Pre-College Experience in Physics 2015

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The Pre-College Experience in Physics (PREP) is a summer program for high school students aimed at fostering interest in the natural sciences and increasing female representation in physics and other STEM (science, technology, engineering, and mathematic) fields. Held on the University of Rochester River Campus, the program runs for three and a half weeks in July from 9:00 a.m. to 3:00 p.m. The program is free to all attendees.

This year’s eighteen participants attended twelve different schools in the greater Rochester area and arrived to the program with varied academic backgrounds in science and mathematics. None of the girls had taken physics, though many excitedly reported they were signed up for a physics class in the fall. The participants also reported a wide range of scientific interests—many expressed a definite desire to pursue the natural sciences, engineering, and/or medicine, with an open mind to considering a wide range of career paths, from becoming a physicist to practicing law.

An average day at PREP consists of lectures and demonstrations on a particular physics concept. The material is then supplemented with activities, labs, hands on demonstrations, tours of research labs, and presentations by professional researchers from the University. Our goal was to provide the participants with fun, hands-on experience in physics that was relaxed while still being educational and challenging. Given that the participants had a wide range of math backgrounds and no prior experience with physics, we started with math basics. Once confident with the preliminary math, these concepts were applied to physics topics. They gained an understanding of trigonometry, vectors, and unit conversions to give them a solid foundation in future study of science. Our ambitious program was met with a surprising level of interest among the participants—we were pleased by the excellent questions that were asked every day. Because the program is run by two instructors, we were able to give the young women plenty of individualized support and make sure they were thoroughly understanding concepts.

Faculty members (almost all women) frequently visited to give the participants a new perspective on their research and to answer questions about their career and experiences. The participants enjoyed meeting the professors and were not shy about asking
challenging and perceptive questions. The PREP participants were also able to visit many University of Rochester research facilities on campus and at the medical center over the course of the program, which not only allowed them an exposure to new fields of study, but insights into what the daily life of a scientist entails. In addition to lab tours, they met with a University Office of Admissions counselor, as well as administrators at the School of Medicine and Dentistry, where they had a brief tour.

One key component of the PREP program is lunches with undergraduate women in STEM fields from various University of Rochester departments. The undergraduates met with small groups of the participants to discuss college, studying science, doing research, and career plans. These informal meetings allowed the girls to see how topics learned in a classroom are applied in a research setting, discover new interests, and get a better understanding about what science (and college) has to offer. The visiting undergraduate students were always female, in order to give the students strong role models of girls like themselves who are successfully pursuing an education in a STEM field.

The PREP program specifically highlights particle physics. Since this is most of the girls’ first exposure to the topic, the students found it to be fascinating. To give the participants a well-rounded introduction to particle physics, we organized lectures, demonstrations, experiments, and a look at real particle physics research conducted at the University of Rochester. To supplement the PREP instructor’s lessons, a University of Rochester professor spoke about her involvement in the Compact Muon Solenoid experiment. The particle physics component of the program got the girls to think about the world from an entirely different perspective and challenged their conventional views on how our universe functions.

Two additional key components of the PREP Program are the Rube Goldberg machine project and the individual research projects. For the Rube Goldberg machines, the participants were placed into groups and given an assortment of random materials and asked to build a machine that has a series of unique chain reactions. The participants were required to include the Newtonian forces they learned about in their machines and had to be able to explain the physics behind every reaction in their machine. This helped the girls apply their newfound physics knowledge and improve their engineering and teamwork skills. They loved working on these projects—a few of them said it was their favorite part of the program.

For their individual projects, the girls researched a topic of their choice within physics and created a poster on what they learned. Our goal with this project was to familiarize the participants with the research process, help them become more comfortable presenting in
front of others, and allow them to explore physics in the context of one of their own interests. The girls worked on their posters during the last full week of the program and had plenty of time to ask questions and gain feedback.

On the final Friday of the program, the girls presented their posters during a poster session that was open to the physics department. The physics department and all those who spoke, gave tours, or helped out with the program were invited to browse the posters and ask the girls questions. The participants were proud to showcase their work and the guests were impressed by the caliber of their work and all the material the girls had learned. Many of the participants were nervous about presenting but later reported that it was a very rewarding experience.

The goal of the PREP Program is not only to foster an appreciation of physics in young women but also to improve problem solving, group work, and research skills. We try to help them realize career potentials and show them that science can be both fun and fulfilling. Through PREP self-evaluations, we noted that many of the women felt their skills improved and their interest in STEM fields increased after completing the program. Participants stated that the program improved their ability to understand concepts and do experiments. They also felt more confident in their ability to apply scientific concepts to real life problems, as well as becoming more adept at working in a group to complete a task.

The PREP program has a lot to offer young women interested in physics and other STEM fields. One benefit to the PREP program is its ability to be flexible to the needs and interests of its participants, and the time to cover a variety of subjects. Another is the ability to connect these girls with other women in STEM fields. Above all, the girls were able to leave with new friends and experiences to inspire them to pursue their interests.