

The Wide World of Physics: Diversity in Science

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Since being awarded \$300 to visit high schools and young women in order to spread knowledge and interest in physics, SPS at UCF has given a presentation to a group of young girls and has visited high schools on three separate occasions.

Young Women Leaders Program

In June 2010, the UCF chapter of SPS hosted a physics demonstration for the Young Women Leaders Program at the UCF Academy for Teaching, Learning and Leadership. The purpose of this demonstration was to get young students involved and excited in physics. In order to accomplish this, SPS members organized activities and performances, many of which allowed the young girls to get a hands-on experience and have some fun. The following demonstrations would not have been possible without the help and support of the National SPS office, Costas Efthimou, and Ray Ramotar at UCF.

- 1) Index of refraction: Using a 1000-mL beaker, a glass rod, and a couple liters of oil, we were able to demonstrate how different materials displace light. By placing the glass rod and the oil in the beaker at the same time, it appeared that the rod itself had disappeared.
- 2) Conservation of angular momentum: Using a stool on a rotating platform, we were able to show explicitly the conservation of angular momentum at work. While spinning on the chair, each student would hold a light weight and extend and retract their arms. This would slow down and speed up the rotation of the stool considerably.
- 3) Electric Potential: We had an SPS member demonstrate how the buildup of potential can make ones hair stand on end.
- 4) Collisions: Using 3 large rubber balls, each of a different size, we were able to approximate an elastic collision. By carefully dropping the balls while stacked on top of each other, we were able to launch the top ball across the room using the kinetic energy of the 2 balls below it.

5) Bed of Nails: Our finale involved sandwiching two students between beds of nails and smashing a cinderblock on top of them. The beds were not light, and the nails were not dull, so this demonstration gave the girls a frightening and exciting exposure to pressure. We spent the entire \$300 on construction of the bed of nails, the cost of which exceeded the awarded amount. This demonstration was carefully performed by trained students and precautions were taken. A video can be found at:

<http://www.youtube.com/watch?v=1CKSgIle4KM>



Lake Mary High School

In early December 2010, Christopher Frye, the vice president of SPS, visited the AP Physics class at Lake Mary High School taught by Steven DeSanto. He gave a theoretical presentation of the vibrating string.

Since all the students in the AP class at LMHS had taken a full semester

of calculus by the time of his visit, CF decided to give a talk that was mathematically involved. He began by introducing the students to functions of two variables and giving examples of how such functions could arise in physics. Next, he defined the partial derivative and taught the students how to calculate partial derivatives of functions with which they were familiar. He concluded the mathematical introduction to the presentation by giving the students an introduction to the definition of a differential equation and its solution. Next, CF derived the equation of motion for small vibrations in a string by using free-body diagrams and Newton's laws. After obtaining the result - the one-dimensional wave equation - he discussed two solutions with the class. First, he showed them the traveling wave solutions on the very long string and showed the students that their physical intuition can guide them to the answer. After this, he showed the students the standing wave solutions on the string with fixed ends. After writing down the standing wave solution, he showed the class how to find the frequency of oscillation of the string and how it depends on the length, tension, and density of the string as well as the harmonic of the oscillation. To conclude the presentation, CF demonstrated to the class how a guitar works, and how varying the length, tension, and density of the strings, as well as the harmonic that is played, will vary the pitch of the note we hear.

Steven DeSanto was very pleased with the presentation, and he kept CF around for about thirty minutes to talk to the students about what physics is like after high school. The students also asked many question about the presentation and about college, and they seemed to enjoy the presentation greatly.

Olympia High School - Visit #1

In mid-December 2010, Matt Suttinger, our web administrator visited Kevin O'Grattan's classroom at Olympia High School to give demonstrations and lectures to the Physics Honors students. He taught the first four periods of the day, and all the classes had the same physics background up to that point (kinematics and some rotational motion). MS went to give some introductory physics demonstrations and explanations.

First period was his first experience giving such demonstrations, and he ran a bit slow. He used the weighted bars, spinning chair with weights, the bicycle wheel, the spark machine, and the faraday cage. With those he ex-

plained the basic concepts of torque and conservation of angular momentum, charge, potential difference, capacitors, air ionization, and the faraday cage effect. He had a couple of students ask questions afterward, and they seemed engaged.

By second period MS had become more comfortable. He decided to give each class a slightly different lecture in order to be able to cover all the material and, with luck, have the students from different periods discuss the presentations with each other to find out about which ones they did not see. He showed them the spark machine, faraday cage, ring launcher, and glass rod in oil. He used these to explain charge, capacitors, air ionization, potential difference, the faraday cage effect, magnetic induction, and Snell's law. He spent a significant amount of time on the ring launcher trying to explain magnetic induction. Since the class had no apparent familiarity with vectors, fields, or magnetism in general, he gave a slow and somewhat repetitive explanation while trying to comprehensively cover the phenomena related to the machine, and the class seemed receptive. He was also able to spend a good deal of time on Snell's law and even explained total internal refraction to them.

MS tried to repeat what he did for the first period in the third period, and this class seemed more attentive than the first class had, so he managed to finish all the material early. Because he had some time left, MS decided to try an explanation of the ring launcher and magnetic induction. He doubts the class retained much, but most seemed to at least follow the explanation on a base level. One person came afterwards and asked some detailed questions about induced currents in the ring, and MS was able to give some explanations and examples and show why the ring with the gap could not launch.

For fourth period, MS had decided to start with some optical effects from a convergent and divergent lens and then go into a detailed explanation of the laser. The class seemed very attentive, but no one had questions after his explanation of the laser. They asked to see some of the other demonstration they saw on the cart, so he went over the spark machine and the faraday cage. This class gave applause at the end, and a couple of students came up afterwards to ask questions about faraday cage effect and light.

Olympia High School - Visit #2

The next day, we went back to Kevin O'Grattan's class at Olympia High School for the first four periods of the day. This time, Candy Reid, our acting president, accompanied Matthew Suttinger, and she presented a lecture with video aids to the four classes.

The talk was generally based on flight and specifically focused on insect flight. Videos for these presentations were obtained from an REU that CR attended at Cornell University during the summer of 2010. The topics that she addressed informed the students of forces on wings in translational flight and how Bernoulli's principle applies. She focused mainly on the forces of lift and drag that both insects and airplanes use to maneuver during flight and on how insects depend on these forces since they cannot rely on propulsion. She discussed vertical flight, forward flight, and hovering, and she conducted a demonstration to show how insects use the angle of attack of their wings to turn. CR finished the presentation with some fun videos of insect flight and fluid flow captured at high speeds. The students were captivated by how different things appear in slow motion, and several students were very inquisitive about two-winged flight vs. four-winged flight, applications of modeling flight, and even on how one can get the opportunity to do research.

Even though the classes included only a few seniors, CR encouraged the entire class to continue their educations in college and to pursue graduate school. We were very well-received and graciously thanked by Mr. O'Grattan for offering the students a chance to experience physics at this level.

Conclusion

We found these experiences to be very exciting and rewarding for us who taught, and we believe that the students also learned a lot. Above all, the students to whom we presented realized that there is much more physics out there than what they see in their high school courses, and many students became curious about how to learn more about these topics in college. We enjoyed these experiences very much, and we all plan to participate in similar activities in the future. We are very grateful for the funds provided by SPS that made these events possible.