PI TAU SIGMA ANNUAL CHAPTER REPORT
2014-2015
Cooper Union Pi Phi

A. Initiations

Cooper Union held two Pi Tau Sigma initiations during the 2014-2015 academic year, one in the fall semester and the other in spring semester. The fall initiation ceremony was held on October 2nd, 2014 and inducted 4 juniors. No senior mechanical engineering students were inducted this semester because the maximum number of senior inductees was reached through previous initiations. Similar to previous initiations procedures at Cooper, the incoming juniors were asked to submit a brief statement of intent describing their qualifications and reasons for pursing admittance to Pi Tau Sigma. There was less interest this semester than in previous years, but four juniors submitted compelling letters and met GPA requirements of at least 3.5/4.0 and ranked in the top 33% of the class. The induction ceremony for the four new members was conducted in a dimly lit room with the standard oaths read by the President and Vice president. All currently enrolled Cooper Union Pi Phi members attended the ceremony, including members who had moved on to Cooper's masters program. The ceremony concluded with a pizza lunch and a discussion of the year's agenda and goals.

The spring induction ceremony was held on March 10th, 2015 and only 2 juniors were inducted. A brief letter of intent was requested again from students who met the 3.5/4.0 GPA requirement and top 33% class rank requirement. Only two juniors expressed interest and both were inducted. Many other juniors qualified for induction this semester but the majority did not wish to join Pi Tau Sigma, even after the Faculty Advisor reached out with additional recruitment efforts. This induction ceremony was held exactly as the last. Cooper's Faculty Advisor also attended and delivered a congratulatory speech for receiving outstanding awards and the convention just a few days earlier.

B. Chapter Activities

Continuing the traditions of outstanding service and performance, Cooper Union Pi Phi focused on expanding and further developing our STEM outreach programs. In the fall semester, Cooper Union visited PS347, a nearby elementary school with which Cooper has worked before. The 4th grade science program in the fall aligned well with proven outreach activities. At the start of their electricity and magnetism unit, Pi Tau Sigma brought nearly all members to PS347 to build small electric motors with plastic cups, wires, batteries and magnets. This exercise proved to be very effective at introducing the students to circuits, electrical power, and electro-magnetic interaction. The students expressed many thanks to Cooper students for providing them with an engaging and enlightening activity. Cooper Union left the constructed motors with PS347 so that the science teachers could use them as demonstrations in future classes.

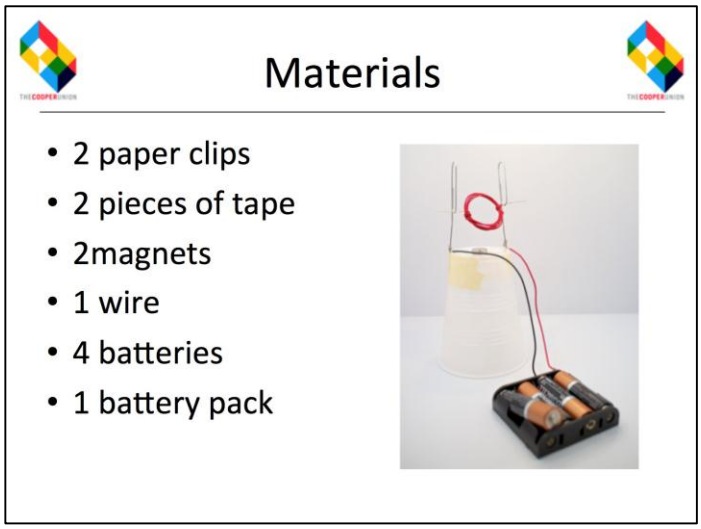

Figure 1: One slide of the motor building instructions given to the students.

Pi Tau Sigma formed relationships with new schools during spring semester. First, Cooper Union invited elementary students from Williamsburg North School for a tour of our LEED Platinum School of Engineering building, tour of the mechanical engineering automotive and experimentation laboratory, and the electric motor building activity. Our Faculty Advisor, Professor of Mechanical Engineering and Associate Dean, George Delagrammatikas, led the students on a tour of our building. He pointed out key green features like Cooper's rooftop gardens that collect rainwater and an exterior mesh that limits solar exposure to keep the building cool during the warmer months. During the tour of the engineering laboratories Pi Tau Sigma members showed the kids the Formula SAE racecar and discussed how Cooper students design it from scratch. The kids were shown CAD models and shown key features of the design. They each even got to sit in the drivers seat. An acetone engine demonstration was also performed to continue the theme of the day, energy. In the afternoon, Pi Tau Sigma members helped the kids build small electric motors (same motors from the PS347 outreach event). While electromagnetic concepts were discussed with the kids, the focus was on the conversion of energy, chemical to electrical energy (battery) and then to mechanical energy (the spinning wire coil).

Figure 2: Left, Williamsburg North students with the FSAE car. Right, George Delagrammatikas (Faculty Advisor) shows and electric motor to a student.

Two other outreach events were hosted at Cooper Union with high school juniors from schools adjacent to Cooper, Grace Church School and La Salle Academy. The activities for each event were identical. First, our Faculty Advisor gave a tour of the School of Engineering. In addition to discussing the green features of our building, students were taken through a few mechanical engineering labs to see an anechoic chamber, 3D printers, laser cutters, industrial robot arms, and machining tools. Students were always full of questions about mechanical engineering, and engineering in general, during the lab tours since many of them were beginning to think about college.

Figure 3: Left, George Delagrammatikas (Faculty Advisor) explains energy efficient features of one of the building's stairwells. Right, Daniel Bach (Vice President) gives a tour of the machine shop.

After the tour, the students were led through a series of modules with the guidance of Pi Tau Sigma, and FSAE members. In one module, students were shown the Formula SAE racecar and given an acetone engine demonstration. Cooper students pointed out key design features of the racecar, showed CAD models, and discussed the engineering design process. The high school students were then given short lesson on combustion and engines, followed by an acetone-engine demonstration to illustrate key points.

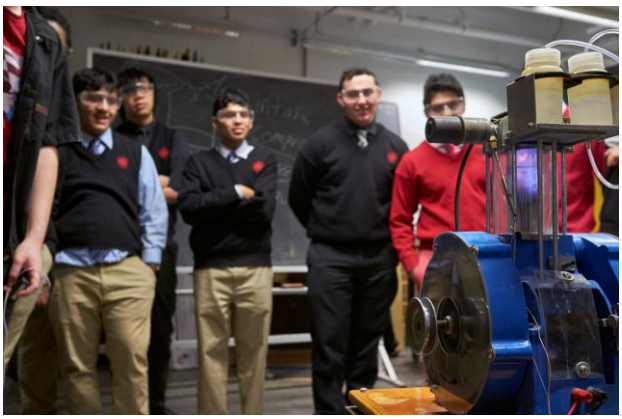

Figure 4: Left, Daniel Bach (Vice President) gives a lesson on combustion engines. Right, high school students watch an acetone engine run.

In the next module the high school students were rotated through two experiments that are part of a junior level mechanical engineering experimentation course at Cooper (ME140 Engineering Experimentation). The first experiment investigated the tendency for a flame to flashback down the tube expelling the air and fuel (propane) for combustion. Students timed the propagation of the flame at different fuel-to-air ratios to find the ideal ratio of fluid flow rates. The second experiment measured the torque and speed of a small DC motor for students to generate a motor torque curve. Students ran the motor at multiple input voltages, measure speed with a tachometer, and read the load on a scale that is depressed by a lever arm attached the motor shaft. In the ME140 course, Cooper students perform an error analysis on each experimental setup and write a report on the engineering concept, experimental results and theoretical predictions. For the outreach events, Pi Tau Sigma members simply explained the significance of the students' results and discuss sources of error with the methods of measurement. Nearly all of the students from both high schools expressed that these experiments were by far the most interesting and enlightening portion of the outreach event. They especially enjoyed that it gave them a hands-on preview of the content and tools used in a college-level mechanical engineering course.

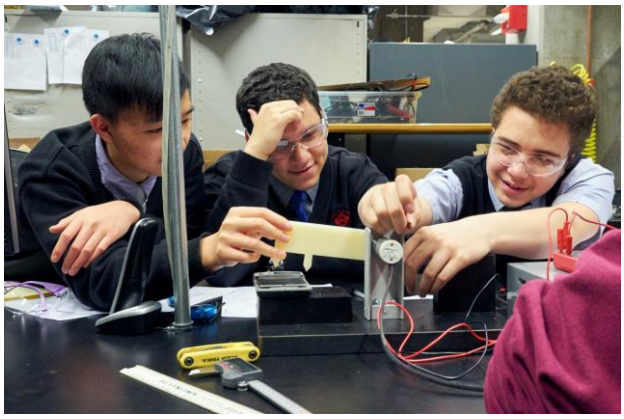

Figure 5: Left, students operate the flame flashback lab. Right, students perform the motor lab.

In the final module, high school students were given a design challenge. With a limited supply of materials (cardboard, hot glue, and popsicle sticks) and overall dimension constraints, students were told to make structures to be crushed in a compression machine over a finite strain limit. Pi Tau Sigma members gave a brief lesson on design for bending, buckling, compression and stiffness, and tabulated the strength-to-weight ratio, maximum load capacity, and maximum linear stiffness of each structure. No scoring criteria were given so that the high school students would see a variety of structures that excel in different aspects. Cooper students provided commentary on each design to help explain why certain structures behaved/failed the way that they did.

Figure 6: Pi Tau Sigma members Hannah Talisse and Yun Jung Lee guide high school students in the construction of their cardboard towers.

Overall, the high school outreach events were a major success. The students expressed that the modules were both fun and interest while the tour helped them understand mechanical engineering as a whole and showed them a nearby college option. These high school outreach events will likely be continued with in the coming years with the next group of juniors. Cooper Union Pi Phi also established a connection with the elementary portion of Grace Church School. No event was held with elementary students from Grace Church School this year but brainstorming sessions with faculty were productive and hopefully outreach with their younger students will begin next year.

In addition to this year's outreach efforts, Cooper Union Pi Phi collaborated with other professional organizations and honors societies to hold an engineering registration session in spring semester. Senior members of Pi Tau Sigma met with freshmen, sophomore, and junior engineering students to provide them with information about mechanical engineering in general, internship and job opportunities, graduate school opportunities, and to discuss the mechanical engineering curriculum and elective courses at Cooper Union. Spanning many concentrations, our members were able to talk to students about mechanical design, manufacturing, aerospace engineering, combustion, thermo/fluids, automotive engineering, biomedical engineering, control, robotics, industrial design, and nanotechnology. Pi Tau Sigma members also discussed past internship or REU experiences, as well as their future job or graduate school prospects. Companies and universities represented through this process included but were not limited to Lockheed Martin, Raytheon, NASA, Makerbot, the National Institute of Health, Drexel University, Georgia Tech, Princeton

University, and MIT. This event saw a large turnout and was huge success! Consequently, this type of event will be continued in the coming years.

Figure 7: A poster created for the registration event. All participating members created a poster with their name, area of interest/expertise, and companies and or schools where they have or will work/study. The posters helped underclassmen meet and learn from like-minded Pi Tau Sigma members.

C. Other

The highlight of Cooper Union Pi Phi's year was winning awards at the 2015 National Convention at the University of Illinois at Urbana Champaign. Cooper Union Pi Phi was awarded 2nd place for Outstanding Performance and 1st place for Outstanding Service. Cooper Union Pi Phi is now engraved in the large Outstanding Service Plaque, which is currently on display in the Dean's Office of the School of Engineering for other students to see our accomplishment. Cooper Union's Pi Tau Sigma chapter will strive to be winners of these awards again and will hopefully see the Outstanding Service plaque return to our campus after future conventions.

Figure 8: Cooper Union Pi Phi members with their awards at the National Convention. Pictured from left to right: Alex Novoselov, Yun Jung Lee, Daniel Bach (Vice President), Peter Ascoli (President), Jackie Le (Future President), and Hannah Talisse.