

US Women in Physics: By the Numbers

To understand any problem, it is best to begin with data. Below, we present a summary of some commonly asked questions about the participation of women in physics. The questions are answered with data from the AIP Statistical Research Center (www.aip.org/statistics), courtesy of Rachel Ivie and Susan White.

Q How has the number of women in physics changed over the course of time?

A It increased between 1980 and 2011.

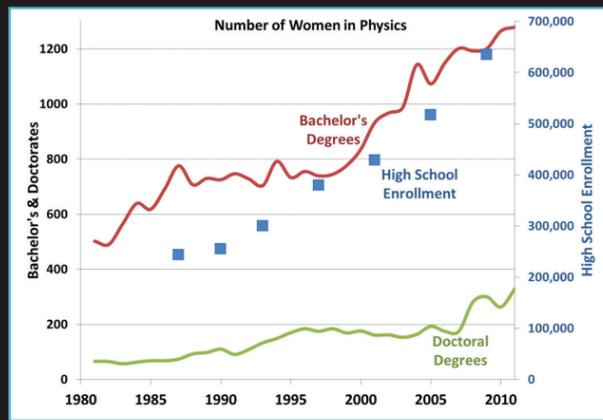


Fig. 1: Number of women in physics, by level (1980–2011). Note that high school data is not collected annually. Data is available for only the years shown.

Q How has the percentage of women in physics changed over the course of time?

A It also increased between 1980 and 2011.

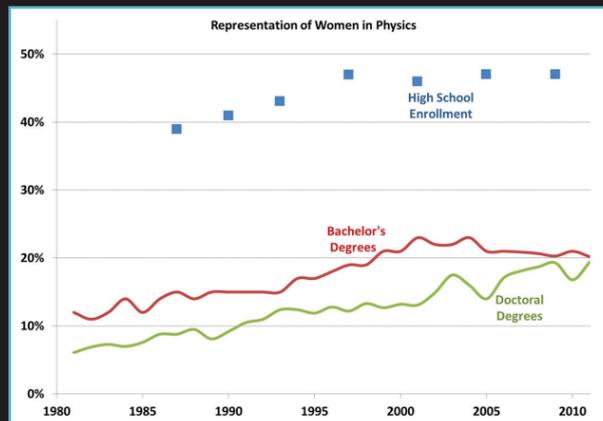


Fig. 2: Percentage of women in physics by level (1980–2011).

Q How does the percentage of women in physics at the bachelor's level compare with that of women in other STEM fields?

A It is significantly lower than in biology, chemistry, and math, but slightly higher than in the fields of engineering and computer science.

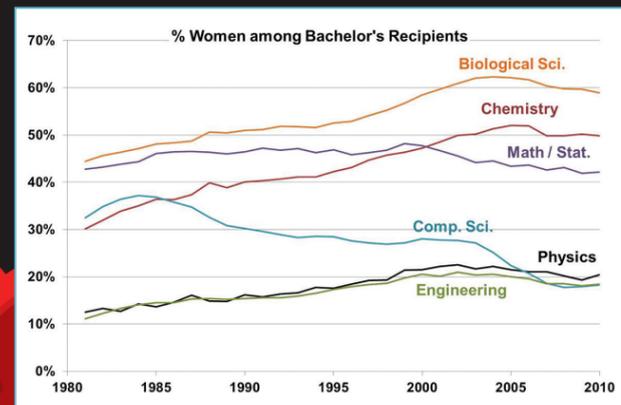


Fig. 3: Percentage of women earning degrees in STEM fields at the bachelor's level (1980–2011).

Advice

"I have seen great benefits to women in physics when the university where they are studying has a social support group for women students which meets regularly."

— Mildred Dresselhaus,
Massachusetts Institute of Technology

"Expect your ability as a physicist to be questioned. Always respond by keeping the discussion professional rather than personal. Math 'em!"

— Ruth Howes, Ball State University

Q Can you say any more about the idea of the "leak" in the pipeline for women pursuing physics careers?

A Our most recent study on this topic is from 2005. (*Women in Physics and Astronomy, 2005*, by Rachel Ivie and Kim Nies Ray). We examined the transition from high school to bachelor's degree to doctorate to assistant professor to associate professor and, finally, to full professor. We note that there is a "leak" in the high school to bachelor's degree transition with females representing about 47 percent of physics students in high school and about 21 percent of bachelor's degree recipients. After this initial leak, women are represented at about the levels we would expect based on degree production in the past. While it is true that the representation of women among full professors is lower than that for associate and assistant professors, it is also true that full professors earned their degrees earlier than the associate and assistant professors. Women are represented among the full professors at the rate one would expect given women's representation among degree recipients for the years during which they earned their degrees.

Q Are there any measurements that give concrete insight into some factors that have an effect on the participation of women in physics?

A Until we do a longitudinal study of individuals, we will not be able to discuss factors that have an effect on the participation of women in physics. The results of the Global Survey of Physicists do draw attention to the need to focus on factors other than representation when discussing the situation of women in physics. For the first time, a multinational study was conducted with 15,000 respondents from 130 countries, showing that problems for women in physics transcend national borders. Across all countries, women have fewer resources and opportunities and are more affected by cultural expectations concerning child care. Limited resources and opportunities hurt career progress, and because women have fewer opportunities and resources, their careers progress more slowly. We also show the disproportionate effects of children on women physicists' careers when compared to male physicists' careers. Cultural expectations about home and family are difficult to change. For women to have successful outcomes and advance in physics, they must have equal access to resources and opportunities. //

Q How is the number of women in physics related to the level of study?

A We can look at the numbers in progressive years; however, this is not necessarily proper since not every student who earns a bachelor's degree in physics took physics in high school, and not every student who earns a doctorate in physics earned an undergraduate degree in the field. To properly examine the pipeline would require a longitudinal study with a large enough initial sample to follow progression fifteen years beyond initial enrollment in freshman physics. With that caveat, we present the following data.

1996-97: 47% of high school physics students are female

2002: 23% of physics bachelor's are awarded to women

2008: 19% of physics doctorates are awarded to women

Fig. 4: Representation of women at various points in the academic progression from high school to a doctorate. The timing shown in the steps is representative. Four to five years is the typical time between earning a high school diploma and a bachelor's degree, and six years is the median time to complete a doctorate.

For comparison, consider data from biology and chemistry.

1996-97: ~49% of high school biology students are female

2002: 61% of biology bachelor's degree recipients are women

2008: 50% of biology doctorates are women

1996-97: ~50% of high school chemistry students are female

2002: 50% of chemistry bachelor's are awarded to women

2008: 37% of chemistry doctorates are awarded to women

Fig. 5: Academic progression of women in STEM fields, based on representative timings for each degree from high school to doctorate.

Actual and Expected Percentage of Women and Men in Physics in the U.S.

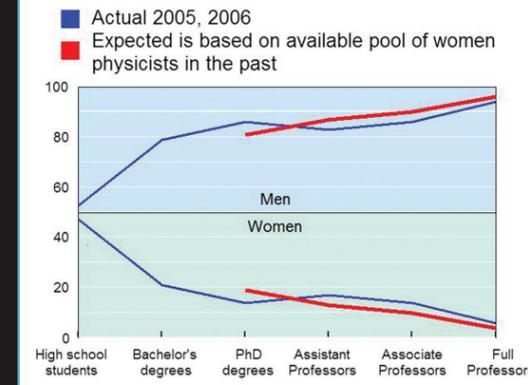


Fig. 6: Actual and expected numbers of women in physics at various levels.

References

Data for Figures 1 and 2 are from studies conducted by AIP's Statistical Research Center. All other data are taken from webcaspar (webcaspar.nsf.gov).

The time to a bachelor's degree is from the *Baccalaureate and Beyond Study (B&B:08)* conducted by the National Center for Education Statistics (nces.ed.gov/surveys/b&b). The time to doctorate is for physicists compiled by AIP's Statistical Research Center. It is not expected to be dramatically different for other science fields.

The 2005 study is *Women in Physics and Astronomy, 2005*, by Rachel Ivie and Kim Nies Ray (www.aip.org/statistics/trends/reports/women05.pdf).

For more about the Global Survey of Physicists, see "Women in physics: A tale of limits" by Rachel Ivie and Casey Langer Tesfaye in the February 2012 issue of *Physics Today*.

For more information on the demographics of the physics community, see the AIP Statistical Research Center: www.aip.org/statistics.