



An Engineering Summer Camp at WPI for Middle School Girls: PROGRAM INFORMATION

Camp Reach

Need for the Program

A technologically literate workforce is a critical and growing need in the United States. While females comprise more than half of our population, only 11% of practicing engineers are women. Full participation of women and minorities in engineering is needed, not only for reasons of equity, but for economic security. New entrants to the work force in the 21st century will be predominantly women and minorities. In order for companies to maintain leadership in a global economy, more women and minorities must be prepared to assume positions as engineers and managers. In addition, a more diverse technological workforce could revitalize corporations, government, non-profits, and universities by providing new perspectives on old problems and by bringing a broader range of skills and life experience.

Studies indicate that a critical time in the "pipeline" of women into technological careers is the middle school years, when it is common for girls to lose interest in math and science.¹ Furthermore, research has shown that women who do enter science-related fields often are motivated by experiences *outside of school*.² WPI is uniquely positioned to provide an intervention program for Central Massachusetts that draws upon the motivating effect of life on a college campus, use of state-of-the-art technological facilities, and mentoring by talented students, faculty, and middle school teachers brought to campus for the program.

Program Goals and Objectives

Camp Reach has been in operation since 1997. In 2003 it received a national award from the Women in Engineering ProActive Network and in 2011, it received the Presidential Award for Excellence in Science, Mathematics, And Engineering Mentoring. The primary goals of Camp Reach are to generate and sustain adolescent girls' interest in engineering and technology, their motivation toward education, and their self-confidence. We seek to have an impact beyond the thirty girls who participate each year by involving other organizations within the greater Worcester community, and in particular, the girls' parents and middle school math and science teachers from Massachusetts.

We believe that a key to realizing the full representation of women among engineers lies in communicating the nature of what engineers do, how they benefit our society, and the breadth of skills that they use. Thus, the objectives of the camp program are for girls to experience the following aspects of engineering:

- Engineering requires collaborative work in teams
- Engineers make the world a better place when they identify problems and design solutions that benefit individuals, organizations, communities, and societies
- Engineering requires excellent written and oral communication among individuals and groups
- Engineers apply knowledge in areas of math and science

¹ See, for example, P. Orenstein, *School Girls, Young Women, Self-Esteem and the Confidence Gap* (New York: Doubleday, 1994), p. 23; S. Brush, "Women in Science and Engineering," *American Scientist* 79, 404-419 (1991).

² E. Stage, *Interventions Defined, Implemented, and Evaluated* (Washington, D.C.: National Academy Press), p. 18.

Program Design

The two-week program is designed for thirty girls entering the seventh grade in the Fall after the camp. Campers stay in one of WPI's residence halls and eat in our dining hall to get them excited about the college environment.

The program content emphasizes that engineering can be a "helping profession" and focuses on hands-on experiences as a means of building interest and confidence. An **Engineering Design Project** is the major focus of the camp experience and is the primary means of introducing the nature of engineering as a collaborative problem solving process. Non-profit organizations in the Worcester area sponsor these projects. For example, one team of ten girls completely redesigned two rooms at the Edward Street Day Care Center to enable teachers to find and utilize supplies more readily. The team defined the problem and constraints, gathered information, defined design specifications, brainstormed alternative solutions and analyzed them against their specifications, and selected the best solution using a decision matrix. Another team designed a library and borrowing program for parents of premature infants in Memorial Health Care's Neonatal Intensive Care Unit. Three such projects are developed for each program, and the project team prepares a written report and two oral presentations of their project work.

The other major aspect of the program is **Discovery Workshops**, which emphasize hands-on learning and exploration rather than finding a "correct answer." For example, in a Rehabilitation Engineering Workshop, girls meet, explore assistive devices that enable the physically disabled to be more independent, and make measurements of WPI's campus to see if walkways, ramps, elevators and entrances comply with Americans with Disabilities Act (ADA) standards.

The daily schedule also includes recreational activities in the evening and free time on computers. During the interim weekend of the two week program, activities are focused on empowering the girls and building self-esteem. Teachers are encouraged but not required to participate in that weekend's activities.

Staffing and Job Descriptions

The staffing structure was created so that the girls are provided with a spectrum of role models from high-achieving women high school and college students, WPI faculty, and middle school math and science teachers. This section gives a brief description of the roles that various staff members have.

Co-Directors: Responsible for advertising, dissemination, fundraising, applications processing, admissions, hiring of staff, compliance with state regulations, scheduling, field trips, the engineering design project selection and teaching materials, and other oversight duties. One of the Co-Directors takes the lead in guiding staff and campers on the design projects and one of the Co-Directors plans and implements the Discovery Workshops. They also determine what, if any, facilitation is needed from other staff members in order to execute the workshop, and prepare the staff members for their roles.

Residential Assistants: Four to five WPI undergraduate or graduate female students who live in the residence hall with the campers, coordinate recreational activities, and supervise the campers from 5pm to 8am.

MIDDLE SCHOOL TEACHERS: Three middle school (grade 6-8) math, science, or technology teachers from Massachusetts work with the campers during their daytime hours (8:30am to 5pm), with assistance from WPI staff members. *Teachers commute from home; they do not stay in the residence hall with the campers.* They participate in staff training to become familiar with the engineering design process as we teach it to young girls. Each teacher (assisted by 2-3 high school students) is assigned to work with one team of ten campers on their Engineering Design Project. During the hours of each day allotted for the project, they help the girls meet specific goals set for each day and facilitate the sharing of ideas and effective teamwork. The projects themselves are not very technical, and the teachers do not need extensive computer or technological knowledge. What they do bring to the team is an all-important adult perspective and the experience of knowing how to work with girls this age.

The reason that the problems given to the team are not especially technical is because the essence of engineering is *solving problems for a customer*. Many times, engineers use computers or other high-tech equipment to develop or implement the solution. However, these are simply tools, and use of such tools will

not be necessary for the projects selected for this program. Teachers do find that they can tie aspects of the project to math and science curricula, and that they can apply many of the techniques used for the engineering design project during their regular school year activities.

Teachers also participate in each day's Discovery Workshop activities. This participation may be in large part observational, while other workshops need more active facilitation and co-teaching on the part of the teachers and other staff members. For the latter cases, all material will be reviewed and explained during staff training, and the workshop leaders will also be available and participating during the workshop itself.

High School Student “Teaching Assistants”: Six to nine high school students are selected for the camp based upon their enthusiasm for math, science, and engineering and their interpersonal skills. These are volunteer positions, and many Camp Reach alumnae apply. They are assigned (in groups of two or three) to assist the Middle School Teachers in facilitation of the design projects. They also supervise campers during workshop activities and escort them around campus. They live in the residence hall with the campers, and serve as important role models and “big sisters.”

Description of Campers

Participants are drawn from sixth grade students in Massachusetts. Applicants must write an essay, and participants are chosen on a lottery basis from those essays found to be of acceptable quality. Prior achievement in math and science courses is not a criterion in the selection process, nor are recommendations. The tuition is \$1295, and financial assistance is available to those with need.

Impacts of the Program on Participants

Key findings for the 2009 program include:

- *After the program, Camp Reach participants expressed higher levels of interest in engineering and a better understanding of engineering.* This year, surveys indicated that participants’ interest in engineering at the end of the program was higher than their initial interest, but the difference was not statistically significant. Parents also reported higher levels of interest in engineering among their daughters. Participants’ self-reported understanding of engineering improved as a result of the program, and that difference was statistically significant. Participants’ descriptions of engineering most often included terms such as building, creating, and designing. Inclusion of “helping” and “solving problems” were more frequent this year and those results were statistically significant. Another interesting result, several participants mentioned creativity and inventiveness in association with engineering. Fewer participants mentioned “problem solving” than in previous years.
- *Camp Reach was also effective in improving measures of engineering efficacy and confidence.* On all 3 measures of confidence and self-esteem, participants responded more positively at the end of the program with all three results being statistically significant. The participants answered the question, “I could be an engineer if I wanted to.” They also completed self-ratings of skills relevant to an engineering career. The third measure was one of self-image and self-esteem based on participant self-ratings. Parents’ assessments of their daughters’ self-confidence were higher several months after the program in comparison to the beginning of the program, and they frequently cited improved confidence and independence when describing effects of the program on their daughters.

The Middle School Teachers on staff left with plans to incorporate the engineering design process into their teaching. Several high school Teaching Assistants reported that the program affirmed or increased their interest in studying engineering in college.

Formative evaluation is conducted in informal ways, through conversations with staff throughout the program, and in formal ways, via surveys that participants complete after the first week of the program and upon completion of the program. Formative evaluations for 2015 were once again strong, and indicate high levels of satisfaction among campers, parents and staff.