Pre-College Experience in Physics 2017

Jeanie Wolfs and Adina Ripin
University of Rochester
Department of Physics and Astronomy
Rochester, NY

The Pre-College Experience in Physics (PREP) is a summer program for high school females aimed at fostering interest in the natural sciences and increasing female representation in physics and other STEM (science, technology, engineering, and mathematic) fields. The program is held on the University of Rochester River campus, in Bausch and Lomb Hall where the Department of Physics and Astronomy is housed, along with research laboratories, a library, classrooms, and office space. This commuter program runs for three weeks in July from 9:00 a.m. to 3:00 p.m. and is free to all attendees.

This year's 21 PREP participants came from 12 public and private schools all over the greater Rochester area representing both suburban and rural neighborhoods. The students' arrived with varied academic backgrounds: most had studied algebra and geometry, though some were preparing to take calculus in the coming school year. Coming into the program, none of the girls had taken a physics course, although many enthusiastically stated in their applications that they would be taking either AP or Honors physics come 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 marine biologist to a sonographer.

An average day at PREP consisted of a lecture in the morning on a particular physics concept, supplemented by demonstrations and followed by hands on labs and activities to bring the material to life. To further bring into perspective the many paths you can take with physics, we also incorporated tours of research labs, a tour of a medical building, and presentations by professors in many different disciplines from across the University.

Our goal was to provide the participants with a 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 focused on physics concepts instead of formulas, and did math problems as a group when necessary. Our ambitious program was met with an encouraging level of interest among the participants – we were excited by the thoughtful and creative questions that we were asked daily.

Faculty members (almost all women) frequently visited to give the participants a new perspective on their research field 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 of the University of Rochester's research facilities such as the medical center, the Laboratory for Laser Energetics, and the Rochester Center for Brain Imaging. The participants also met with an admissions counselor, which gave them the chance to ask questions about the college process.

One key component of the program is lunches with undergraduate students doing research over the summer in various fields of study. Each lunch group consisted of five PREP participants and two or three undergraduate women. Each PREP participant attended these lunches two or three times over the course of the program. These meetings allowed the girls to see how lecture concepts are applied in a research setting, discover new interests, and get a better understanding of how science is "actually done." Undergraduates who spent time with the girls were majoring in physics, astronomy, optics, chemistry, biology, computer science, and biomedical engineering, and attended a variety of colleges. These undergraduates served as role models for women in science and gave the students the opportunity to network, have their questions answered directly, and learn about all science and college has to offer.

The PREP Program specifically highlights particle physics. Since this was most of the girls' first exposure to the topic, many found it fascinating. To give the students a well-rounded introduction we organized lectures, demonstrations, experiments, and a look at real particle physics research conducted at the University of Rochester. To supplement the instructors' lecture of particle physics, Professor Regina Demina spoke with the students on symmetry, the fundamental forces, particles, and the Compact Muon Solenoid experiment at CERN, as well as her experience being a woman in physics. 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 competition and the individual research projects. For the Rube Goldberg competition, the students are placed into groups and given an assortment of random materials – cardboard boxes, legos, hot wheels tracks, and other toys– and asked to build a machine that had several unique reactions. The students were required to include the Newtonian forces they learned about in their machines and must be able to explain them. This helped the girls apply their knowledge and improve their engineering and teamwork skills. The girls loved working on these projects; a few of them said it was their favorite part of the program. The theme of

the projects this year was the Pixar movie “Finding Dory.”

For their individual projects, the girls were told to research “The Physics of _____” and create a poster. Our goal was to familiarize the students 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. We arranged for a tour of the physics library that showed them how to use the library search databases of a university as well as locate books so they did not rely solely on the internet. The girls were given class time to work on their posters and therefore had plenty of time to ask questions and gain feedback on their work.

On the second to last day of the program, the girls presented their posters to the class and then held an open poster session. The physics department and all those who spoke, gave tours, or helped out with the PREP program were invited to browse the posters and ask the girls questions. The students were proud to showcase their work and many of the guests were impressed by the caliber of their work and all the material learned. Many of the students were nervous about presenting during the poster session but later reported that it was a very rewarding experience that boosted their self-confidence.

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 young 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. One participant said, “I really enjoyed PREP- my favorite part was getting to see how physics applies to so many different things!”

The PREP program has a great deal 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 and freedom to cover a variety of subjects, especially those not traditionally covered in a high school physics class such as particle physics, quantum mechanics, and astronomy. The program also has the ability to connect these girls with other women in STEM fields. Above all, the girls were able to leave this program with new friends, experiences, and self-confidence to inspire them to pursue their interests.