

## 2. Where Are the Women of Graduate Science and Engineering

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I have my B.S. in Mechanical Engineering, did two years graduate work in mechanical engineering, and am currently in the Ph.D. program in Environmental Engineering Science at the University of Minnesota. Ever since I switched from liberal arts studies to engineering as an undergraduate, I have been a minority as a woman in my major field. Where are the women of engineering and science? From my own experiences and from sharing with other women in science, I think the basic issue is that science and engineering are still a “man’s world.” This idea has many implications and, in my opinion, goes a long way in explaining many of the challenges faced by women in the sciences.

Much of the stage for how women relate to science is set far earlier in their lives than college study. It is important to understand these early influences in the context of later consideration of graduate study. As children, women go to the same schools as men do. They attend the same classes with the same teachers from pre-school through high school. So, why don’t women pursue careers in science and engineering as often as men? A large part of the answer may be found in the suggestion that women receive a different education than men. At the elementary and secondary level of education they often are not given the attention in the classroom that their male counterparts receive. They often are not encouraged and sometimes are actively discouraged from the sciences. Girls often are expected by society not even to display aptitudes for science and math. In high school, a girl may be socially ostracized for academic achievement in the sciences. On a more fundamental level, aggression by women is discouraged in many aspects of life. In education, this may mean less class participation and active questing for learning. These social forces are fundamental in shaping a woman’s attitudes toward her ability and opportunity to be a scientist.

Negative attitudes toward women in science often extend beyond schools into families and society in general. The examples in the companion article, *Jeopardy — Category: U.S. Women in Water Resources*, show the long history and pervasiveness of these attitudes in our society, even recently. These perceptions may be so ingrained in a woman’s life as to make overcoming them very difficult.

Women don’t lack analytical or technical capabilities. Being female does not mean that the talents necessary for being a good scientist or engineer are not part of the

inherent make-up of a person. However, due to the disparity in education and treatment by society, women often do lack other qualities necessary to succeed in science. Women entering post-secondary educational programs often are missing the confidence and sometimes even the recognition that careers in science and engineering are open to them. Studying the sciences is quite challenging and requires confidence to persevere. Without the security of knowing that she has the right and capability of attempting any career, many women do not even consider the sciences when planning their futures.

Women who do choose to study science or engineering at the university level may face continuing difficulties based on their gender. There is one observation I would like to point out from my own undergraduate experience that I found surprising. Most of the resistance to women in engineering that I experienced came from my fellow students. Neither my department nor my professors ever made me feel less a part of the program because I am a woman. However, the male students with whom I attended class every day often made me feel separate and not always welcome as an engineer. There were many times when I heard references to women getting engineering jobs based on preferential hiring practices to fill quotas. The fact that women may be employed because they have good qualifications as engineers was not always considered relevant to their hiring. I actually heard comments such as “she’s a woman, she won’t have any problem getting a job as an engineer after graduation.” Although it would be nice to think that this statement implies that women have natural abilities for science based on their gender, I doubt this was the case. Consider what it is like to be faced with having individual talent disregarded at the outset based on gender.

Reactions of male students to female students also occur on a social level in addition to a professional level. Female science/engineering students often sacrifice being socially acceptable to their peers in order to be professionally acceptable. To be professionally acceptable to male students, a woman may often become “one of the guys.” This then sets her apart socially as a female engineer first, and a woman second.

Although women in science and engineering face special challenges as “minority students,” many never receive any nurturing as undergraduates. Without encouragement and sometimes with open opposition as **undergradu-**

ates, they do not consider continuing their education at the graduate level. Consideration of graduate work in the sciences can be daunting because of the high caliber of work and dedication required. Faced with this perception and lacking positive reinforcement during their undergraduate studies, many women may not feel that they could succeed in a graduate program. In my own case, despite academic success, I did not consider myself of graduate student caliber. Fortunately, one professor made the effort to tell me he thought I should consider graduate school and recommended I apply for an undergraduate research position to see what research could be like. This small episode of mentoring changed my attitude enough that I am currently pursuing a doctorate in an engineering program.

Many of the challenges to women in undergraduate programs are intensified for women in graduate programs. In some departments or programs, they may be in an even smaller minority than in an undergraduate program. Being a minority in a program of male students and faculty can be difficult. Drawing on personal experience, I have vivid memories of sitting in a weekly seminar required of all graduate students in the department sometime during their graduate studies. There often would be about 100 students, of which four or five were women. It was an extremely odd feeling. None of the attending faculty were women. None of the speakers were women. I also attended a conference where I was literally the only woman in a room full of men. I took one series of graduate classes that lasted three quarters, and I was the only woman in the class for the entire year. Experiences like these can constantly remind a woman that she is "in a man's world."

I have found that interactions with fellow graduate students and faculty are as much a part of graduate school experience as attending classes and doing research. These situations, where there is a lack of women as colleagues and role models, are influential on the success of women in entering and completing graduate programs. As I pursue my doctorate, I have yet to have a woman professor in a class, which would serve as a reminder that women achieve advanced degrees and the professional success that accompanies them. Achieving a Ph.D. in science is a long, challenging process, and the demonstration that there are rewards for women as well as men for the effort expended would help to ease the road.

The experiences I have shared may be extreme examples of being a minority as a woman in engineering. However, I believe a general feeling of exclusion is a common experience for women in science and engineering.

There are several obvious avenues of breaking down the barriers that should and are helping to change current attitudes. For example, more women must join engineering and science faculties to provide role models and active mentoring for women. This is a burden shared by

women attaining graduate degrees in engineering and science and the departments that need to diversify their faculty. All faculty in such departments must be aware of the special challenges facing their female students. It is vital that departments provide encouragement and active mentoring to help women overcome their own doubts and the biases of others. Women must be encouraged at early ages to keep an open mind toward the sciences and their abilities to participate in science. Unfortunately, many of the obstacles to science for women are not so obvious and are an integral part of our society. Removing them will take extended effort by men and women alike for some time to come.

As I mentioned before, I personally have never experienced overt or implied prejudice based on my gender from faculty, even though all of my professors for science and engineering classes have been men (except for two classes co-taught by one man/one woman teams). I have wondered if I have been fortunate in having enlightened professors or if they feel compelled by affirmative action and discrimination guidelines to be careful in their behavior towards women in their programs. I will continue to give them the benefit of the doubt and thank them for not actively adding to the problem of getting and keeping women in science. Additionally, it is important to recognize those in academic programs who are actively trying to change their own and others' attitudes toward women in science and engineering programs. To them and to the women of courage who have gone before, I extend my gratitude and continued hope through my own presence in science.