Gender Issues in Physics/Science Education (GIPSE) – Some Annotated References * † ◊

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AACU. 2002. Association of American Colleges & Universities: "Women " online at < **http://www.aacu-edu.org/issues/women.cfm** >; especially:

a. "National Initiative for Women in Higher Education
< **http://www.campuswomenlead.org/** > and its Resources
< **http://www.campuswomenlead.org/resources.htm** > with links to:
Women's Networks, Work/Life, Leadership in a New Century,
Teaching/Learning/Research, and Campus and Community Connections.

b. Program on the Status and Education of Women (PSEW)
< **http://www.aacu-edu.org/psew/index.cfm** >.

c. Women and Scientific Literacy: Building Two-Way Streets
< **http://www.aacu-edu.org/womenscilit/index.cfm** >.

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† The reference is Mallow, J.V. & R.R. Hake**.** 2002. "Gender Issues in Physics/Science Education (GIPSE) – Some Annotated References"; online at < **http://www.luc.edu/depts/physics/mallow.html** > and < **http://www.physics.indiana.edu/~hake** >: about 300 references and 200 hot-linked URL's. A few non-gender-oriented education-reform references (preceded by asterisks *) are included because the authors believe that progress towards gender (and minority) equity in science/math requires, among other things, the general reform of K-16 science/math education for *ALL* students.

◊ This is a work-in-progress. Comments on, and suggestions for, references will be welcomed by Jeffry Mallow <jmallow@luc.edu> and Richard Hake <rrhake@earthlink.net>. All URL's were checked on 10 July 2002.

AAS. 2002. American Astronomical Society. "Committee on Status of Women in Astronomy" (CSWA) online at < **http://www.aas.org/~cswa/** >. Archives of CSWA's biannual publication *STATUS* are online at < **http://www.aas.org/~cswa/pubs.html** >. "*STATUS* consists of original and reprinted articles on topics relating to women in astronomy, in science and/or in society." A "Find" search for "*STATUS"* will disclose articles from that source in the present list.

AAUW 1992. "How Schools Shortchange Girls," American Association of University Women. Wellesley College Center for Research on Women, Wellesley, MA and AAUW Educational Foundation, Washington, DC; an executive summary is online at < **http://www.aauw.org/2000/hssg.html** >. [Also available in paperback as *How Schools Shortchange Girls: The AAUW Report: A Study of Major Findings on Girls and Education*. Marlowe & Co.] But see the dissent by psychologist Judith Kleinfeld (1998).

ACM. 2002. Committee on Women in Computing; online at < **http://www.acm.org/women**/ >.

ADA Project. 2002; online at < **http://tap.mills.edu/** >: "The Ada Project (TAP) - named in honor of Ada Lovelace - is a clearinghouse for information and resources related to women in computing. See also "Women in Science and Engineering – References by TAP"; online at **< http://www.cs.yale.edu/homes/tap/sci-women-refs.html** >.

AIP. 2002. American Institute of Physics. "Data On Women In Physics"; online at < **http://www.aip.org/statistics/trends/wmtrends.htm** >. Links to Ivie & Stowe (2000) and various other reports and websites.

Ambrose, S. A., K.L. Dunkle, B.B. Lazarus, I. Nair, & D.A. Harkus, eds. 1997. *Journeys of Women in Science and Engineering: No Universal Constants*. Temple University Press.

Anon. 1996. "Women in Physics Make Modest Gains, While Minorities Remain Level," *APS News*, June; online (for APS members) at < **http://www.aps.org/apsnews/0696/11492.html** >: "Over the last 30 years, the percentage of physics Ph.D.s awarded to women annually has risen from three percent to 12 percent, but the percentages of African-Americans and Hispanics receiving Ph.D.s has remained essentially level at 1 percent each, according to recent data collected by the American Institute of Physics (AIP). Speakers at a Wednesday afternoon session, at the March Meeting, on women and minorities in physics discussed possible reasons why the percentage for minorities in physics has remained stagnant, considered some factors for the improvement in the numbers of women, and discussed how changes in affirmative action policies might affect the numbers of women and minorities in physics."

Anon. 1996. "Fighting the Gender Gap: Standardized Tests Are Poor Indicators of Ability in Physics" *APS News*, July; online (for APS members) at < **http://www.aps.org/apsnews/0796/11538.html** >: "Women and underrepresented minorities typically score significantly lower than men on the standardized tests designed to predict performance in undergraduate and graduate physics and math courses, and are hence more likely to be disqualified during the initial admissions screening process. But according to speakers at a Friday afternoon session at the 1996 Joint APS/AAPT Meeting, standardized tests such as the SAT and GRE are in reality very poor indicators of students' success in these rigorous subject areas. . . . according to Pamela Zappardino, a professional psychologist and executive director of FairTest, a Cambridge, Massachusetts organization that focuses solely on assessment reform . . . *'At best, the SAT only accounts for about 16 percent of the in first-year college grades. That isn't a great predictor, by anybody's yardstick*.'. . . An April 1995 study at the University of California, Berkeley, found that women with identical academic indexes to men obtained higher grade point averages in every major on campus, including math and physical sciences." (Our *italics*.) For criticism of the SAT and GRE see, respectively Atkinson (2001) and Georgi (2000b). Georgi offers extensive anecdotal evidence of the disconnect between physics-research ability and GRE scores, based on his experience as physics-department chair and graduate admissions committee member.

Anon. 2002. "International Conference Grapples with Issues of Women in Physics" *APS News*, May; online (for APS members) at < **http://www.aps.org/apsnews/0502/050203.html** > : "Concern over the low number of women in physics worldwide was one of the underlying themes at a groundbreaking international conference on women in physics, held 7-9 March in Paris, France, and organized by the International Union of Pure and Applied Physics (IUPAP). More than 300 delegates - about 15% male, and another 15% or more women in their early careers- in 65 national teams gathered to discuss such issues as attracting more girls into physics, balancing family and career, and getting more women into the physics leadership structure." [See also the reports on this conference in *Physics Today* by Feder (2002) and in *Science* by Tobias et al. (2002).]

Anon. 2002. "Women Physicists Explore Survival Skills at March Meeting," *APS News*, May; online (for APS members) at < **http://www.aps.org/apsnews/0502/050202.html** >: "Looking around at a physics conference like the March Meeting, it is not difficult to see that there are not many women attendees. Indeed, it has been no secret that women are severely under-represented in physics. To address this issue, the Committee on the Status of Women in Physics (CSWP), for the first time, hosted a special workshop on the Survival Skills for Successful Women Physicists in conjunction with the March Meeting."

APS News Archives. 2002. Online (for APS members) at < **http://www.aps.org/apsnews/archives.html** >. A "Find" search for "*APS News"* will disclose articles from that source in the present list.

APS. 2002. American Physical Society. "Committee on Status of Women in Physics," online at < **http://www.aps.org/educ/cswp/** >: "The Committee on the Status of Women in Physics (CSWP) was founded in 1972 to address the encouragement and career development of women physicists. The Committee consists of nine volunteer members appointed by the President of the APS. Throughout its 30 year history, the CSWP has sponsored a number of studies, programs and publications. Brief descriptions of these programs are included. " See especially links to:

> *Workshop on Survival Skills for Women Physicists*
> CSWP hosted a workshop on "Survival Skills for Successful Women Physicists" at the APS' March 2002 Meeting. The program and handouts from several of the presenters can be found at < **www.aps.org/educ/cswp/skills.html** >. A similar workshop is planned for the April 2003 meeting.
>
> *CSWP Events at APS Meetings*
> At the March and April Meeting of the APS, CSWP organizes invited sessions during which women physicists present technical talks. In addition, CSWP co-sponsors receptions with the Committee on the Minorities in Physics (COM) which are an excellent opportunity to meet, greet and network. The events are open to all with an interest in women in physics.
>
> *Colloquium Speakers List of Women in Physics:*
> This publication, available online and in hard copy, lists the names and talk titles of 320 women, indexed by field and state.
>
> *The Gazette*: This publication is the official newsletter of the CSWP. Items featured in the Gazette include updates on CSWP activities and programs, book reviews, statistical reports, and articles on programs designed to increase the participation of women and girls in science. Now available in PDF format!
>
> *WIPHYS (Women in Physics) Listserver:* Over 750 subscribers from around the world exchange advice, network, and discuss issues of interest to women in physics on WIPHYS.

Astin, H.S. & L. Sax. 1994. "College Women In Science: Personal And Environmental Influences On The Development Of Scientific Talent"; abstract online at < **http://www.gseis.ucla.edu/heri/heri.html** >: "By the time women come to college, their interest in science is well below that of men's. Among all college freshmen in 1994, eighteen percent of men and only four percent of women reported that they would major in physical science, mathematics or engineering (Astin, Korn, Sax, & Mahoney, 1994)."

Astronomy Program. 2002. Univ. of Alabama, Dept. of Physics and Astronomy, *Four Thousand Years of Women in Science*; online at < **http://www.astr.ua.edu/4000WS/4000WS.html** >: "4,000 years of women in science! Did you know that? Women are, and always have been, scientists. This site lists over 125 names from our scientific and technical past. They are all women! This site grew out of the public talks given by Dr. Sethanne Howard. . . (2000). . . currently with the National Science Foundation. As we learn more, we add it to this page. We hope you will share what you know with us. This includes inventors, scholars and writers as well as mathematicians and astronomers. We hope you enjoy learning about some of these women."

*Atkinson, R.C. 2001. "Achievement Versus Aptitude in College Admissions: Students should be selected on the basis of their demonstrated success in learning, not some ill-defined notion of aptitude," *Issues in Science and Technology Online*, Winter: < **http://bob.nap.edu/issues/18.2/atkinson.html** >: "Fortunately, today we do have an analysis of the SAT's value in admissions decisions. Because our students have been taking the SAT I . . . (an "aptitude" test). . . and the SAT II . . . (an "achievement" test). . . for more than three decades, UC is perhaps the only university in the country that has a database large enough to compare the predictive power of the SAT I with that of the achievement-based SAT II tests. UC researchers Saul Geiser and Roger Studley have analyzed the records of almost 78,000 freshmen who entered UC over the past four years. They concluded that the SAT II is, in fact, a better predictor of college grades than the SAT I. The UC data show that high school grades plus the SAT II account for about 21 percent of the explained variance in first-year college grades. When the SAT I is added to high school grades and the SAT II, the explained variance increases from 21 percent to 21.1 percent, a trivial increment."

Auchincloss, P. 1998. "Physics and Feminism," *APS News*, May; online (for APS members) at < **http://www.aps.org/apsnews/0598/059815.html** > : ". . . These feminist studies of science . . . . (by Evelyn Fox Keller, Helen Longino, and Donna Haraway). . . do not describe a different science - certainly not a 'feminine science' - but they shift the emphasis so that we see the importance, even necessity, of diversity among scientists. Moreover, they improve on more traditional accounts of science by explaining both its achievements and its lapses. As part of a strategy for increasing the proportion of women in science, feminist studies raise issues of women and science as intellectual questions within the academy, rather than pushing them to the margins of institutional life. *And feminist studies undoubtedly challenge our underlying assumptions about the making of men, women, and science.* Thus, feminist studies of science may hold a key to the success of efforts to attract and retain women in physics, to create gender equitable environments in physics departments, *and to reform physics education*. Bringing together physics and feminism - allowing physics to become more feminist - has potential to bring about positive change in the culture of physics and realize a truly diverse physics community." (Our *italics*.) (See the responses by Kilty et al. 1998).

AWIS. 2002. Association for Women in Science; online at < **http://www.awis.org/** > : ". . . dedicated to achieving equity and full participation for women in science, mathematics, engineering and technology. . . . AWIS has over 5,000 members in fields spanning the life and physical sciences, mathematics, social science, and engineering. Over 50% of AWIS members have doctorates in their respective fields, and hold positions at all levels of industry, academia, and government." See especially:

a. *AWIS Magazine* < **http://www.awis.org/magazine.html** >. A "Find" search for "*AWIS"* will disclose articles from that source in the present list.

b. AWIS Publication Descriptions < **http://www.awis.org/publications.html** >.

c. Book Reviews < **http://www.awis.org/book_reviews.html** >.

d. References on women and minorities in science, as well as career resources < **http://www.awis.org/chatcourse.html** >.

e. Mentoring < **http://www.awis.org/mentoring.html** >.

AWM. 2002. Association for Women in Mathematics; online at
< **http://www.awm-math.org/** >. See especially:

a. Newsletter < **http://www.awm-math.org/newsletter.html** >.

b. Education Resources < **http://www.awm-math.org/education.html** >.

c. Bibliography < **http://www.awm-math.org/bibliography.html** >.

d. Mentor Network < **http://www.awm-math.org/mentornetwork.html** >.

Baartmans, B. G. & S. A. Sorby. 1996. *Introduction to 3-D Spatial Visualization* (and accompanying Teacher's Resource Manual). Prentice Hall. On average, males usually score about two standard deviations above females on spatial visualization tests (Pallrand & Seeber 1984, Linn & Peterson 1985, Lord 1987, Howe & Doody 1989, Friedman 1995). This difference is often attributed to cultural factors. Supporting this assumption, Baartmans & Sorby showed that women engineers at Michigan Technological University could perform as well as men on spatial visualization tests if brought up to speed by a one-quarter (6 hr/week) visualization course based on this text. See also Sorby & and B. G. Baartmans (1996 a,b).

Baartmans, B. G. and S. A. Sorby. 1996. "Making Connections: Spatial Skills and Engineering Drawings," *The Mathematics Teacher* **89**(4): 348-357.

Bailey, S.M. 2002. *The Jossey Bass Reader in Gender in Education*. Jossey Bass.

Bailey, M.J. 1998. *American Women In Science: 1950 To The Present: A Biographical Dictionary.* ABC-CLIO.

Barr, J., & L.I. Birke. 1998. *Common Science?: Women, Science And Knowledge, Race, Gender, and Science.* Indiana University Press.

Baxter Magolda, M. B. 1992. *Knowing and reasoning in college: Gender related patterns in students' intellectual development*. Jossey-Bass.

Baxter Magolda, M. B. 1994. "Post-College Experiences and Epistemology," *Review of Higher Education* **18**(1): 25-44.

Baxter Magolda, M. B. 1996. "Epistemological Development in Graduate and Professional Education," *Review of Higher Education* **19**(3): 283-304.

Baxter Magolda, M. B. 1992. *Knowing and reasoning in college: Gender related patterns in students' intellectual development*. Jossey-Bass.

Baxter Magolda, M. B. 1994. "Post-College Experiences and Epistemology," *Review of Higher Education*, **18**(1): 25-44.

Baxter Magolda, M. B. 1996. "Epistemological Development in Graduate and Professional Education," *Review of Higher Education* **19**(3): 283-304.

Baxter Magolda, M. B. 1999. *Creating Contexts for Learning and Self-Authorship: Constructive-Developmental Pedagogy*. Vanderbilt University Press. According to < **http:www.vanderbilt.edu/vupress/baxterm.htm** > : "By observing four semester-length college courses in mathematics, zoology, human development, and education and intensively interviewing students and their instructors, Baxter Magolda provides much-needed, concrete principles that will lead to valuable improvements in the classroom environment." See also the perceptive review by Nelson (2000a).

Baxter Magolda, M. B., ed. 2000. *Teaching to Promote Intellectual and Personal Maturity: Incorporating Students' Worldviews and Identities into the Learning Process*. Jossey-Bass.

Baxter Magolda, M. B. 2001. *Making Their Own Way: Narratives for Transforming Higher Education to Promote Self-Development*. Stylus Publishing.

Baxter Magolda, M. B. & W. Porterfield. 1982 & 1985. "Measure of Epistemological Reflection (MER)" For information see < **http://isu.indstate.edu/wbarratt/dragon/ix/sa-mer.htm** >: "The purpose of . . .MER. . . is to determine a student's level of intellectual development (using the Perry scheme of cognitive development)."

Belenky, M.F., B.M. Clinchy, N.R. Goldberger, J.M. Tarule. 1986. *Women's Ways of Knowing: The development of self, voice, and mind.* Basic Books.

Beyer, K. 1991. "Gender, science anxiety and learning style," *GASAT 6*.**

Beyer, K., S. Blegaa, and M. Vedelsby. 1985. "Sex-roles and physics education," *GASAT 3*.**

Beyer, K. and J. Reich. 1987. "Why are many girls inhibited from learning scientific concepts in physics?" *GASAT 4* . **

Billard, L. 1991. "The Past, Present, and Future of Academic Women in the Mathematical Sciences," *Notices of the American Mathematical Society* **38**(7); 707-714; online at < **http://www.awm-math.org/articles/notices/199107/billard/** >.

Bisgaard, S., L.V. Brillhart, A.B. Burgess, J.H. Cramer, D.D. Denton, J.D. Downer, S.L. Dunwoody, A.B. Ellis, P.W. Hewson, W.G. Secada, & S.Tobias. 1995 . "College Level One: Articulation, Equity, and Literacy Issues. The Report of a Workshop Organized by the College Level One Team." Online as a pdf at < **http://www.wcer.wisc.edu/nise/Publications/** >.

Here and below, "GASAT" stands for "Gender And Science And Technology." GASAT is an international association of those concerned about interactions between gender and science and technology. There have been ten GASAT international conferences: #1: 1981, Eindhoven, Netherlands; #2: 1983, Oslo, Norway; #3: 1985, London, UK; #4: 1987, Ann Arbor, USA; #5: 1989, Haifa, Israel; #6: 1991, Melbourne, Australia; #7: 1993. Waterloo, Canada; #8: 1996, Ahmedabad, India [some *GASAT 8* papers are available at < **http://www.wigsat.org/gasat/ >]; #9: 1999, Accra, Ghana; #10: 2001, Copenhagen, Denmark.

For information see the GASAT websites in:
(a) U.K. < **http://www.gasat.org.uk/internat.htm** >: "Contributions to, and Proceedings of, GASAT Conferences *provide the single most important source of information on research and intervention in the field of Gender and Science and Technology*" (our *italics*), and
(b) Canada < **http://www.gasat-canada.org/** >: "GASAT made vital contributions towards the inclusion of science and technology in the Platform of Action during the 4th UN Conference on Women (Beijing, 1995 < **http://www.igc.org/beijing/beijing.html** >) and is an active member of the Once and Future Action Network" (OFAN < **http://www.igc.org/beijing/ngo/ofan.html** >).

GASAT proceedings volumes are sometimes distributed to conference attendees, but – unfortunately – do not appear to be generally available in libraries or on the web (*GASAT 8 is an exception*). For an excellent report on the Ghana (1999) meeting see Jacob (1999). According to the *GASAT 10* organizers, there is a possibility that *GASAT 10* Proceedings may be placed on the web. We thank Karin Beyer, Mary Anderson-Rowland, Kirsten Grønbaek Hansen, Jan Harding, Shantha Jacob, and Hilary Lips for providing information on GASAT.

Brown University. 2002. "Achieving Gender Equity in Science Classrooms: A Guide for Faculty," online at <**http://www.brown.edu/Administration/Dean_of_the_College/homepginfo/equity/Equity_handbook.html** >: "Compiled by Women Science Students and Science Faculty and Staff at NECUSE Colleges (New England Consortium for Undergraduate Science Education) and Based Upon Initial Work by Students at Brown University."

Brown University. 2002. "Women in Science, Mathematics, and Engineering" online at <**http://www.brown.edu/Administration/Dean_of_the_College/homepginfo/equity/women.html**>.

Bleier, R. 1988. *Feminist Approaches to Science.* Pergamon Press.

Browne, N. ed. 1991. *Science and Technology in the Early Years: An Equal Opportunities Approach.* Open University Press.

Brush, S. G. 1991. "Women in Science and Engineering," *American Scientist* **79**: 404-419.

Buna, D. 2001. "Women in Physics: Trends in Recent Decades," *AWIS Magazine*, Spring; online at < **http://www.awis.org/magazine.html** >.

Burbidge, M. 2000. "Glass Ceilings and Ivory Towers" *STATUS*, January; online in pdf form at < **http://www.aas.org/~cswa/pubs.html** >: "I will close by endorsing Meg Urry's. . . .(1999). . . . list of 'ten things you can do' . . . . Number 9 on this list — 'Listen' — reminds us that the concerns of young women today are not what they were 10 years ago, much less 40 years ago. Women can apply for observing time on any telescopes that are available to their male colleagues, and I believe their applications are considered only on scientific merit. *But fair treatment in the job market, in the committee structure of academic institutions where appointments and promotions are dealt with, is another matter, and this must be addressed by all of us*." (Our *italics*.)

Butler, C. 2002. "Reaching for the Stars – Interviews with Women Astronauts: Sally Ride," *AWIS Magazine*, Spring; online at < **http://www.awis.org/magazine.html** >. (See Ride 2002.)

Byers, N. and Colleagues. 2002. "Contributions of 20th Century Women to Physics"; online at < **http://www.physics.ucla.edu/%7Ecwp/** >: "Presented here is an archive of data on 86 twentieth century women who have made original and important contributions to physics. The citations describe and document their major contributions and provide biographical information pertaining to the scientific lives of the women. The archive is limited to citations of 20th century women whose contributions to physics were published before 1976.   A cutoff was necessary owing to limited R&D resources. The number of women publishing original and important contributions to physics since then is rapidly increasing, and is much larger than it was in earlier times."

Canizares, C. R. 1999. "Commentary," *STATUS,* June; online in pdf form at < **http://www.aas.org/~cswa/pubs.html** >**:** "To paraphrase Mark Twain, recent reports of the death of discrimination have been greatly exaggerated. These accounts accompany a pernicious surge in legal and political challenges to affirmative action programs, based in part on the premise that such efforts are no longer needed. It is true that significant progress has been made in swelling the ranks of both women and minorities in some areas where they have been previously underrepresented, from Cabinet offices to Boardrooms to the tenured ranks of research universities. The fact that people bother attacking affirmative action programs is itself a sign that, whatever their shortcomings, they have had effect . . . .Where should we be in terms of the representation of women in astronomy? *I strongly believe the only conceivable answer is that women, and indeed all segments of society, should be represented roughly in proportion to their representation in the population at large*." (Our *italics*.) [Canizares is the Bruno Rossi Professor of Experimental Physics and Director of the Center for Space Research at MIT.]

Chiarelott, L. and C. Czerniak. 1985. "Science anxiety among elementary school students: an equity issue," *J. Educ. Equity and Leadership* **5**: 291-308.

Chiarelott, L. and C. Czerniak. 1987. "Science anxiety: Implications for science curriculum and teaching," *The Clearing House* **60**: 202-205.

Chipman, S. F., D.H. Krantz, and R. Silver. 1992. "Mathematics anxiety and science careers among able college women.," *Psych. Science* **3**: 292-295.

Chipman, S. F., L.R. Brush, D.M. Wilson. 1985. *Women and Mathematics: Balancing the Equation.* Lawrence Erlbaum.

Cole, J.R. (1987 – first printing 1979). *Fair science: Women in the scientific community*. New York: Columbia University Press. For a review see White (1982). [Sociologist Jonathan Cole < **http://www.columbia.edu/cu/provost/docs/jrcpage.html** >, Provost and Dean of Faculties at Columbia University, has had – along with his brother Stephen - a long interest in the social organization of science.]

Cole, J.R. 1993. "Balancing Acts: Dilemmas of Choice Facing Research Universities." *Daedalus* **122**(4); online at < **http://www.columbia.edu/cu/provost/docs/dilemmas.html** >. (From an issue entitled "The American Research University."): "One of these. . .(dilemmas). . is represented by a significant attack on the prevailing organizational axioms, or presuppositions, on which research universities have been built. A second is represented by a fundamental challenge to what John Searle calls "the Western Rationalistic Tradition" in his essay in this volume of *Daedalus.* This attack is leveled against the presuppositions of rationality, of objectivity, of truth, of 'there being a there out there,' among other basic epistemological and metaphysical presuppositions that have guided discourse throughout most of Western history, and certainly since the seventeenth century. These challenges to the university's organizational principles and to its philosophical presuppositions are interrelated. They involve conflicting views of the basic principles and what is required to prove that one or another organizational principle is right or wrong."

Cole, J.R. 1996. "The Two Cultures Revisited," *The Bridge* (National Academy of Engineering) **26**(3-4): 16-21; online at < **http://www.nae.edu/nae/naehome.nsf/weblinks/NAEW-4NHMJT?opendocument** >.

Cole, J.R. & S. Cole. 1973. *Social Stratification in Science*. University of Chicago Press.

Cole, J.R. & H. Zuckerman. 1987. "Marriage, Motherhood, and Research Performance in Science," *Scientific American* **255**(2): 119-125. Also in (a) *The Sociology of the Sciences*, Vol. I, Brookfield: Elgar Publ., pp. 254-267; (b) Zuckerman et al. (1991).

Cole, S. & R. Fiorentine. 1991. "Discrimination Against Women in Science: The Confusion of Outcome with Process," in Zuckerman et al. (1991).

Cole, J.R. & B. Singer. 1991. "A Theory of Limited Differences: Explaining the Productivity Puzzle in Science" in Zuckerman et al. (1991). See also Finn (1995).

*Colwell, R. 1998. AAAS Science Policy Seminar Series, 16 September; online at < **http://www.nsf.gov/od/lpa/forum/colwell/rc80916.htm** > "Furthermore, we cannot expect the task of science and math education to be the sole responsibility of *K* through 12 teachers while scientists and graduate students live only in their universities and laboratories. *There is no group of people who should feel more responsible for science and math education in this nation than our scientists and scientists-to-be*. In fact, I would say that America's continuing leadership will depend more on the caliber of its human resource than on any other resource. It will not be enough to have a top layer of scientific elite, and another of mediocrity below. And the situation is really worsened by widespread public science illiteracy." (Our *italics*.)
Rita Colwell < **http://www.nsf.gov/od/lpa/forum/colwell/rrcbio.htm** > is the current director of the National Science Foundation and former President of the University of Maryland Biotechnology Institute.

Colwell, R. 2000. Preface to Wasserman (2000); online at < **http://www.nap.edu/catalog/6375.html** >, pp. ix-xii: "Intelligence is not linked to the Y chromosome; to exclude half the population from scientific inquiry is to deny us, as a nation, an extraordinary amount of ability and intelligence. . . .The cost of excluding any group has simply become to high. Why are women underrepresented in science today? I wish there were a single reason because then the problem could be easily targeted and changed. But the answer is not simple. *In part, it lies in what I call the 'valley of death' in education, when girls grades 4 through 8 are, in subtle and not so subtle ways, discouraged from pursuing science and engineering. Not only is the invitation not extended, but even those with a natural bent toward science are too often directed elsewhere.* Add to this the dearth of role models (at least ones they might have been told about) and a lack of mentors, and it no surprise that these girls pass science by. . . . Now, having achieved success, I look back and realize that I was indeed climbing a steep hill and that someone was constantly rolling boulders into my path. *Our task today is to prevent someone from rolling those same boulders into the path of young women who seek to make their contribution to the world of science*. . . .The stories of many of the women profiled in "The Door in the Dream" parallel my personal trek. All have the mental toughness to passionately pursue interests they love and to persevere in the face of obstacles. Eventually, like myself, they have reaped the rewards of being underdeterred and true to themselves." (Our *italics*.)

Colwell, R. 2001. Keynote Address to the Association for Women in Science 30th Anniversary Leadership Conference Washington, D.C., 19 October; online at < **http://www.nsf.gov/od/lpa/forum/colwell/rc011019awisconf.htm** > ". . . one of the most tenacious problems that we still confront is that 'all' . . . (of the science and engineering community). . . does not include a very high percentage of women and minorities. . . . Far too many girls and women fail to even cross the threshold into science and engineering. We know that obstacles and cultural conditioning begin to appear very early in life. In a study of young children reported in the book *Athena Unbound*. . . (Etzkowitz et al. 2000). . . . a four-year-old boy told researchers that '...only boys should make science.' . . . The National Assessment of Educational Progress shows a gender gap in science proficiency as early as age 9. The gap widens further through ages 13 and to age 17. There has been little change in this trend over two decades. It is interesting that between ages 25 and 34, the typical American female is more educated than her male counterpart. Women now earn more than half of all college degrees, and over half of those are in the life sciences. Well over 40% of math and chemistry bachelor's degrees also go to females. But some developments are deeply disturbing. For example, the percentage of women receiving bachelor's degrees in computer science has been dropping since the mid-1980s. We see a downward trend for both men and women--but it's been more precipitous for women. If we take a closer look at doctorates earned in the United States by women, we see a divergence among the disciplines. Women now earn around 40% of all doctorates. However, this differs greatly by field. In the life sciences, women earn over 40% of doctorates. *But in the physical sciences and mathematics, women earn fewer than 20%. In engineering, they receive a little over 10% of PhDs*. . . .(See NSF 2002d). . . But, our problem is larger than the institutions of higher learning. In more than 400 job categories in our economy, women are found predominately in only 20 categories. Women comprise less than a quarter of the total science and engineering labor force. The S&E workforce looks very exclusive. This is dangerous for the nation. We need the talent of every worker in order to compete and prosper. NSF has taken several steps to reverse this trend. We are, in essence, sealing the pipeline from beginning to end. We have programs targeting girls starting in their preschool days. We fund research to develop computer software and games that encourage interactions in science, math, and engineering. *With our new flagship program, ADVANCE*. . . . (< **http://www.nsf.gov/pubsys/ods/getpub.cfm?nsf02121** >) . . . , *we'll award more than 40 million dollars this year to spark system-wide changes that foster a more positive climate for women to pursue academic careers*. NSF support for women researchers has tripled over the past decade to approach 500 million dollars. (Our *italics*.)

Cross, K.P. & M.H. Steadman, 1996. "Classroom Research: Implementing the Scholarship of Teaching." See the index sections on "gender differences."

*Crouch, C.H. & E. Mazur. 2001. "Peer instruction: Ten years of experience and results,'' *Am. J. Phys.* **69**: 970–977; online at < **http://mazur-www.harvard.edu/library/librarymenu.html** >. The abstract reads in part: "We report data from ten years of teaching with Peer Instruction (PI) in the calculus- and algebra-based introductory physics courses for nonmajors; our results indicate increased student mastery of both conceptual reasoning and quantitative problem solving upon implementing PI."

Crouch, C.H. , L.E. McCullough, E. Mazur, and D. MacIsaac. 2001. "Gender, Educational Reform, and Instructional Assessment: Part II, *AAPT Announcer* **31**(4): 113 ; online at < **http://physics.uwstout.edu/staff/mccullough/physicseduc.htm** > (scroll to the bottom of the page).

Curtin, J.M.. G. Blake, & C. Cassagnau. 1997. "The Climate for Women Graduate Students in Physics," *Journal of Women and Minorities in Science and Engineering* **3** (1&2).

Davis, C.S. , A. B. Ginorio, C. S. Hollenshead, B. B. Lazarus, P. M. Raymond & Associates, eds. 1996. *The Equity Equation: Fostering the Advancement of Women in the Sciences, Mathematics and Engineering*. Jossey-Bass. For a list contributions see < **http://www.enc.org/resources/records/full/0,1240,017148,00.shtm** >.

D'Iorio. M., J. McKenna, A. McMillan, & E. Svensson. 2002. "The Canadian Challenge: Attracting and Retaining Women in Physics." Online poster at < **http://www.physics.utoronto.ca/~peet/deptwebp/gic/iupap-poster.pdf** >.

Dresselhaus, M.S., J.R. Franz, & B.C. Clark. 1994. "Interventions to increase the participation of women in physics," *Science* **263**: 1392-1393. The first two women are listed in Byers & Colleagues (2002) above.

Dresselhaus, M.S. 2000. "Strategies and policies to recruit, retain and advance women scientists. In NAP (2000), pp. 55-56.

Drew, D.E. 1996. *Aptitude Revisited: Rethinking Math and Science Education for America's Next Century.* Johns Hopkins University Press. For a review by George Campbell, Jr. see *Issues in Science and Technology Online,* Spring 1997 at < **http://bob.nap.edu/issues/13.3/campbe.htm** >. "An important thread spanning *Aptitude Revisited* is the limited access to mathematics and science education among traditionally underrepresented groups. 'Women, poor people and disadvantaged minority students consistently are discouraged from studying science and mathematics, the very subjects that would give them access to power, influence and wealth.' "

Education Development Center. 2002. < **http://www.edc.org/** >:
a. "Gender Equity in Math and Science: Learning Online" online at < **http://www.edc.org/GDI/gems/gemabout.htm** >,
b. Gender & Diversity Institute < **http://www.edc.org/GDI/** >,
c. The Gender and Science Digital Library < **http://www.edc.org/GDI/GSDL/index.htm** >.

Eisenhart, M.A. & E. Finkel. 1998. *Women's Science: Learning and Succeeding from the Margins.* University of Chicago Press.

*Elmore, R.F. 1997. "The Politics of Education Reform," *Issues in Science and Technology Online*, Fall: < **http://bob.nap.edu/issues/14.1/elmore.htm** >.

Erickson, G. L. and L. J. Erickson. 1984. "Females and science achievement: Evidence, explanations, and implications." *Science Educ.* **68**: 63-89.

Etkina, E., K. Gibbons, B. L. Holton, G. K. Horton. 1999. "Lessons learned: A case study of an integrated way of teaching introductory physics to at-risk students at Rutgers University," *Am. J. Phys.* 67(9): 810-818. The abstract reads: In order to provide a physics instructional environment in which at-risk students (*particularly women and minorities*) can successfully learn and enjoy introductory physics, we have introduced "Extended General Physics" as an option for science, science teaching, and pre-health professions majors at Rutgers University. We have taught the course for the last five years. In this new course, we have used many elements that have been proven to be successful in physics instruction. We have added a new component, the minilab, stressing qualitative experiments performed by the students. By integrating all the elements, and structuring the time the students invest in the course, we have created a successful program for students-at-risk, *indeed for all students*. Our aim was not only to foster successful mastery of the traditional physics syllabus by the students, but to create a sense of community through the cooperation of students with each other and their instructors. We present a template for implementation of our program elsewhere. (Our *italics*.)

Etzkowitz, H., C. Kemelgor, & B. Uzzi. 2000. *Athena Unbound: The Advancement of Women in Science and Technology*. Cambridge University Press.

Feder, T. 2002. "Women, and Some Men, Ask Why Women Don't Flock to Physics," *Physics Today* 55(5): 24; online at < **http://www.aip.org/pt/vol-55/iss-5/p24.html** >. A report on the International Union of Pure and Applied Physics (IUPAP)-sponsored international conference on women in physics held 7 to 9 March 2002 in Paris < **http://www.if.ufrgs.br/~barbosa/conference.html** > . [See also the reports on this conference in *Science* by Tobias et al. (2002) and in *APS News* by Anon (2002).]

Fennema, E. & G.C. Leder. 1990. *Mathematics and Gender.* Teachers College Press.

Finn, R. 1995. "Deficit vs Difference." *The Scientist* **9**(22), 13 November; online at < **http://www.the-scientist.com/yr1995/nov/gender_951113.html** > : "A recently released study from Harvard University examining the careers of scientists who showed high promise as postdocs has found persistent gender differences in career outcomes. The study, called Project Access . . . (Holton & Sonnert 1993). . . reveals clear evidence of a glass ceiling for women in certain fields, notes differences in publication patterns, and elucidates the way that family-related issues-such as raising children and living in a two-scientist household-disproportionately affect women. . . . Project Access is the first of three major studies of gender disparities in science expected to be released over the next few months. A longitudinal study of a matched sample of 92,904 scientists and engineers who received Ph.D.'s between 1973 and 1989 is under review at the National Research Council (NRC), and is expected to be issued by the end of the year. And Mary Frank Fox, a professor of sociology at the Georgia Institute of Technology in Atlanta, will present the results of her survey of 5,400 doctoral candidates and faculty members at the annual meeting of the American Association for the Advancement of Science in February. . .(see Fox (1995-2002) . . . . Sonnert and Holton examine the effects of luck in scientific career paths with reference to a 'kick-reaction model' . . . .(Cole & Singer 1991). . . 'A kick is any event in the environment that has a potential effect on the individual's career, be it positive or negative,' write Sonnert and Holton. 'Likewise, the individual's reaction to a kick can be positive or negative. Over the course of a career, the pattern of kicks and reactions changes.' Notes Sonnert, 'Negative or positive kicks can be subtle. Several women told stories about how some important decisions are made at a very informal level, maybe not even in the office, but after hours in a bar. And these were things they might not get invited to or might not feel comfortable with. So they would miss out on potential good kicks-that is, being involved in the decision-making.' "

Fitzpatrick, S.M. 1999. "The Protégé to Peer Transition," *AWIS Magazine*, Volume 28(3); online at < **http://www.jsmf.org/zarticles&pap/susan/prot%E9g%E9_to_peer_transition.htm** >. Susan Fitzpatrick is Vice President of the James S. McDonnell Foundation < **http://www.jsmf.org/** >.

*Ford, K.W. 1987. “Guest Editorial: Whatever Happened to *Curriculum S*?” *Phys. Teach.*, March, pp. 138-139: From the ….. second Ann Arbor Conference, November 1962 - came a succinct and memorable recommendation: that two kinds of curricula for physics majors be developed (to meet the needs of two kinds of students). These were named curriculum R and curriculum S. Curriculum R (for Research) was the then-current (and still dominant) undergraduate curriculum, whose principal aim is to prepare students for graduate study. *Curriculum S (for Synthesis) was to serve students who wanted to study physics as background for something other than physics research: business, law, medicine, teaching, some other scientific study, or just informed citizenship.* What has happened? Sad to say, nothing. Curriculum R was already strong and is still strong. *Curriculum S did not exist then and it does not exist now* (in first approximation). . . . *It is time to look again at Curriculum S* . . . . We need majors with aspirations other than physics research. Ours is an exciting field, a central part of the liberal arts. It provides a useful background for many activities. Should we not promote its serious study by future teachers, lawyers, and business people? Above all, *we need a physics major program suitable for (and attractive to) some of the teachers of the next generation - not just high-school physics teachers, but elementary and middle school teachers as well.*” (Our *italics*.) (See also Jossem 1964, Hake 2000b, Lindenfeld 2001.)

Fox, M.F. 1991. "Gender, Environmental Milieu, and Productivity in Science," in Zuckerman et al. (1991).

Fox, M.F. 1995. "Women and Scientific Careers," in S. Jasanoff et al., ed., *Handbook of Science and Technology Studies.* Sage. pp. 205-223.

Fox, M.F. 1996. "Women, Academia, and Careers in Science and Engineering," in C.S. Davis et. al. (1996).

Fox, M.F. 1998. "Women in Science and Engineering: Theory, Practice and Policy Programs." *Signs* 42(1): 201-223.

Fox, M.F. 1999. "Gender, Hierarchy, and Science." In *Handbook of the Sociology of Gender*, J. S. Chafetz, ed. pp. 441-457. Kluwer Academic/Plenum Publishers.

Fox, M.F. 2000. "Organizational Environments and Doctoral Degrees Awarded to Women in Science and Engineering Departments," *Women's Studies Quarterly* **28** (Spring/summer): 47-61.

Fox, M.F. 2001. "Women, Science, and Academia: Graduate Education and Careers." *Gender & Society* **15** (October): 654-666.

Fox, M.F. & P. Stephan. 2001. "Careers of Young Scientists: Preferences, Prospects, and Realities by Gender and Field." *Social Studies of Science* **31** (February): 109-122.

Fox, M.F. 2002. "Gender, Faculty, and Doctoral Education in Science and Engineering." In *Equal Rites, Unequal Outcomes: Women in American Research Universities*, L. Hornig, ed. Kluwer Academic/Plenum.

Franz, J.R. 1995. "Improving the Climate for Women in Physics," APS & AAPT Department Chairs Conference, May, online at < **http://www.aps.org/jobs/dcc/climate.html** >.

Friedman K. 1989. "Mathematics and the gender gap: A meta-analysis of recent studies of sex differences in mathematical tasks," *Review of Educational Research* **59**: 185-213.

Friedman, L. 1995. "The space factor in mathematics: gender differences," *Review of Educational Research* **65**(1): 22-50.

*Fuller, R., S. Agruso, J.V. Mallow, D. Nichols, R. Sapp, A. Strassenburg, G. Allen. 1985. "Developing Student Confidence in Physics," Workshop manual, Amer. Assoc. of Physics Teachers, College Park, Maryland.

*Gardiner, L. 1998. "Why We Must Change," *NEA Higher Education Journal* **71**: 121-138; online as a pdf at < **http://www.nea.org/he/heta98/s98pg71.pdf** >: "Most faculty work long and hard. We care about educating our students. Thanks to our efforts, many of them experience deep personal transformation during their college years. However, *when we subject the quality of our collective work as educators to the same close examination we demand in our disciplines, we find a substantial body of evidence that clearly demonstrates a crisis of educational quality in our nation's colleges and universities*." (Our *italics*.)

*Gardiner, L. 1996. *Redesigning Higher Education: Producing Dramatic Gains in Student Learning*. John Wiley.

Glazer, J.S., E. M. Bensimon, & B. K. Townsend. Eds. 1993. *Women in Higher Education: A Feminist Perspective.* ASHE Reader. Ginn Press [Simon & Schuster].

Gebbie, K. 1996. "Why Encourage Women To Enter Physics?" *APS News*, July; online at **< http://www.aps.org/apsnews/0796/11552.html** >; Gebbie was the 1996 chair of the APS Committee on the Status of Women in Physics (CSWP) – see APS (2002): "Why encourage women to make careers in physics? Is it fair to them? Will they not simply swell the numbers of unemployed and underemployed physicists?

J. Robert Schrieffer, APS President, gave the following answer to these questions:

> *"...We believe that our goal of advancing and diffusing the knowledge of physics is best served if the profession draws upon the widest possible spectrum of talented individuals. We are therefore committed to removing barriers that limit the participation of women in physics and to making available to women the same range of career choices traditionally open to men. Women have the right, the need and the talent to compete for these opportunities..."*

Howard Georgi of Harvard stated:

> *"If science is to thrive, we must make it our goal to achieve a scientifically literate society, a population that understands and values the contributions that science can make to our national well-being. Women are half that population. Only when women see that women are participating fully in the scientific endeavor-as researchers in the laboratory, as scientific leaders, and as policy makers-will they feel equal partners in a technological society."*

Sheila Tobias (1994,) wrote:

> *"No one should be encouraged to 'go into' physics. You should pursue a career in physics when you are called to it - when your love for the beauty of this way of looking at the world makes other choices impossible. It is not supposed to be easy. Except for a few extraordinary times in history, it hasn't been. But everyone should be encouraged to explore physics, to learn about it, and to have the chance to learn to love it. The wrong that the CSWP tries to set right is that at every level of our educational and professional structure, there are obstacles that make it more difficult for women than for men to have this opportunity. If we can remove these barriers, then more women will be called to physics careers. Indeed, this may make it more difficult for everyone who is called. At the same time, however, I believe that new opportunities for careers in physics will open up. This is a critical time for the future of science in the United States."*

Gelernter, D. 2000. "Women and Science at Yale," *STATUS*, January; online in pdf form at < **http://www.aas.org/~cswa/pubs.**html >: "Affirmative action seems to be entering a new phase: As the public turns against it, universities are growing increasingly desperate in their support. *I teach at Yale, where the administration has made it clear that (in particular) it wants more female professors in technology and the hard sciences*. Other universities have the same goal; they have longed for women scientists for years, but their longing seems to have entered a new phase of grim determination.. . .the Yale administration is doing the academic world no favor by joining the crowd that has gathered to poke and prod this particular hornets' nest. The approaching hornet swarm is bad news for universities and society in general. Whether or not you approve of affirmative action, it's clear that certain of its goals can be achieved and others can't. If you are determined, say, to increase the proportion of Hispanics in your undergraduate population, you can probably do it; Hispanic applicants are available. *If your goal is a large increase in female science and engineering professors, you can't do it, because the candidates are not available."* (Our *italics*.) For pro-affirmative-action views see Harvard high-energy theorist Howard Georgi (2000b), MIT space-research physicist Claude Canizares (1999), and the "Baltimore Charter" as discussed by Meg Urry (1999).

George, Y.S. , D.S. Neale, V. Van Horne, and S.M. Malcom. 2001. *In Pursuit of a Diverse Science, Technology, Engineering ,and Mathematics Workforce: Recommended Research Priorities to Enhance Participation by Underrepresented Minorities*. American Association for the Advancement of Science. Online as a pdf (3.6 MB) at < **http://ehrweb.aaas.org/** >.

Georgi, H. 2000a. "Is There an Unconscious Discrimination Against Women in Science*?" APS News*, January; online (for APS members) at < **http://www.aps.org/apsnews/0100/010016.html** > (excerpted from Gorgi (2000b) : "Our selection procedures tend to select not only for talents that are directly relevant to success in science, but also for *assertiveness* and *single-mindedness*. This causes a problem for women (and others as well). There are probably other gender-linked traits that we also select for, but I will focus on these two because I think they are particularly obvious and damaging." (Our *italics*.)

Georgi, H. 2000b. "A tentative theory of unconscious discrimination against women in science." In NAP (2000), pp. 45-48.

Georgi, H. 2000c. "Views From an Affirmative Activist." *STATUS*, January; online in pdf form at < **http://www.aas.org/~cswa/pubs.html** > : "Affirmative action seems to have become a divisive issue. I think that this is sad, because I believe that there are situations in which it should not be controversial, if properly understood. I feel strongly that affirmative action to encourage women in science continues to be important, and today I want to explain why. In my view, there are two basic and related issues — evaluation and climate. I firmly believe that improvements in these areas will be good for everyone, not just women."

Google. 2002. Google's search engine at < **http://www.google.com/** > yields the following numbers of hits (*without* the quotes): 715,000 for "women physics"; 248,000 for "gender physics"; 255,000 for "female physics". In addition, Google yields the following numbers of hits (*with* the quotes): 434,000 for "Women's Studies"; 24,400 for "Women's Resource Center".

Gould, P. 1997. "Women and the culture of university physics in late nineteenth-century Cambridge," *British Journal for the History of Science* **30**: 127-150.

Gould, P. 2002. "Portraits of Science: Two Good Women, or Too Good to Be True?" *Science* **296**(7): 1805-1806. Online at < **http://www.sciencemag.org/feature/data/150essay.shl** >.

Grinstein, L.S., R. K. Rose, M.H. Rafailovich, eds. 1993. *Women in Chemistry and Physics: A Biobibliographic Sourcebook.* Greenwood Press.

*Hake, R.R. 1998. "Interactive-engagement vs traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses," *Am. J. Phys.* **66**: 64-74; online at < **http://www.physics.indiana.edu/~sdi/** > : " . . . the conceptual and problem-solving test results strongly suggest that the classroom use of Interactive Engagement methods can increase mechanics-course effectiveness well beyond that obtained in traditional practice."

*Hake, R.R. 1999. "REsearch, Development, and Change in Undergraduate Biology Education (REDCUBE): A Web Guide for Non-Biologists" at < **http://www.physics.indiana.edu/~redcube** >. Gives a point of entry into the vast literature and web resources relevant to research, development, and change in undergraduate biology education. Contains 47 biology-educator profiles; 446 references (including 124 relevant to general science-education reform); and 490 hot-linked URL's on

(a) Biology Associations,
(b) Biology Teacher's Web Sites,
(c) Scientific Societies and Projects (not confined to Biology),
(d) Higher Education,
(e) Cognitive Science and Psychology,
(f) U.S. Government, and
(g) Searches and Directories.

The references and URL's may be generally useful to teachers and education researchers, and may provide some ideas for hastening education reform.

*Hake, R.R. 2000a. "What Can We Learn from the Physics Education Reform Effort?", online at < **http://www.physics.indiana.edu/~hake** > as a pdf document, and at < **http://hitchcock.dlt.asu.edu/media2/cresmet/hake/** > as PowerPoint plus video. The latter slide 7 indicates the reaction of the sensitive and intelligent Sylvia Plath to her physics class: "The day I went into physics class was death. . ."

*Hake, R.R. 2000b. "Is it Finally Time to Implement Curriculum S?" *AAPT Announcer* **30**(4), 103; online as ref. 13 at < **http://www.physics.indiana.edu/~hake** >. (See also Jossem 1964, Ford 1987, Lindenfeld 2001.) A large number of references relevant to the reform of K-16 education is given on pages 55-99.

*Hake, R.R. 2000c. "Using the Web to Promote Interdisciplinary Synergy in Undergraduate Education Reform," *AAPT Announcer* **30**(4), 120 (2000). Soon to be on the web at < **http://www.physics.indiana.edu/~hake/** >.

*Hake, R.R. 2002a. "Lessons from the physics education reform effort." *Conservation Ecology* **5**(2): 28; online at < **http://www.consecol.org/vol5/iss2/art28** >. See especially the section "Are There Important 'Hidden Variables'" [for references see the article]: "Hake (1995), Henderson et al. (1999), McCullough (2000), Galileo Project (2001), and Meltzer (2001) have reported gender differences [<g>males > <g>females] in <g>'s. . . . (normalized gains for the Force Concept Inventory). . . for some classes. Hake calculated a gender-difference effect size 0.58 for IU95S [see Hake (2002a]. Meltzer calculated gender-difference effect sizes of 0.44 and 0.59 for two classes [N = 59, 78] at Iowa State University, but observed no significant gender difference in two other classes [N = 45, 37] at Southeastern Louisiana University. . . . *the <g> dependence on the gender 'hidden variable' is small relative to the very strong dependence of <g> on the degree of interactive engagement (effect size 2.43)*. . . " Therefore, in our opinion, efforts to move traditional instruction more towards the interactive engagement for ALL students should receive a higher priority than concern for the apparently relatively small gender differences in test results as discussed by McCullough (2001a, 2002), McCullough & Meltzer (2001), and Crouch & McCullough (2001).

*Hake, R.R. 2002b. "Assessment of Student Learning in Introductory Science Courses". PKAL Roundtable on the Future: *Assessment in the Service of Student Learning*, March 2002; updated on 6/1/02; online at < **http://www.pkal.org/events/roundtable2002/papers.html** >. (PKAL = Project Kaleidoscope < **http://www.pkal.org/** >.)

*Hake, R.R. 2002c. "Whence Do We Get the Teachers? (Response to Madison)". PKAL Roundtable on the Future: *Assessment in the Service of Student Learning*, Duke University, March 1-3; updated on 6/17/02; online at < **http://www.pkal.org/events/roundtable2002/papers.html** >.

*Hake, R.R. 2002d. "Physics First: Precursor to Science/Math Literacy for All?" to appear in the Summer 2002 issue of the American Physical Society's *Forum on Education Newsletter* < **http://www.aps.org/units/fed/index.html** > / "Forum newsletters" where "/" means "click on." Also online as ref. 19 at < **http://www.physics.indiana.edu/~hake** >. For a more complete illustrated version see Hake (2002e).

*Hake, R.R. 2002e. "Physics First: Opening Battle in the War on Science/Math Illiteracy?"; Submitted to the *American Journal of Physics* on 26 June 2002. Online as ref. 20 at < **http://www.physics.indiana.edu/~hake** >.

Hanna, G., ed. 1996. *Towards Gender Equity in Mathematics Education: An ICMI Study*. Kluwer; for information see < **http://www.wkap.nl/prod/b/0-7923-3922-3** >; ICMI = International Commission on Mathematics Instruction.

Harding, S. 1986. *The Science Question in Feminism.* Cornell University Press. [For comments on Harding's standpoints see Holton (1993), Koertge (1998), and Newton (1997)].

Harding, S. 1992. "Why Physics Is a Bad Model of Physics,"in R.Q. Elvee, ed., *The End of Science? Attack and Defense.* University Press of America. (See comments by Holton 1993.)

Hassan, F. 2001. "Islamic Women in Science," *Science* **290**: 55-56, 6 October.

Hedges, L. V. and A. Nowell. 1995. "Sex differences in mental test scores, variability, and numbers of high-scoring individuals, " *Science* **269**: 41-45.

Hollenshead, C., P. Soellner-Younce, & S. A. Wenzel. 1994. "Women Graduate Students in Mathematics and Physics: Reflections Upon Success," *Journal of Women and Minorities in Science and Engineering* **1**(1).

*Holt, R. 2001. "Science Education is Not Just for Scientists" *APS News*, June: online (for APS members) at < **http://www.aps.org/apsnews/0601/060117.html** >: Our country must devote attention to the quantity, quality, and professional work environment of our teachers. There are two very important, although often neglected, principles that are critical to the success in this effort: *Everyone can learn science. And excellent teaching can be learned.* In the next ten years, we will have to hire 2.2 million teachers just to stay even with the attrition of our teaching force. Most of these teachers, including all elementary school teachers, will be called on to teach science. Many will feel inadequate to teach it. . . . Congresswoman Connie Morella and I have taken the Glenn Commission's recommendations and introduced legislation that seeks to make these changes. The National Improvement in Mathematics and Science Teaching Act (H.R. 117) would establish a new Title in the Elementary and Secondary Education Act to improve the quality of our math and science education." (Our *italics*.)

Holton. G. 1993. *Science and Anti-Science* (Harvard University Press, 1993); especially Chapter 6: "The Anti-Science Phenomenon": "A fourth group. . .(who oppose what they conceive of as a hegemony of science-as-done-today in our culture). . .is a radical wing of the movement represented by such writers as Sandra Harding who claims that physics today 'is a poor model [even] for physics itself' (Harding 1992). For her science now has the fatal flaw of 'androcentrism'; that, together with faith in the progressiveness of scientific rationality, as brought us to the point where, she writes: "a more radical intellectual, moral, social, and political revolution [is called for] than the founders of modern Western cultures could have imagined' (Harding 1986). One of her like-minded colleagues goes even further, into the fantasy that science is the projection of Oedipal obsessions with such notions as force, energy, power, or conflict."

Holton, G. 1999. "Different Perceptions of 'Good Science' and Their Effects on Careers," in *Women in Science and Engineering: Choices for Success*, edited by C.C. Selby, *Annals of the New York Academy of Sciences*, volume 869, pg. 79.

*Holton, G. 2001. "What is the Imperative for Basic Science that Serves National Needs?" *APS Forum on Physics & Society Newsletter*, Spring; online at < **http://www.aps.org/units/fps/apr01/ap1.html** >: "Among the familiar research styles are two modes of basic research, well established and utterly needed to be adequately supported in the total range of efforts. One mode. . .(the 'Newtonian'. . .) is primarily curiosity-driven basic research, without the expectation of any but perhaps long-term social benefits, apart from the important one of increasing of scientific understanding itself. The other mode. . .(the 'Baconian') . . . is that part of R&D pursued in the reasonable hope that a fairly early harvest would result, for use and practice beyond the originating laboratory. . . Both must of course continue to flourish, not least because all modes interact. But research in the *Jeffersonian mode*, by contrast, places itself on an uncharted area on the map of science, which, if the expedition succeeds, *may reasonably soon have a bearing on a persistent national or global problem.* It is in a sense a combined mode, and the label I chose for it reflects the fact that Thomas Jefferson himself saw two intertwined goals for science--not only the full understanding of nature, which he treasured, but in addition what he called simply 'the freedom and happiness of mankind.' *It is not difficult to imagine intentionally targeted basic science research projects where, with less uncertainty and less time delay than from Newtonian research, one can reasonably hope to find a key to alleviate specific, well recognized societal dysfunctions.* For example, much remains to be done in . . . . *research on the remaining social and psychological obstacles that still stand in the way of greater participation and diversity, not least in careers in science and technology*. (Our *italics*.) An earlier and more complete version of this paper appears as the "The Lewis Branscomb Lecture" of 2000 at < **http://www.ksg.harvard.edu/iip/lmb/holton.htm** >.

Holton, G. & G. Sonnert. 1993. "Project Access, 1987-1990"; online at < **http://www.radcliffe.edu/murray/data/ds/doc0994.htm#summary** >: "This study explored two alternative models for the later careers of successful women scientists: the 'glass ceiling' and the 'threshold.' Specifically, Holton asked whether distinguished women scientists, having overcome gender-specific barriers during training, continued to face such obstacles (indicating a 'glass ceiling') or reached a 'threshold' after which their careers proceeded without such barriers. The sample consisted of 804 scientists, including 295 women, all of whom were former Bunting Fellows, National Research Council Associates, or National Science Foundation Postdoctoral Fellows. This sub sample of women represents a significant portion of elite female scientists in the country." [See also Sonnert 1995, 1995-96, 1999; Sonnert et al. 1995; Finn 1995; Fox 1995-2002]

Hornig, L. 1987. "Gender and science." *GASAT 4*. ** (See footnote on page 9.) This paper, which challenged the then nascent claims from some feminists that science was intrinsically inappropriate for women, and that is why they avoided it, has been rarely cited: "…although it is true that the concentration of women in most science fields is below one-third, compared to about one-half in the humanities, the numbers of women scientists far exceed those of women humanists. Thus, among the total current stock of Ph.D.s in this country, there are about 63,000 women scientists and about 27,000 women humanists, or a ratio of 2.33. The ratio of new women Ph.D.s in sciences to those in humanities in 1985 stood at 3.44, so that the disparity is growing just as it has among men. The fields regarded as least congenial to women –physical and mathematical sciences --produced over 900 doctorates in 1985, contrasted with about 630 in the so-called traditional fields of English and other modern languages…. more women have been Nobel laureates in the sciences than in either literature or peace endeavors…. When we compare women to men, determining the relative proportions of each sex in various activities, we see great inequalities. When we compare women in one field to those in another, determining how they distribute themselves among the choices open to them, we discover two things: the patterns of choice resemble those of men, and the disadvantages women face are essentially invariant across fields. In short, women face some discrimination in all careers because they are women, not because they are unsuited to science or science to them."

Howard, S. 2000. "Science Has No Gender," *STATUS*, January; online in pdf form at < **http://www.aas.org/~cswa/pubs.html** >: "For over 4,000 years the historical record has, now and then, included scientists, engineers, and natural philosophers. For over 4,000 years there have been women in that list just as there have been men. Who would have thought it? It’s true. Science is as traditional a role for women as it has been for men. . .. The people who can combine the sensible chunks into useful solutions are scientists and engineers. Scientists do tend to share certain attributes: luck, intelligence, education, ability, courage, and sweat. There is no gender lurking in these features. None. THE RESULTS OF SCIENCE HAVE NO GENDER. . . .With the help of Dr. Deborah Crocker at the University of Alabama we created a web page . . . (Astronomy Program. 2002). . . with all the details." (EMPHASIS in the original.)

Howe, A.C. and W. Doody. 1989. "Spatial visualization and sex-related differences in science achievement. " *Science Educ.* **73**: 703-709.

Huang, A.S. 2002. "Things Your Professor Should Have Told You," *STATUS*, January 2002; online in pdf form at < **http://www.aas.org/~cswa/pubs.html** >. From the forward by Catherine Pilachowski & Anneila Sargent: ". . .Alice Huang, former Dean of Science and Professor of Biology at New York University, and now Faculty Associate in Biology at Caltech, discusses strategies that can be effective in the professional arena. Most importantly, these are not confined to advice on coping with the workplace but describe how women who have achieved a degree of success in their careers can make enormous contributions to improving conditions for those who follow."

Huang, G., N. Taddese, & E. Wa l t e r. 2000. *Entry and persistence of women and minorities in college science and engineering education* (NCES Publication No. 2000-601). U.S. Department of Education. Office of Educational Research and Improvement.

ICWES 12. 2002. *Women in a Knowledge-Based Society*, July 27- 31, 2002, 12th International Conference of Women Engineers and Scientists hosted by the University of Ottawa and Carleton University at the Ottawa Congress Centre, in Ottawa, Ontario, Canada. Announcement online at < **http://www.carleton.ca/cwse-on/icwes12/index.htm** >. We thank Professor Hilary Lips for bringing this reference to our attention.

Institute for Women and Technology. 2002. Online at < **http://www.iwt.org/contactus.html** >: "The Institute for Women and Technology was founded in 1997 by Dr. Anita Borg and is led by Executive Director, Dr. Sara B. Hart. The Institute's mission is to increase the impact of women on all aspects of technology and to increase the positive impact of technology on the lives of the world's women. The Institute helps communities, industry, education and government benefit from these increases. The Institute accomplishes this mission through four specific programs: The Grace Hopper Celebration of Women in Computing conference, The Sisters online community, The Senior Women's Summit, and the Virtual Development Center (VDC)."

Institute of Physics (British). 2002. "Women in Physics Group Home Page," online at < **http://www.iop.org/IOP/Groups/WP/** >.

Ivie, R. & K. Stowe. 2000. American Institute of Physics publication #R-430. "Women in Physics 2000"; online at < **http://www.aip.org/statistics/trends/wmtrends.htm** > as a pdf < **http://www.aip.org/statistics/trends/reports/wominphys.pdf** >: "Although women now earn more than one half of all bachelor's degrees in the U.S., physics is not attracting women as quickly as other fields, including life sciences, chemistry, and engineering . . . Compared to other fields, women are sorely underrepresented in physics at both the bachelor's and PhD levels . . . . . Observers have offered various explanations for women's poor representation in physics. Many of the explanations do not hold up in light of available data. It is possible that women still experience subtle discrimination leading them away from physics and that women choose careers that are less clearly linked to physics."

Jacob. S. 1999. "Report of Gender and Science and Technology Association Conference (*GASAT 9* – Accra, Ghana),"** June; see the GASAT footnote on page 9); online at < **http://www.nt.gov.au/wac/sjacob-report-genderscienceconf.doc** >.

Johnson, S., P. Murphy, R. Driver, J. Head, and D. Palacio. 1983. "The science performance of boys and girls aged 11-15," *GASAT 2*. ** (See footnote on page 9.)

Johnson, S. and P. Murphy. 1984. "The underachievement of girls in physics: towards explanations," *Eur. J. of Science. Educ.* **6**: 401-411.

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Jones, M. G. and J. Wheatley. 1990. "Gender differences in teacher-student interactions in science classrooms." *J. Res. Science Teaching* **27**: 861-874.

*Jossem, E.L. 1964 "Undergraduate Curricula in Physics: A Report on the Princeton Conference on Curriculum S," *Am. J. Phys*. **32**(6): 491–497. (See also Ford 1987, Hake 2000b, Lindenfeld 2001.)

Journal of Women and Minorities in Science and Engineering. 2002. Online at < **http://www.cis.vt.edu/sage/journal/** >. Lists Table of Contents for volumes 1(1994) – 6(2000).

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Kahle, J.B. 1988b. "Recruitment and Retention of Women in College Science Majors." *Journal of College Science Teaching*. March/April: 382-384.

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Kass-Simon, G. & P. Farnes, eds. 1990. *Women Of Science: Righting The Record*. Indiana University Press.

Keller, E.F. 1985. *Reflections on Gender and Science*. Yale University Press. For counters to Keller see, e.g., Newton (1997), pages 27 and 209; and the index entries for "Keller" in Koertge (1998).

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Kelly, A., ed. 1981. *The Missing Half: Girls and Science Education*. Manchester U. Press.

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Keys, W. and M.B. Ormerod. 1976. "A comparison of the pattern of science subject choices for boys and girls in light of pupils' own expressed subject preferences," *School Science Review* **58**: 348-350.

Kilty, K. T., K. Allen, D. Pushkin, C. Barker, E. Finkel. 1998. "Reader Responses to 'Physics and Feminism,' " May 1998 by Priscilla Auchincloss," *APS News*, July. [See Auchincloss 1998.] Respondent Crystal Barker writes: "Physics, more feminist? Physics does not need to be more anything - except appreciated. It certainly does not need to be more feminist. Yes, I have encountered bias from males in physics, as well as the occasional derogatory remark or tasteless comment. But one should be careful not to confuse the science with the scientist. Auchincloss tells us that the group provides 'criticism or approval, and the paradigm to allow integration of the various parts of the puzzle.' So now objectivity is a paradigm, and not a primary assumption? Is she trying to explicate the scientific method and concomitant practice of peer-review? If so, she's done a poor job. Couching it in the language of feminist rhetoric lessens the impact of the power of reproducibility. Reproducibility means that when I make an observation, you can make the same observation independently, whether you like me or not, agree with my lifestyle, philosophy, or gender. This is where science derives its power and beauty. There is nothing exclusionary or oppressive here. *I think Auchincloss' energies would be better spent improving the overall quality of physics education.* This way, when an argument is lost due to lack of knowledge, no one need cry 'sex discrimination' or worse, 'old boy network.' " (Our *italics*.)

Kleinfeld, J. 1998. "The Myth That Schools Shortchange Girls: Social Science in the Service of Deception," prepared for "The Women's Freedom Network"; online at < **http://www.uaf.edu/northern/schools/myth.html** >. (See AAUW 1991.) Kleinfeld < **http://www.uaf.edu/northern/program/faculty/klnfld.html** > is professor of psychology at the University of Alaska Fairbanks, with publications on gender issues, the education of culturally diverse children, and the education of children with fetal alcohol syndrome. In 1993, she won the Emil Usibelli Award for Distinguished Research.

Koertge, N. ed. 1998. *A House Built on Sand: Exposing Postmodern Myths About Science*. Oxford University Press. (For anti-postmodernist comment on the work of Ruth Bleier, Sandra Harding, Evelyn Fox Keller, Helen Longino, and Londa Schiebinger see the corresponding index headings.)

Kulis, S., D. Sicotte, S. Collins. 2002. "More than a Pipeline Problem: Labor Supply Constraints and Gender Stratification Across Academic Science Disciplines," *Research in Higher Education* **43**(6); online at < **http://www.public.asu.edu/~atssk/ssk_rhe02b.html** > **.**

Laws, P., P. Rosborough, & F. Poodry. 1999. "Women's responses to an activity-based physics program," *Phys. Educ. Res. Suppl., Am. J. Phys.* **67**(7): S32-S37: "What have we learned from our Workshop Physics experience about the potential for activity-based constructivist science courses to attract more women to the study of science? We don't seem to detect a significant gender gap in attitudes toward the study of science between men and women who take physics as underclassmen. If the negative attitude of upper-class women is related primarily to socialization in other science and mathematics courses, we can close the gender gap for all women. To do this we should expose women to many courses that encourage reasoning and direct observations early in their schooling and in their college careers. *We must take steps to promote educational reform at all levels and in all subject areas, especially science and mathematics, so that students understand how vital and empowering the process of constructing scientific knowledge can be*. (Our *italics*.)

*Lederman, L.M. 1999. "A science way of thinking." *Education Week*, 16 June; 1999 < **http://www.edweek.org/ew/1999/40leder.h18** >: *Our reform thrust, in military metaphor, is toward a weak section of the barriers to change that surround the school system***s**. We have observed that 99 percent of our high schools teach biology in 9th (or 10th) grade, chemistry in 10th or 11th grade, and, for survivors, physics in 11th or 12th grade. This is alphabetically correct, but by any logical scientific or pedagogical criteria, the wrong order. A standards-based science curriculum must contain at least three years of science and three years of mathematics. And the coherent order begins with 9th grade physics**,** *taught conceptually* and exercising only the math of 8th and 9th grade; then chemistry, building on the knowledge of atomic structure to study molecules; then the crowning glory of modern, molecular-based biology_ . . . . We stress that this is a design for ***all*** students . . . (*even including young women*!). . . , work bound, liberal arts-college-bound, or science-and-technology-bound. The schools that are "doing it right" report greatly expanded enrollments in fourth-year electives and Advanced Placement science courses**.** *Thus, a solid, core curriculum will enlarge rather than* . . . (diminish the pool of). . . *future scientists*. (Our *italics*.) (See also Hake 2002d,e.)

Lederman, L.M. 2000. "A Plan, A Strategy for K-12," in NRC (2000), pp. 7- 11: "We hear that after the new sequence is installed, increases take place in fourth-year science electives, enrollment in AP science courses zooms up, college successes are recorded, and then, here is the funny thing, *there is a dramatic effect on women and minority students from poor families who come into high school without a strong positive science and math experie*nce. Many of these. . .(new sequence). . .schools tell us things like 'AP physics how has 53% women.' I remember AP physics as having one, two, or no women. What is going on?"

Lee, O. 1998. "Current Conceptions of Science Achievement in Major Reform Documents and Implications for Equity and Assessment." Online as a pdf at < **http://www.wcer.wisc.edu/nise/Publications/** "Research Monographs">.

*Lindenfeld, P. 2001. "We can do better: A Report on Some Teaching Innovations," Forum on Physics and Society Newsletter, July; online at < **http://www.aps.org/units/fps/jul01/701art1.html** > : "At Rutgers University we are trying to address several of the major problem areas: the declining number of physics majors, the dissatisfaction with the introductory courses, the barrier that physics courses represent for students who are not well prepared, the often marginal support system that we provide for our students, and the neglect of these problems by many members of the faculty. We have the normal physics major curriculum with standard courses and provision for honors projects. It provides excellent preparation for graduate school. *If this 'professional' major were our only one, we would have of the order of* ***ten*** *graduates per year, as is true for comparable institutions*. Some decades ago we added the 'general' major, with a less demanding curriculum, based on the premise that we can provide substantive science-based education to students who do not intend to pursue a research career in physics. . . .[Compare Jossem (1964), Ford (1987), and Hake (2000b) on "Curriculum S"]. . . This . . . (the 'general major,' two new full year post-introductory courses, a 5-year program in conjunction with the College of Engineering, and an applied physics major). . . *puts us in the rarified range of* ***45*** *graduating seniors this year* . . . . Our efforts have to continue, for the sake of the students, and for our own. We can do better!" (Our *italics*.) See also Etkina et al. (1999).

*Lindenfeld, P. 2002. "Guest Comment: Format and content in introductory physics," *Am. J. Phys.* **70**(1): 12-13.

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Long, J.S., ed. 2001. *From Scarcity to Visibility: Gender Differences in the Careers of Doctoral Scientists and Engineers.* National Academy Press; online at < **http://www.nap.edu/catalog/5363.html** >: "Although women have made important inroads in science and engineering since the early 1970s, their progress in these fields has stalled over the past several years. This study looks at women in science and engineering careers in the 1970s and 1980s, documenting differences in career outcomes between men and women and between women of different races and ethnic backgrounds."

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*Lopez, R.E. & T. Schultz. 2001. "Two Revolutions in K-8 Science Education." *Physics Today* **54**(9): 44-49; online at < **http://physicstoday.org/pt/vol-54/iss-9/p44.html** >.

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Macklis, R.M. 2002. "Scientist, Technologist, Proto-Feminist, Superstar," *Science* **295**: 1647-1648, 1 March: "With the possible exception of Albert Einstein, Marie Curie was the most famous scientist of her era and is almost certainly the most celebrated female scientist in history. . . . She was one of the exceedingly rare Nobel laureates to win the prize twice (physics and chemistry). Her life will forever reflect dogged determination, unswerving devotion to work, political tenacity, and an optimistic belief in scientific positivism. *On a more personal note, she unfortunately has also come to symbolize a cautionary tale concerning the difficulties encountered when a woman enters and succeeds dramatically and publicly in a sphere traditionally dominated by men.* " (Our *italics*.)

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Mallow, J.V. 1994. "Gender-related Science Anxiety: A First Binational Study." *Journal of Science Education and Technology* **3**(4): 227-238.

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Markowitz, D. 2000. "My Opinion - Others May Differ: Who Wears Pythagoras' Trousers?" *APS News*, March; online (for APS members) at
< **http://www.aps.org/apsnews/0300/030008.html** > : The book is *Pythagoras' Trousers*: *God, Physics, and the Gender Wars*. . . . (Werthheim 1997). . . The title reminds us that Pythagoras and his followers combined natural and supernatural studies. They originated the idea God is a mathematician, an idea that still has currency. The author covers much of the history of Western science, religion, and society, and she does so with a deft hand. Her main points are that women have been deliberately excluded from the highest callings of the mind, encompassing both science and religion, and that the persistence of this situation bodes ill for science, for society, and for women. In the introductory chapter Wertheim zooms in on the most egregious religion and the most offending science by saying: 'Physics is thus the Catholic Church of science'. . . .' A good deal of Wertheim's argument is that male physics and female physics are different, and, being different, it would be beneficial to have both. It is a yin/yang kind of thing. But is it so?"

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McCullough, L. 2001c. "Women in Science"; online at < **http://physics.uwstout.edu/staff/mccullough/womensci.htm** >.

McCullough, L. 2002. "Women in Physics: A Review." *Phys. Teach.* **40**(2): 86-91: "The widely used *Force Concept Inventory* mentions rockets, hockey pucks, and cannon balls, contexts with which men are typically more comfortable than women. These male oriented contexts may be negatively affecting women's scores . . . Researchers studying the theoretical underpinnings of the nature of science itself [Keller 1985, Bleier 1988, Schiebinger 1999] suggest that *the very nature of science itself and the scientific method is inherently masculine*, which can serve as a barrier to women." (Our *italics*.) For counters to Keller (1985) see, e.g., Newton (1997), pages 27 and 209; and the index entries for "Keller" in Koertge (1998). For counters to Schiebinger (1999) see e.g., index entries for "Schiebinger" in Koertge (1998).

McCullough, L.E. & C.H. Crouch. 2001. "Gender, Educational Reform, and Instructional Assessment: Part I," *AAPT Announcer* **31**(4): 113 ; online at < **http://physics.uwstout.edu/staff/mccullough/physicseduc.htm** > (scroll to the bottom of the page).

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McGrayne, S.B. 2001. *Nobel Prize Women in Science: Their Lives, Struggles, and Momentous Discoveries*, Second Edition. Joseph Henry Press. Online at < **http://www.nap.edu/books/0309072700/html/** >.

*Meltzer, D.E. & K. Manivannan. 2002. "Transforming the lecture-hall environment: The fully interactive physics lecture, " *Am. J. Phys*. **70**(6): 639-654. The abstract reads, in part : ". . .We report on seven years of development and testing of a variant of Peer Instruction as pioneered by Mazur that aims at achieving virtually continuous instructor – student interaction through a 'fully interactive' physics lecture. . . . We also discuss a variety of assessment data that indicate strong gains in student learning, consistent with other researchers. We conclude that interactive-lecture methods in physics instruction are practical, effective, and amenable to widespread implementation."

Mentor Net. 2002. "The E-Mentoring Network for Women in Engineering and Science"; online at < **http://www.mentornet.net/** >.

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Merton, R.K. 1973. "The Sociology of Science: Theoretical and Empirical Investigations," Univ. of Chicago Press. See especially pp. 439-459 on the "Matthew Effect in Science."

Merton, R.K. 1988. "The Matthew Effect in Science, II: Cumulative advantage and the symbolism of intellectual property" *ISIS* **79**: 606-623. Online in pdf form at < **http://www.garfield.library.upenn.edu/merton/list.html** >.

Merton, R.K. 1995."The Thomas Theorem and The Matthew Effect" *Social Forces* **74**(2): 379-424. Online in pdf form at < **http://www.garfield.library.upenn.edu/merton/list.html** >.

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1. EDITORIAL "Physics needs women" at < **http://physicsweb.org/article/world/15/3/1** >

2. RELATED LINKS:
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    < **http://www.if.ufrgs.br/~barbosa/conference.html** >
    b. IOP Women in Physics group
    < **http://www.iop.org/IOP/Groups/WP/** >
    c. Women in Science, Engineering and Technology (SET) in the UK
    < **http://www.set4women.gov.uk/** >

3. RELATED STORIES
    a. Turning women into leaders < **http://physicsweb.org/article/world/15/3/2** >
    b. Mixing motherhood and science < **http://physicsweb.org/article/world/15/3/3** >
    c. Liberté, égalité and fraternité
    < **http://physicsweb.org/article/world/15/3/8** >
    d. Learning lessons from the classroom
    < **http://physicsweb.org/article/world/15/3/9** >
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a. The MIT Report and Responses
b. National Reports and Data on Women in Science and Engineering
c. Reports and Data From Other Universities
d. Women Scientists and Engineers in the Academy (annotated)
e. Work and Family (annotated)
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c. "Women and Science Program" < **http://www.uwosh.edu/programs/wis/** >;
d. "The History Of Women And Science, Health, And Technology: A Bibliographic Guide To The Professions And The Disciplines" < **http://www.library.wisc.edu/libraries/WomensStudies/bibliogs/hws/hws.htm** >.

Urry, M. 1999. "The Baltimore Charter and the Status of Women in Astronomy," *STATUS*, June; online in pdf form at < **http://www.aas.org/~cswa/pubs.html** >: "The purpose of the Baltimore Charter was to suggest concrete action (not just griping) to improve the status of women in astronomy. It represents the consensus of many views, with input from a significant fraction of the active astronomical community. . . . . It was released in June 1993 at the semi annual meeting of the American Astronomical Society, receiving a lot of attention from the national press and popular science publications. In subsequent months the Baltimore Charter and/or its goals were endorsed by the AAS, NASA, NSF, AURA, and several prominent universities. . . . . The Charter states five basic premises and briefly justifies them . . . A key assertion is that positive action is required to change the status quo, hence the five major recommendations of the Charter. *The most important of these, and the most controversial, is the statement that "Affirmative action is a necessary part of the solution.* . . . . The Charter ends with a call to action, to all our colleagues, to facilitate the full participation of women. . . . There was no mass movement to endorse the Baltimore Charter or to implement its recommendations widely, although it appears to have helped some individual women, especially those isolated in small departments."

Urry, M. 2000. "The Status of Women in Astronomy," *STATUS*, June; online in pdf form at < **http://www.aas.org/~cswa/pubs.html** >.

Urry, M. 2001. "Criticism and Defense of the MIT Report." *STATUS*, June; online in pdf form at < **http://www.aas.org/~cswa/pubs.html** >: "MIT's . . . . (MIT 1999). . . . admission two years ago that it had unintentionally discriminated against women was unprecedented. . . . Then came the follow-up meeting at MIT, attended by university presidents, chancellors, provosts, and 25 women faculty, representing top research universities. They met January 29, 2001 to discuss equitable treatment of women faculty in science and engineering. The statement issued by the leaders of the nine universities . . .Cal Tech, MIT, Michigan, Princeton, Stanford, Yale, Berkeley, Harvard, Pennsylvania . . . recognized that barriers to women still exist and promised to work for full and equal participation by women faculty in their institutions." [See also MIT (1999) and Wilson (1999.]

Urry, M. & L. Frattare. 1999. "The status of *STATUS*. *STATUS*, January; online in pdf form at < **http://www.aas.org/~cswa/pubs.html** >: "This issue marks our debut as editors of *STATUS*."

Valian, V. 1999. *Why so Slow?* MIT Press. A synopsis, evidently by Valian herself, appears at < **http://maxweber.hunter.cuny.edu/psych/faculty/valian/valian.htm** >: "Why do so few women occupy positions of power and prestige? This book uses concepts and data from psychology, sociology, economics, and biology to explain the disparity in the professional advancement of men and women. The claim is that men and women alike have implicit hypotheses about gender differences - *gender schemas* - that create small sex differences in characteristics, behaviors, perceptions, and evaluations of men and women. Those small imbalances accumulate to advantage men and disadvantage women. *The most important consequence of gender schemas for professional life is that men tend to be overrated and women underrated.* Although most men and women in the professions sincerely hold egalitarian beliefs, those beliefs alone cannot guarantee impartial evaluation and treatment of others. Only by understanding how our perceptions are skewed by gender schemas can we begin to perceive ourselves and others accurately. The goal in *Why So Slow?* is to make the invisible factors that retard women's progress visible so that fair treatment of men and women will be possible. *The book makes its case with experimental and observational data from laboratory and field studies of children and adults, and with statistical documentation on men and women in the professions*. The many anecdotal examples throughout provide a lively counterpoint." (Our *italics*.) According to *MIT World* at < **http://web.mit.edu/mitworld/content/engineering/valian.html** > : "Virginia Valian is Professor of Psychology and Linguistics at Hunter College and the Graduate Center of the City University of New York (CUNY). She is a cognitive scientist whose research focuses on language acquisition in two-year-olds, second language acquisition, and sex differences in cognition."

Valian, V. 1999. "Sex, Schemas, and Success: What's Keeping Women Back?" *STATUS*, January; online in pdf form at < **http://www.aas.org/~cswa/pubs.html** >.

*Valverde, G.A. & W.H. Schmidt, "Refocusing U.S. Math and Science Education: International comparisons of schooling hold important lessons for improving student achievement" *Issues in Science and Technology Online*, Winter: < **http://bob.nap.edu/issues/14.2/schmid.htm** >.

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Yarrison-Rice, J.M. 1995, "On the problem of making science attractive for women and minorities: An annotated bibliography." *Am. J. Phys.* **63**(3): 203-210. The abstract reads: "How can educators assess and address the lack of interest exhibited by underrepresented youth in science? What strategies can be employed to recruit and retain these young people? Along with a bibliography, the author provides the reader with a brief summary of 20 notable works in the field of recruitment and retention of underrepresented students in math and science. Although highlighted retention and intervention programs reported herein are targeted at young women in particular, many of the suggested strategies are applicable to all students regardless of race, gender, or socio-economic background. It provides scientists who have an interest in science education with basic literature addressing this topic."

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