Online Ethics Center
FOR ENGINEERING AND SCIENCE

Diversity in Education and the Workplace Bibliography

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Description

An annotated list of websites, books and articles looking at diversity in education and the workplace.

Body

Web Sites

American Indian Science and Engineering Society
AISES seeks to substantially increase the representation of American Indian and Alaska Natives in engineering, science and other related technology fields.

Association for Women in Science
AWIS is dedicated to achieving equality and full participation for women in science, technology, engineering and mathematics.

Committee on Women in Science, Engineering and Medicine of the National Academies

The Committee on Women in Science, Engineering, and Medicine (CWSEM) is a standing committee in the Policy and Global Affairs division of the National Academies of Sciences, Engineering, and Medicine. Its mandate is to coordinate, monitor, and advocate action to increase the participation of women in science, engineering, and medicine.

EngineerGirl

The EngineerGirl website is designed to bring national attention to the exciting opportunities that engineering represents for girls and women.

National Institutes of Health Women in Biomedical Careers

Home page of the NIH Working Group in Biomedical Careers that considers barriers for women and science and seeks to develop innovative strategies to promote entry, recruitment, retention and sustained advancement of women in biomedical and rese arch careers.

National Research Mentoring Network

Website of a nationwide consortium of biomedical professional and institutions collaborating to provide all trainees in biomedical, behavioral, clinical and social sciences with mentorship and professional development programing. One of the program's goals is to address the benefits and challenges of diversity, inclusivity and culture within mentoring relationships and more broadly in the research workforce.

National Society of Black Engineers

NSBE's mission is "to increase the number of culturally responsible Black Engineers who excel academically, succeed professionally and positively impact the community."

National Society of Black Physicists

This organization seeks to develop and support efforts to increase opportunities for African Americans in physics, both in the international scientific community and within society at large.

Society for Advancement of Chicanos and Native Americans in Science

SACNAS is a society of scientists dedicated to fostering the success of Hispanic/Chicano and Native American scientists—from college students to professionals—in attaining advanced degrees, careers, and positions of leadership.

Society of Women Engineers

SWE aims to empower women to succeed and advance in the field of engineering,

and to be recognized for their life-changing contributions as engineers and leaders.

Statistics about Women and Minorities in Science from the National Science Foundation

The National Center for Science and Engineering Statistics regularly collects data about minorities, women and persons with disabilities in science and engineering, including education, employment, and work-life balance.

Books and Reports

Burke, Ronald J and Mary C Mattis. 2007. *Women and Minorities in Science, Technology and Mathematics: Upping the numbers.* Cheltenham, UK: Edward Elgar.

Advances in science, technology, engineering and mathematics (STEM) are key factors in contributing to future economic performance, higher living standards and improved quality of life. As dominant white males near retirement and immigration slows, developed countries face a serious skill shortage in critical STEM disciplines. This book examines why the numbers of women and minorities in STEM are low, outlines the potential consequences of this and prescribes much needed solutions to the problem.

Byers, Nina and Garry Williams. 2006. *Out of the shadows: Contributions of twentieth-century women to physics*. Cambridge: Cambridge University Press.

This volume explores the many women who overcame discrimination and became major players in the field of physics in the twentieth century.

Bystydzienski, Jill M. and Sharon R. Bird. 2006*. Removing Barriers: Women in academic science, technology, engineering and mathematics*. Bloomington: Indiana University Press.

The essays in this collection examine the persistence and seeming intractability of the under-representation of women in academic STEM areas, discusses the successes and failures of current programs meant to help increase the number of women going into these fields, and offers some guidance on how universities, professional organizations, and government institutions can effectively approach and find solutions to these problems.

Ceci, Stephen J. and Wendy M. Williams (eds.). 2007. *Why Aren't More Women in Science?: Top researchers debate the evidence.* Washington, D.C.: American Psychological Association.
In a collection of fifteen essays, top researchers on gender differences in ability explore the latest research and questions raised about the small number of women in scientific fields.

Coleman, Arthur L. Katherine E. Lipper, Jamie Lewis Keith, Daryl E. Chubin, and Teresa E. Taylor. 2012. *The Smart Grid for Institutions of Higher Education and The Students They Serve: Developing and Using Collaborative Agreements to Bring More Students to STEM.* Washington D.C.: American Association for the Advancement of Science.
Using the metaphor of the Smart Grid, this report discusses the array of challenges institutions face in recruiting diverse students to STEM fields and This paper addresses the development of voluntary educational collaborations between institutions of higher education to expand the pipeline for all students – including but not limited to women, non-Asian minorities, and students from low socio-economic backgrounds – into progressively higher levels of STEM education.

Didion, Catherine, Norman L. Fortenberry, and Elizabeth Cady. 2012. *Colloquy on Minority Males in Science, Engineering, and Mathematics.* Washington, DC: National Academies Press.
On August 8-12, 2010 the National Academy of Engineering (NAE), with funding from the National Science Foundation (NSF), convened the Colloquy on Minority Males in Science, Technology, Engineering, and Mathematics (STEM), following the release of several reports highlighting the educational challenges facing minority males. The NSF recognized the need to gather input from research communities that focus on minority males about how to frame investigations of gender-based factors that impact learning and choice in STEM education (both at the precollege and higher education levels) and the workforce for minority males. There was particular interest in framing a research agenda to study how interactions between minority males and societal and educational systems (both formal and informal) encourage or discourage the young men's interest and persistence in STEM. In addition, NSF hoped to gain community input to inform the parameters of a future NSF research program that could effectively address minority male participation in STEM. This report summarizes the findings of this meeting.

Fort, Deborah, Stephanie J. Bird and Catherine J. Didion. 2005. *A hand up: Women mentoring women in science*. Washington, D.C.: Association of Women in Science.
Beginning with interviews of women working in the fields of science, math, and engineering, this book identifies the personal and professional challenges faced by women in these fields, offers advice on how to deal with these challenges, and provides a list of over 100 feminist and education organizations that support women in the sciences.

Gray, Monica and Ken D. Thomas. 2017. *Strategies for Increasing Diversity in Engineering Majors and Careers.* Hershey, PA : Engineering Science Reference.
Provides the latest research on the need for diversity and inclusion within the engineering workforce and provides approaches to restructuring engineering education to achieve this goal.

Land of Plenty: Diversity as America's competitive edge in science, engineering and technology. United States: Congressional Commission on the Advancement of Women and Minorities in Science, Engineering and Technology Development, 2000.
Report examines the challenges faced by women, minorities, and individuals with disabilities in the fields of science, engineering and technology, and discusses changes that need to be made in the education and practice of these fields to surmount these challenges.

Malcom, Shirley M., Daryl E. Chubin and Jolene K. Jesse. 2004. *Standing our Ground: A guidebook for STEM educators in the Post-Michigan era*. Washington, D.C.: American Association for the Advancement of Science.
This report provides legal guidance on two Michigan rules that affirmed the importance of a diverse learning environment, but struck down the use of race as a quantitative "plus factor" in undergraduate admissions decisions. The report discusses what these rulings mean for university departments that have programs that try to bring minority and women students into the disciplines of engineering and science, and best practices for the development of these kinds of programs.

Mansour, Nasser and Rupert Wegerif. 2013. *Science Education for Diversity: theory and practice.* Dordrecht: Springer.
Reflecting the very latest theory on diversity issues in science education, including

new dialogic approaches, this volume explores the subject from a range of perspectives and draws on studies from around the world. The work discusses fundamental topics such as how we conceptualize diversity as well as examining the ways in which heterogeneous cultural constructs influence the teaching and learning of science in a range of contexts.

Misa, Thomas. 2010. *Gender Codes: Why Women are Leaving Computing.* Hoboken, N.J.: Wiley.
The computing profession faces a serious gender crisis. Today, fewer women enter computing than anytime in the past 25 years. This book provides an unprecedented look at the history of women and men in computing, detailing how the computing profession emerged and matured, and how the field became male coded.

National Academy of Engineering. 2014. *Advancing Diversity in the US Industrial Science and Engineering Workforce: Summary of a Workshop*. Washington, DC: The National Academies Press. https://doi::.org/10.17226/13512.
Thousands of gifted individuals, including women and underrepresented minorities, remain a disproportionally small fraction of those in science, technology, engineering, and math (STEM) careers. Industry, as the largest employer category of those with STEM backgrounds, stands to benefit considerably from greater inclusion of women and underrepresented minorities in the workforce. However, nothing short of a game-changing environment must be created to harness the talent of those not fully represented in the STEM workforce.

National Academy of Sciences, National Academy of Engineering, Institute on Medicine. *Beyond bias and Barriers: Fulfilling the potential of women in academic science and engineering*. Washington, D.C.: National Academies Press, 2007.
A report by the National Academy of Sciences discussing strategies and best practices for helping to attract and sustain women students, faculty, and practitioners in the sciences.

National Research Council and National Academy of Engineering. 2014. *Career Choices of Female Engineers: A Summary of a Workshop*. Washington, DC: The National Academies Press. https://doi::.org/10.17226/18810.
Despite decades of government, university, and employer efforts to close the gender gap in engineering, women make up only 11 percent of practicing engineers in the

United States. What factors influence women graduates' decisions to enter the engineering workforce and either to stay in or leave the field as their careers progress? Researchers are both tapping existing data and fielding new surveys to help answer these questions.

Nelson, Donna J. 2007. *A national Analysis of Diversity in Science and Engineering Faculties at Research Universities*. Department of Chemistry and Biochemistry, University of Oklahoma.
Report gives the results of a survey of the top 50 departments in fourteen science and engineering disciplines to discover the number and status of women and minority tenure and tenure-track faculty at major research universities in the United States.

Seymour, Elaine and Nancy M. Hewitt. 1998. *Talking about Leaving: Why undergraduates leave the sciences*. Boulder, CO: Westview Press.
Abstracts of chapters:

- Review of Findings: The Problem Iceberg
- The Problems of Women in Science, Mathematics, and Engineering
- The Problems of Minority Group Students in Science, Mathematics, and Engineering
- Students Speak Out: Quotes about Switching
- Student Quotes on Bad Teaching

Sheffield, Suzanne Le-May. 2005. *Women and Science: Social impact and interaction*. Rutgers University Press.
Collection of essays discussing the important contributions of women scientists from the eighteenth to the twentieth century and also examines the challenges and barriers women scientists have faced in Western science.

***Surmounting the Barriers: ethnic diversity in engineering education: summary of a workshop*. 2014. Washington, D.C. : National Academies Press.**
This report is the summary of a workshop held in September 2013 to take a fresh look at the impediments to greater diversification in engineering education. While the goal of diversifying engineering education has long been recognized, studied, and subjected to attempted interventions, progress has been fitful and slow. This report discusses reasons why past recommendations to improve diversity had not been adopted in full or in part. Surmounting the Barriers identifies a series of key

impediments, including a lack of incentives for faculty and institutions; inadequate or only short-term financial support; an unsupportive institutional and faculty culture and environment; a lack of institutional and constituent engagement; and inadequate assessments, metrics, and data tracking. The report also shares success stories about instances where barriers to diversity have been identified and surmounted, and the resources that could enable real solutions to implement steps toward progress.

Thorn, Mary. 2001. *Balancing the Equation: Where are women and girls in science, engineering and technology?* Washington, D.C.: National Academies Press.
A report looking at hundreds of programs with the goal of attracting and retaining women in science and engineering, that identifies best practices for these kinds of programs. Includes a large number of statistics about women in these fields.

Zoli, Corri, Shobha Bhatia, Valarie Davidson, and Kelly Rusch. 2008 *. Engineering: Women and Leadership*. San Ravael: Morgan & Claypool Publishers.
A series of lectures that explores the changes occurring in leadership for academic women in the sciences and engineering. The lectures explore the sources of this increase of women in academic science and engineering as well as the persistent problems and obstacles that remain as barriers to women's full participation in these fields.

Journal Articles

Adamuti-Trache, Maria and Robert Sweet. 2014. “Science, technology, engineering and math readiness: Ethnolinguistic and gender differences in high-school course selection patterns.” *International Journal of Science Education.* 36(4): 610-634. Doi:: 10.1080/09500693.2013.819453
This study examines science-related course choices of high-school students in the culturally diverse schools of the province of British Columbia, Canada. The analysis employs K-12 provincial data and includes over 44,000 students born in 1990 who graduated from high school by 2009. The research sample reflects the presence of about 27% of students for whom English is not a first language. We construct an empirical model that examines ethno-linguistic and gender differences in Grade 12 course choices while accounting for personal and situational differences among

students. Findings indicate that math- and science-related course selection patterns are strongly associated with ethnicity, qualified not only by gender and prior math and science achievement but also by the individual's grade level at entry to the system and enrollment in English as a Second Language program. Students who are more likely to engage in math and science courses belong to Asian ethno-linguistic groups and entered the provincial school system during the senior high-school years. The authors suggest that ethnic diversity and broader academic exposure may play a crucial role in changing the gender composition of science classrooms, university fields of study and science-related occupations.

Allen. A. 1998. "The role model argument and faculty diversity." *The Journal of Higher Education*. [OEC Abstract]
Article examines the responsibility of institutions to provide diverse faculty that will provide role models for minorities.

Anderson, Vivian. 1995. "Identifying special advising needs of women engineering students." *Journal of College Student Development*. 322-329.[OEC Abstract]

Ayre, Mary, Julie Mills and Judith Gill. 2013. "'Yes I do belong': the women who stay in engineering." *Engineering Studies*. 5(3): 216-232. doi:: 10.1080/19378629.2013.855781
Despite considerable work to encourage girls and women to enter the profession, engineering continues to be heavily male dominated, a situation which has implications for quality and gender equity. This study focuses on the converse question, 'What makes some women stay when many others leave?' A survey of a cohort of Australian female civil engineers found an unusually high retention rate. Interviews with volunteers from the group revealed that they had all entered the profession strongly believing in themselves as engineers, a belief that had endured despite the difficulties they encountered. Their persistence in the profession appeared to be connected to steps they had taken to ensure that their work environment matched their expectations of interesting, challenging and enjoyable work in a supportive and inclusive culture.

Bailyn, Lotte. 1986. "Experiencing technical work: A comparison of male and female engineers." Cambridge, MA: Sloan School of Management, Massachusetts Institute of Technology. [OEC Abstract]

Barres, Ben A. 2006. "Does gender matter?" *Nature*. 442:7099: 133-136. doi:: 10.1038/442133a
Article reflects on the comments made by Harvard President Larry Summers that suggested that women have an innate inability towards achieving science advancement.

Begley, Sharon. 2006. "He, once a she, offers own view on science spat**." *Wall Street Journal*. 248:10: B1-B5.**
Being first a female scientist and then a male scientist has given Prof. Barres, a neurobiologist at Stanford University, a unique perspective on the debate over why women are so rare at the highest levels of academic science and math: He has experienced personally how each is treated by colleagues, mentors and rivals.

Bickenstaff, Jacob Clark. 2005. "Women in science careers: Leaky pipeline or gender filter?" *Gender & Education*. 17(4): 369-386. doi: 10.1126/science.opms.r1000084
The author reviews the literature looking at a broad array of explanations for the absence of women in science, technology, engineering, and mathematics, and discusses how the very nature of science may contribute to the removal of women from these fields. The author also makes recommendations for the reform of science education to address this problem.

Bonetta, Laura. 2010. "Reaching gender equity in science: The importance of role models and mentors." *Science*. 327(5967): 889-895. doi: 10.1126/science.opms.r1000084
The article discusses gender equity in science and the importance of role models and mentors for women scientists.

Bonetta, Laura. 2009. "The road to diversity: Are we there yet?" **Science. 324(5926) 540-544. doi: 10.1126/science.opms.r0900070**
Article discusses the emerging prominence of women and members of racial minorities in U.S. academic science.

Bouville, Mathieu. 2008. "Is diversity good?: Six possible conceptions of diversity and six possible answers." Science and Engineering Ethics. 14: 51-63. **doi: 10.1007/s11948-007-9032-7**
The author discusses the many ways the concept of diversity can be construed, and how each of these ideas can differ greatly in their nature and properties. The author

discusses how diversity as an instrumental good can give rise to policies, the weaknesses of these policies, and finally considers the example of female enrollment in science and engineering, interpreting the various arguments found in the literature in light of this policies.

Bouville, Mathieu. 2008. On enrolling more students in science and engineering. Science and Engineering Ethics. 14(2): 279-290. doi: 10.1007/s11948-007-9038-1
This article looks at a discrepancy in arguments usually used in how universities should enroll more female students in science and engineering. It is not that universities should try and recruit as many female students as possible into the scientific disciplines, but rather to allow female students the freedom of choice in deciding what field she wishes to go to. In other words, looking for ways to remove barriers that may stop females students from choosing majoring in the sciences over another field.

Brumfiel, Geoff. 2008. "Data shows extent of sexism in physics." *Nature* 452:7190: 1. doi: 10.1038/452918a
Article discussing a study showing institutional sexism at an experiment at one of America's highest-profile physics labs.

Byars-Winston, Angela. 2014. "Toward a framework for Multicultural STEM-focused career development." *Career Development Quarterly*. 62(4) 340-357. doi: 10.1002/j.2161-0045.2014.00087.x
The author summarizes STEM education and workforce trends and articulates an equity imperative for broadening and diversifying STEM participation. The author then offers a multicultural STEM-focused career development framework to encourage career development professionals' knowledge and awareness of STEM education and careers and delineates considerations for practice aimed at increasing the attainment and achievement of diverse groups in STEM fields.

Davis, Cinda-Sue G. and Cynthia J. Finelli. 2007. "Diversity and retention in engineering." *New Directions for Teaching & Learning.* 111: 63-71. doi: 10.1002/tl.287
The authors describe three initiatives designed to increase the academic achievement and retention of historically underrepresented students in engineering.

Clauset, A., Arbesman, S., Larremore, D. 2015. "Systematic Inequality and Hierarchy in Faculty Hiring Networks." *Science Advances*, 1 (1), 1-6. doi:

10.1126/sciadv.1400005
Women graduating with PhDs from prestigious institutions are hired by less prestigious institutions than their male counterparts. In general, faculty are hired by institutions 27 to 47 ranks below the institution where they did their doctorate, but the median change-in-rank is somewhat worse for women than men. This effect is more pronounced at the most prestigious computer science and business programs.

Felder, Richard M, et al. 1995. „A longitudinal study of engineering student performance and retention. III. Gender difference in student performance and attitudes." *Journal of Engineering Education* 84(2): 151-163. [OEC Abstract] [Full Text]

Fox, Mary, Gerhard Sonnert, and Irina Nikiforova. 2009. "Successful programs for undergraduate women in science and engineering: Adapting versus adopting the institutional environment." *Research in Higher Education*. 50(4): 333-353. doi: 10.1007/s11162-009-9120-4
In this study of programs offered by universities for undergraduate women in science and engineering, the authors found that programs that regarded issues, problems and solutions as rooted in institutional/structured centered as opposed to individual/student centered had more positive outcomes in the number of undergraduate degrees awarded to women in science and engineering.

Foster, Michael, et al. 2014. "Increasing the Diversity of U.S. Conservation Science Professionals via the Society for Conservation Biology." *Conservation Biology* 28(1) 288-291. doi: 10.1111/cobi.12182
The article explores the role of the Society for Conservation Biology (SCB) in increasing the diversity of biological conservation professionals in the U.S. Topics discussed include the importance of a diversified membership to the organization's strategic plan and the strategies used to increase the diversity of the science, technology, engineering and mathematics (STEM) workforce. Also outlined are several recommendations to increase diversity in the field.

Hallar, A., McCubbin, I., Hallar, B., Levine, R., Stockwell, W., Lopez, J., Wright, J. 2010. "Science in the Mountains: a Unique Research Experience to Enhance Diversity in the Geosciences." *Journal of Geoscience Education* 58:55-100.
Ethnic and racial minorities constitute an important part of the geosciences community because of their diverse perspectives and backgrounds. However, the geosciences have the poorest diversity record of all the science and engineering

fields. The Geoscience Research at Storm Peak (GRASP) program provides a model for retaining students in the geosciences pipeline and encouraging students' interest in geoscience careers. GRASP offers college age students research experiences in urban and rural environments, introduces students to a wide range of geosciences career options, and connects students to mentors and role models.

Hernes, Robby. Et al. 1995. "Improving the academic environment for women engineering students through faculty workshops." *Journal of Engineering Education*. 84(1): 59-67. [OEC Abstract]

Hopewell, Lindsey, Connie L. McNeely, Erik W. Kuiler, Jon-on Hahm. 2009. "University leaders and the public agenda: Talking about women and diversity in STEM fields." *Review of Policy Research*. 26(5): 589-607. doi: 10.1111/j.1541-1338.2009.00407.x
The authors describe a study undertaken to investigate public statements and pronouncements from leaders at various universities to gain insight into institutional values and environments relative to women and their participation and advancement in science, technology, engineering, and mathematics (STEM) and other disciplinary fields. The authors found that while gender equality is addressed as a separate topic in its own right, university leaders raise issues of gender in the context of STEM participation primarily in conjunction only with other topics. As expected, the data also support arguments suggesting diversity in general as an important goal espoused in the rhetoric of university representatives. Questions remain, however, concerning whether these speeches presage concrete institutional commitments and responses relative to the achievement of diversity, gender equality, and gender equity in the STEM professoriate.

Hughes, Cayce C., Kristen Schilt, Bridget K. Gorman, and Jenifer L. Bratter. 2017. "Framing the Faculty Gender Gap: A View from STEM Doctoral Students." *Gender, Work & Organization* 24 (4):398-416. doi: 10.1111/gwao.12174.
Drawing on 48 interviews with science, technology, engineering and mathematics (STEM) doctoral students at a private research university in the United States (US), the authors examine how students make sense of the preponderance of men at the faculty level despite increasing gender parity among students.

Ihsen, Susanne, and Sabrina Gebaur. 2009. "Diversity issues in the engineering curriculum." *European Journal of Engineering Education*. 34(5): 419-424. doi: 10.1080/03043790903137551

The authors discuss the importance of teaching engineering students about diversity issues as part of the curriculum of the engineering program. By teaching them what is meant by diversity and what it means for their (professional) lives sensitizes them towards more responsibility. The idea is to connect diversity issues with technical subjects. Topics like technical development, human-machine communication or power management and other topics relevant to society are ideal for this purpose.

Johnson, Angela. 2005. "Policy implications of supporting women in the sciences." *Journal of Women, Politics and Society*. 27(5): 135-150. doi: 10.1300/J501v27n03_09
Article discusses a study on the influence of the University of Colorado Minority Arts and Sciences Program supporting women science students of color through graduate, and the values, dispositions, and goals of these women. Author also discusses the implications of supporting women of color interested in science to the program.

Johnson, Angela C. 2007. "Unintended consequences. How science professors discourage women of color." *Science Education*. 91(5): 805-821. doi: 10.1002/sce.20208
This study examined how sixteen Black, Latina, and American Indian women science students reacted to their undergraduate science classes. The research took place at a large, predominantly White research university; participants were recruited from a science enrichment program for high-achieving students. Through interviews and attending classes with the students, the author found that the women in the study found three features of science classes particularly discouraging: the size of the lecture classes, asking and answering questions in class, and (in some cases) engaging in undergraduate research. They were negatively impacted by two cultural values: a narrow focus on decontextualized science and the construction of science as a gender-, ethnicity- and race-neutral meritocracy.

Kahveci, Ajda, Sherry A. Southerland, and Penny J. Gilmer. 2006. "Retaining undergraduate women in science, mathematics and engineering." *Journal of College Science Teaching*. 36(3): 34-38.
Discusses the effectiveness of a program in retaining women in science, mathematics and engineering programs.

Knobloch-Westerwick, S., Glynn, C., & Huge, M. (2013. "The Matilda Effect in Science Communication: An Experiment on Gender Bias in Publication Quality Perceptions and Collaboration Interest." *Science Communication*

35 (5), 603-625.
Gender bias is acute for women working in male-typical fields. In one study, researchers randomly assigned men's and women's names to abstracts and asked participants to judge the quality of the work and their desire to collaborate with the researcher. Abstracts with men's names were associated with greater scientific quality overall, and, in particular, for male-typed topics, such as politics or technology. Both men and women scored higher when their abstracts were in gender-congruent fields. Respondents who more strongly supported gender equality rated women's work more highly.

Kodate, Naonori, Kashiko Kodate, and Takako Kodate. 2010. "Mission Completed? Changing Visibility of Women's Colleges in England and Japan and Their Roles in Promoting Gender Equality in Science." ***Minerva: A Review of Science, Learning & Policy*** **48 (3):309-330. doi: 10.1007/s11024-010-9150-2.**
Discusses the important role that women's colleges have played in bringing more women to science, technology, engineering and mathematics fields.

Kuo, Maggie. 2016. "Changing the Face of Computer Science." *Science Careers*. November 21, 2016.
This article profiles an online documentary series called **Lab Daze** *that follows one university computer lab's efforts to get younger people – especially young people of diverse backgrounds – interested in computer science.*

Laefer, Debra F. 2009. "Gender disparity in engineering as a function of physics enrollment and its implications for civil engineering." *Journal of Professional Issues in Engineering Education and Practice.* 135(3): 95-101.
This paper focuses primarily on women in secondary education in terms of both attitudes toward and enrollment levels in pre-engineering courses such as calculus, chemistry, and physics. Additional consideration is given to enrollment and achievement in advanced placement courses, as reflected in national examination rates. This paper concludes that secondary school participation and achievement in physics courses is a critical differential factor as one explanatory element of female engineering enrollment levels and provides specific recommendations as to how to increase interest, enrollment, and achievement in physics, including the segregation of entry-level engineering courses based on previous experience.

Leboy, Phoebe S., and Janice F. Madden. 2012. "Limitations on Diversity in Basic Science Departments." ***DNA & Cell Biology*** **31 (8):1365-1371. doi:**

10.1089/dna.2012.1756.
While great strides have been made about bringing a more diverse group of students into science departments, the authors argue that many universities need to work more about recruiting and retaining more diverse faculty.

Leonard, Kathleen M., and Gillian M. Nicholls. 2013. "History and Status of Female Faculty in Civil Engineering." *Journal of Professional Issues in Engineering Education & Practice* 139 (3):218-225. doi: 10.1061/(ASCE)EI.1943-5541.0000152.
This article presents a brief history of females in the civil engineering profession and discusses some of the issues affecting them, particularly those in academia.

Lisa, Tsui. 2007. "Effective strategies to increase diversity in STEM fields: A review of the research literature." *Journal of Negro Education*. 76(4): 555-581.
Based on a literature review, the author discusses ten intervention strategies commonly adopted by universities who are striving for diversity in the areas of science, technology, engineering and mathematics. The author also discusses three model programs, the Meyerhoff Program, the Minority Engineering Program, and the Mathematics Workshop, and concludes with a discussion of recommendations for future action and research.

MacNell, L., Driscoll, A., & Hunt, A. 2014. "What's in a Name: Exposing Gender Bias in Student Ratings of Teaching." *Innovation Higher Education*, 1-13. doi: 10.1007/s10755-014-9313-4
Gender bias may extend to student's evaluations of professors. In an experiment, students in an online college course gave the same instructors lower ratings when the students thought the instructor was a woman than when they thought the instructor was a man, regardless of the instructor's actual gender.

Male, Sally A., Mark B. Bush, and Kevin Murray. 2009. Think engineer, think male? *European Journal of Engineering Education*. 34(5): 455-464. doi: 10.1080/03043790903137759
Engineering education needs to develop the competencies required for engineering work, and to attract and retain students from diverse backgrounds. This study sought to investigate the possibility that the perceived importance of competencies is subconsciously influenced by gender assumptions, and this may lead to a lowering in the status given to stereotypically feminine competencies. Reports from a series of surveys of engineers found that there are stereotypically feminine competencies

that are important to engineering, and suggested that senior male engineers in the study gender typed engineering jobs, consequently under-rating the importance of some stereotypically feminine competencies recently added to the engineering curricula.

McGee, Ebony O., and Lydia Bentley. 2017. "The Troubled Success of Black Women in STEM." *Cognition & Instruction* 35 (4):265-289. doi: 10.1080/07370008.2017.1355211.

The authors examine the experiences of 3 high-achieving Black undergraduate and graduate women in science, technology, engineering, and mathematics (STEM). These findings reveal that structural racism, sexism, and race-gender bias were salient in the women's STEM settings. These experiences were sources of strain, which the women dealt with in ways that demonstrate both resilience and trauma. The authors discuss how their experiences might motivate institutions to offer support for high-achieving students who sometimes face risks from multiple sources.

McLoughlin, Lisa A. 2009. “Success, recruitment and retention of academically elite women students without STEM backgrounds in US undergraduate engineering education.” *Engineering Studies*. 1(2): 151-168. doi: 10.1080/19378620902911592.

This longitudinal, cross-institutional, qualitative study of undergraduate women engineering students revealed that Non-traditional Engineering Organized (NEO) students have excellent overall high school grades and organizational skills but lack a concentrated background in science, technology, engineering, and math (STEM) areas compared with the familiar Traditional Engineering Discipline (TED) Students with strong STEM backgrounds. In this study, both types of students were able to achieve success academically and in terms of their happiness. This indicates that more attention to NEO students may be warranted in attempting to recruit high school women into engineering. In recruiting these students, social aspects of engineering design should be emphasized, and recruiters should visit all advanced placement classes, not just STEM-oriented ones.

Murthy, Dhiraj, Atilano, Rodriguez and Linda Kinstler. 2013. “The potential for virtual communities to promote diversity in the sciences.” *Current Sociology*. 61(7): 1003-1020. doi: 10.1177/0011392113502994

This article investigates the role of online networks in providing support and mentoring resources for underrepresented groups. The case study of the virtual community of practice WomenScientists1 explores how online communities can be

mobilized to help close the 'leaky pipeline' that too often leads women to leave the sciences after completing a post-secondary degree. The forum provides a virtual space for scientists around the world to discuss how gender impacts professional life in scientific fields, both within the academy and beyond. By examining textual data and the sentiment of posts, the article concludes that this virtual environment provides unique forms of support that specifically promote mentorship and the exchange of personalized advice for women in the life sciences.

Nelson, Beryl. 2014. "The data on Diversity." *Communications of the ACM*. 57(11):86-95. doi: 10.1145/2597886

The article examines the benefits of diversity to teams and the cognitive factors that hinder the achievement of optimal levels of diversity. Topics discussed include social scientists' claim that teams and organizations with members who are heterogeneous have a higher potential for innovation, better financial results and innovation from diverse teams, greater sales revenue for organization with racial diversity and a study of collective intelligence and creativity that noted a predictor of team collective intelligence.

Newberry, Byron. Katherine Austin, William Lawson , Greta Gorsuch and Thomas Darwin. 2011. "Acclimating international graduate students to professional engineering ethics." *Science and Engineering Ethics*. 17(1): 171-94. doi: 10.1007/s11948-009-9178-6

This article describes the education portion of an ongoing grant-sponsored education and research project designed to help graduate students in all engineering disciplines learn about the basic ethical principles, rules, and obligations associated with engineering practice in the United States. While the curriculum developed for this project is used for both domestic and international students, the educational materials were designed to be sensitive to the specific needs of international graduate students.

Plaut, Victoria. 2014. "Inviting everyone in." *Scientific American*. 311(4): 52-57. doi: 10.1038/scientificamerican1014-52

The article discusses strategies for bringing diversity to the workplace or classroom. Topics include common misconceptions that interfere with the creation of a more inclusive work or class environment, a study by the author and her colleagues on the impact on employees of color when white employees ignored ethnic differences, the role of unconscious bias, studied by Jennifer A. Richeson and colleagues, and the importance of the ways diversity efforts are structured within organizations.

Prince, Robert. 2006. “Teaching Engineering Ethics using role-playing in a culturally diverse student group.” *Science and Engineering Ethics*. 12: 321-326. doi: 10.1007/s11948-006-0030-y

The use of role-playing ("active learning") as a teaching tool has been reported in areas as diverse as social psychology, history and analytical chemistry. Its use as a tool in the teaching of engineering ethics and professionalism is also not new, but the approach develops new perspectives when used in a college class of exceptionally wide cultural diversity. York University is a large urban university (40,000 undergraduates) that draws its enrolment primarily from the Greater Toronto Area, arguably one of the most culturally diverse cities in the world, embracing the largest percentage of Canada's immigration. Although students admitted from this international pool have usually been exposed to western attitudes during secondary education and are rapidly assimilated into Canadian culture, responses to specific ethical issues are strongly influenced by their prior culture. Two and three-part scripts for case studies based on NSF or original scenarios were written to illustrate issues such as gifts, attitudes towards women and ethnic minorities, conflict of interest, whistle-blowing, sexual harassment, individual rights, privacy, environment, intellectual property, and others. Following the presentation, the actors lead group discussion based on previously specified questions. Once the initial shyness and reluctance of some cultures has been overcome through the building of rapport, students have written original scripts based on hypothetical or prior personal situations. The method is now being adopted in a short course format to assist the professional integration of foreign trained engineers.

Rayman, Paula and Belle Brett. 1995. “Women science majors: What makes a difference in persistence after graduation?” *Journal of Higher Education.* 66(4): 388-414. [OEC Abstract]

Sadler, P., Sonnert, G., Hazari, Z., Tai, R. 2012. „Stability and Volatility of STEM Career Interest in High School: A Gender Study.” *Science Education* 96:411-427. doi: 10.1002/sce.21007

This retrospective cohort study characterizes how interest in science, technology, engineering, mathematics (STEM) careers changes during high school for more than 6,000 students in a representative national sample of 34 two- and four-year colleges taking mandatory college English courses. Overall, large gender differences in career plans were found, with males showing far more interest particularly in

engineering, whereas females were more attracted to careers in health and medicine during their high school years. The key factor predicting STEM career interest at the end of high school was interest at the start of high school. There was an additional effect of gender, indicating both a lower retention of STEM career interest among females and a greater difficulty in attracting females to STEM fields during high school. During the high school years, the percentage of males interested in a STEM career remained stable (from 39.5 to 39.7), whereas for females it declined from 15.7 to 12.7. The students' initial specific (disciplinary) career interests were found to influence the stability of their interest in a STEM career, with those interested in physics careers at the start of high school having the highest retention in STEM.

Sheltzer, Jason M and Joan C. Smith. 2014. Elite male faculty in the life sciences employ fewer women. Proceedings of the National Academy of Sciences of the United States of America. 111:10107-10112. doi: 10.1073/pnas.1403334111

Women make up over one-half of all doctoral recipients in biology-related fields but are vastly underrepresented at the faculty level in the life sciences. To explore the current causes of women's under-representation in biology, we collected publicly accessible data from university directories and faculty websites about the composition of biology laboratories at leading academic institutions in the United States. We found that male faculty members tended to employ fewer female graduate students and postdoctoral researchers (post-docs) than female faculty members did. Furthermore, elite male faculty-those whose research was funded by the Howard Hughes Medical Institute, who had been elected to the National Academy of Sciences, or who had won a major career award-trained significantly fewer women than other male faculty members. In contrast, elite female faculty did not exhibit a gender bias in employment patterns. New assistant professors at the institutions that we surveyed were largely comprised of postdoctoral researchers from these prominent laboratories, and correspondingly, the laboratories that produced assistant professors had an overabundance of male postdocs. Thus, one cause of the leaky pipeline in biomedical research may be the exclusion of women, or their self-selected absence, from certain high-achieving laboratories.

Sonnert, Gerhard, Mary Frank Fox, and Kristen Adkins. 2007. "Undergraduate women in science and engineering: Effects of faculty, fields, and institutions over time." *Social Science Quarterly*. 88(5): 1333-1356. doi: 10.1111/j.1540-6237.2007.00505.x

A study showing the power of role models in attracting and retaining women students in the fields of science and engineering.

Townley, Cynthia. 2010. "More on enrolling female students in science and engineering." *Science and Engineering Ethics*. 16(2): 295-301. doi: 10.1007/s11948-009-9160-3
This paper investigates reasons for practices and policies that are designed to promote higher levels of enrolment by women in scientific disciplines. It challenges the assumptions and problematic arguments of a recent article questioning their legitimacy. Considering the motivations for and merits of such programs suggests a practical response to the question of whether there should be programs to attract female science and engineering students.

Williams, J., Phillips, K., Hall, E. (2014). "Double Jeopardy? Gender Bias against Women of Color in Science." Work Life Law, 1-60.
The experience of discrimination depends on both race and gender. While women in general have to provide more evidence of their competence to their colleagues than men, in a recent survey Black women reported this bias significantly more than Latinas, Asian-American, and White women. Asian-American women were more likely to report having to play traditionally feminine roles in the office than White women and Latinas, who in turn felt this pressure more than Black women. Asian-American women also reported more pushback for being assertive or self-promoting than the other groups. White women were more often asked to do service work. While three quarters of women overall reported that women supported each other in the workplace, only 56 percent of Black women agreed.

Zimmerman, Julia Beth and Jorge Vanegas. 2007. "Using sustainability education to enable the increase of diversity in science, engineering, and technology-related disciplines." *International Journal of Engineering Education*. 23(2): 242-253.
The authors discuss how teaching about sustainable development in science, engineering, and technology-related fields can help attract women and minority students to these disciplines.

Further Bibliographies

Diversity in Engineering Bibliography (DinE)

The Diversity in Engineering online biography is a searchable database of journal articles and conference papers from 2005-2010 focused on diversity.

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