study of gifted adolescents' attitudes toward scientific research. *Journal for the Education of the Gifted*. Vol.11, No.3, p.19-35.

Questionnaires completed by 146 Westinghouse Science Talent Search winners identified curiosity as their primary research impetus. Females reported more concern with social impacts of scientific research, less variability in self-image as scientists, and a greater tendency to credit hard work and dedication, versus intelligence/creativity for success than did males.

Technical Education

579 Ahmed, I. 1987. Technology, production linkages and women's employment in South Asia. *International Labour Review*. Vol.126, No.1, p.21-40.

The author reviews the social benefits and costs of technological advancement to South Asian women. Some women have experienced improved work environments due to technology, but the poorest women have either lost their jobs and have not been trained to use the new technology, or their work has not been affected by it.

580 Ivey, E.S. 1987. Recruiting more women into science and engineering. *Issues in Science and Technology*. Vol.4, No.1, p.83-87.

Calls for increasing the number of women into science and

engineering professions, while improving the competitiveness of the United States at the same time. Suggests that more of the current statistics regarding women in these professions be publicized and programs be initiated to actively recruit more women into these careers.

581 Leach, J.D. and Roberts, S.L. 1988. A soft technology: recruiting and retaining women and minorities in high tech programs. *Community, Technical, and Junior College Journal*. Vol.59, No.2, p.34-37.

Describes a program at Washtenaw Community College, Michigan, to upgrade the basic skills of women and minority students and provide the academic support needed for success in high technology occupational training programs. Examines the following program components: academic progress, counseling, peer support, financial aid, and advocacy.

582 Leigh-Doyle, S. 1991. Increasing women's participation in technical fields: a pilot project in Africa. *International Labour Review*. Vol. 130, No. 4, p.427-444.

In 1988, the Commonwealth Association of Polytechnics in Africa (CAPA), in collaboration with the International Labour Organization (ILO), established a pilot project to address the issue of under-representation of women in technical education and training. The ILO/CAPA Women in Technical Education and Training Project (WITED) was based on 6 key strategic elements namely contact and cooperation with an international and regional network of institutions; institutional involvement in project design and implementation; a pilot action-research phase; training and awareness raising for the project staff; a policy seminar and information dissemination. Research results highlight the urgent need to increase the level of participation of women in technical education, training, and jobs as students and trainees, academic staff and managers of training institutions, and employees.

583 Lewis, D. 1990. Nightmare on your street! Coping with technological terror. *British Telecom World (UK)* Jun, p.10-12.

High-technology equipment, no matter how user-friendly, triggers either a fight or flight reaction in technophobes, people who are frightened by technology. While the fight response occasionally results in extreme violence against technology, the more common expression of hostility is through subtle acts of sabotage. The flight response is characterized by anxiety and avoidance. Women are more likely than men to be technophobic, because many think that anything technical or mechanical is beyond their comprehension. The technophobe's anxiety increases with inadequate training and insufficient practice. In addition, the more complicated a piece of equipment appears to be, the greater the incidence of technophobia. The following rules can help reduce much of the technophobe's needless fear and loathing: be patient in explaining how new technology works; do not expect the staff to grasp everything at once, tape instructions; include basic troubleshooting in the training program; and discourage negative thinking.

584 Rothschild, J. 1989. Technology and education: a feminist perspective. *American Behavioral Scientist*. Vol.32, No.6, p.708-718.

Content of courses that focus on women and technology is examined. Discusses the problems arising from the attempt to mainstream feminist scholarship on technology into the curriculum. Argues that a feminist framework is essential to achieving the dual goals of including women in the professions and improving the professions.

585 Sanders, J. and Lubetkin, R. 1989. Preparing female students for technician careers: dealing with our own elitist biases. *Peabody Journal of Education*. Vol.66, No.2, p.113-126.

Women are under-represented in professional positions in mathematics, science, engineering, and technology. Female students

need to understand that such careers do not necessarily require college, but they do require mathematics. Non-college-bound females need more information about and preparation for today's technician careers, beginning in elementary school.

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