

for women physicians. Other sources see increasing similarities in how male and female physicians interact with patients, although there are some stylistic differences in communication patterns of women. In general women physicians talk to their patients more and allow the patients more time to talk to them and ask them questions. Their nonverbal communication style seems to encourage greater participation by patients.

Use of preventive services also is encouraged more by women physicians, according to some research. Some studies argue that this is partly because of practice patterns; that women are more likely to be primary care providers and to practice in managed care environments; and that it is these practice characteristics, rather than gender, that explain the difference in encouragement of use of preventive measures.

Despite growing numbers of women physicians, women have not been moving rapidly into leadership roles in medicine, although this has started to increase in the last decade. This issue of lower representation of women in leadership positions and in medical school positions is true in most European countries as well as in American medicine, although there has been more change in Europe. If women move into top leadership positions, they may bring some changes to medicine, such as perhaps greater attention to the psychosocial needs of patients. However, it is not yet clear whether the growing numbers of women in medicine will alter the impact of medical training and the standard biomedical outlook of the profession or not, especially in the United States.

See Also: Equal Pay; Health, Mental and Physical; Health Insurance Issues.

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Physics, Women in

Physics is a discipline of natural sciences defined as "the scientific study of matter and their interactions using the electromagnetic, gravitational and nuclear forces of nature." Historically, the percentage of women contributing to new discoveries in physics and academic teaching of physics has been considerably less than the percentage of men. Despite the modern feminist movement, the number of women in physics continues to be less than the number of men, particularly in leadership positions. As there is no rational reason for women to trail men in achieving new scientific discoveries or excel in academic teaching, the cause of this trend is attributed to existing gender biases in the perception and practice of science. Thus, increasing the number of women in physics as well as emphasizing their relevance in physics have emerged as women's issues.

Women in History of Physics

Hypatia (370–415) lived in Alexandria in Egypt and taught philosophy and astronomy. She is one of the earliest women scientists in recorded history. Contributions of women astronomers have been recognized for centuries. In 1786, J. K. Lalande published his "Astronomy for Ladies," which has a history of the women astronomers. Physicist Laura Bassi (1711–78) became the first woman to be awarded a university professorship in Europe and is known for her work in fluid mechanics and devising experiments in

electricity. Emilie Marquise du Chatelet (1706–49) translated Newton's *Principia* in French. Emmy Noether (1882–1935) is perhaps the most famous woman scientist, whose mathematical theorems gave birth to modern algebra. "Noether theorem" is used in physics to obtain conserved charges in systems with continuous symmetries. Marie Curie (1867–1934) was the first woman to receive two Nobel Prizes in physics and chemistry for her work in radioactivity. Maria Goeppert-Mayer is the only other woman to have received a Nobel Prize in physics, awarded in 1963 for her work in nuclear physics.

Statistics of Women in Physics in Today's World

The percentage of women in physics at undergraduate and graduate levels is high (30–50 percent) in most developed countries (e.g., in the United Kingdom and the United States). The number reduces considerably for midcareer women (10–20 percent) to very low (less than 5 percent) for senior and leadership positions. This gives rise to a scissors diagram in the plot of male-female ratios in physics career graphs. The details differ in some countries. A set of illustrative examples taken from the proceedings of the 3rd International Conference on Women in Physics are listed below. In Australia, approximately 24 percent of undergraduate students are female, and 28.3 percent of postgraduate students are women.

Selected universities in Australia have 22 percent women as academic staff, whereas women in government research labs are about 9 percent of the total. Across Canada, the percentage of women at undergraduate level in physical and life sciences and technology is 55.7 percent and 46.5 percent at graduate level. The percentage of women in full-time teaching positions in Canadian universities in mathematical and physical sciences is 14.6 percent (in 2004). In France, 25 percent of undergraduate and graduate students are women; 21 percent of faculty at French universities are female. The percentage of female graduates from the Physical Society of Japan (JPS) is 9 percent, and the percentage of women members of the JPS is 5 percent.

At the undergraduate and graduate levels in Kenya, the percentage of women is below 10 percent. In Kenya, the percentage of women teaching staff is less than 1 percent. In Lebanon, 45 percent of the undergraduates

in the physics department at St. Joseph's University are female, and 15 percent of the professors are women. In Peru, the percentage of women at NMU University is 53 percent at the undergraduate level and 14.6 percent at the graduate level. In South Africa, 33.3 percent of the students are female, whereas at the researcher level 16 percent of the members of the South African Institute of Physics are women. Some prestigious universities like Harvard University in the United States have tenured their first female faculty, Melissa Franklin and Lisa Randall, in recent years.

Feminism and Physics

The issue of women in physics is deeply rooted in the rise of the feminist movement in the world. The feminist movement aims for equal rights and opportunities for women in all spheres of human endeavour. In the first wave of the feminist movement, women obtained the right to vote. Scientific institutions and universities started admitting women students and hired women teachers and researchers in the natural sciences. The second wave of feminism rose as an effort to end gender biases and discrimination and is based on the idea of difference feminism.

This movement is reflected in the sciences and as an effort to find sociological and cultural reasons that discourage women from pursuing a career in physics. The number of women in biological sciences has risen to be significant, as it is considered a "soft science," whereas the number of women in physics remains low, as it is perceived as a "masculine science" requiring mathematical and logical skills, which are traditionally deemed as masculine. Similarly, women remain underrepresented in academics in countries where physics is considered prestigious, as in the United States and in Germany. On the other hand, in countries like Turkey, the percentage of women in academics is comparatively higher (30 percent) because a teaching job is not well paid and men prefer disciplines such as law, which is considered prestigious in Turkish culture.

Gender Bias in Physics

Conclusive physiological evidence for innate differences in the practice of science by men and women has not been found. However, there is evidence of differences induced due to social conditioning of men and women, and this is known as "gender bias." Societal

gender biases in science teaching and practice start at a very young age. Girls are encouraged to take up feminine roles advocated by school books and toy manufacturers. The Barbie doll's vocabulary had the words *math class is tough* before the manufacturers removed it due to protests by women. Physics is an exact science; the laws of physics are based on experimental data. Devising experiments is sometimes deemed as masculine in textbooks. At the undergraduate level this discouragement persists when a female chooses a career. Graduate, postdoctoral, and tenure-track positions require intense focus for career building; however, these stages coincide with a woman's childbearing age. Provisions of good maternity benefits and day care facilities are limited in universities and research institutes in most countries. It has been found that work environments in physics departments are not female-friendly. Women researchers are isolated in the male-majority departments and are ignored in promotions or in assigning of duties, preventing their progress to senior and leadership positions.

Establishing a Gender-Sensitive Practice of Physics

Several organized efforts have started to counter existing discrimination in the practice of science and encourage women to take up a career in physics. Scientists in School is a Canadian effort formed by women who interact with elementary school children to inspire them to develop an interest in science. The Indian government has announced the introduction of flexible working hours of mothers of children under age 3. The Hertha Spöner Prize, named in honour of a German female physicist, is awarded by the German Physical Society to a young female researcher. The International Union of Pure and Applied Physics has a working group focused on women that organizes an international conference for women in physics. This is a very concerted effort to bring women of all countries together to brainstorm on encouraging women in physics. The European Commission's aim to have gender equity in science and achieve 25 percent representation of women in permanent academic positions is a very positive action.

The American Institute of Physics (AIP), the Canadian Association of Physics (CAP), and the Institute of Physics (IOP) in the United Kingdom have specific working groups devoted to gender issues. These seek

to build networks of women, to increase their visibility, and to increase awareness about existing gender-based biases. The use of site visits to assess the environment of a physics department or institute was initiated by the AIP and the IOP. This has served to increase gender sensitivity in the work environment. Affirmative action has been implemented in various Universities and research institutes in the world to encourage women in physics. Key goals of women in physics are to work toward minimizing biases, to engage in activities designed to educate the broader community about the impact of physics in daily life, and to take every opportunity to highlight positive female role models in physics. Furthermore, the images of physics and physicists that are presented in textbooks and the media must ensure that women are well represented.

See Also: Affirmative Action/Equal Opportunity; American Association of University Women; Astronomy, Women in; Education, Women in; Science, Women in Science Education for Girls; STEM Coalition.

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