Overview

The outreach presentation was given to two of Ms. Julie Jensen's advanced chemistry classes at Middleton High School. We also had five students from Memorial High School come and watch our presentation as well. The class consisted of sophomores, which means they were around the ages of fifteen and sixteen years old. Each class was fifty minutes long. This time was spent with about 20 minutes on a presentation that covered the definition of engineering, the different disciplines of engineering, biomedical engineering, and our design project. The rest of the time was spent on an in class activity. We had the students build card towers out of small note cards, large note cards, and staples with a different "cost" for each item. The students were asked to apply general engineering skills and logical thinking to balance the cost with how tall they could make the tower and how much weight it could hold.

Ms. Jensen did not place any restraints on us; she only asked that we present for both her advanced chemistry courses and take up the entire class period. The students appeared to be interested in the topic, though it was difficult to get them involved at first. Since it was a class of sophomores, we attempted to get and keep their attention by asking them questions throughout the class period, such as "What is an engineer?" and "What type of products would these types of engineers work on?" In the beginning, answers were few, but after one student provided an answer, the rest seemed to become more comfortable and the entire class was more active.

The material that seemed to be the most interesting to them was our own motivation to become engineers and our design project. When we recounted our personal experiences and what inspired us, the class seemed to become more alert. Our design project, and the potential for patents and grants based on designs created by college students seemed to be the most interesting topic for them. Many students asked questions about these topics during the presentation and during the activity. The career prospects also seemed to interest them because of the potential to get a co-op or an internship while still in college. To improve our presentation, we could have chosen an activity that was more focused on biomedical engineering. The activity went over very well, but it only required general engineering problem solving skills instead of specific biomedical engineering applications. We could have brought in biomedical equipment (e.g. a spirometer and have the students take their own readings). We also could have been more involved in the actual activity by going from group to group and asking questions about their designs.

Presentation

The presentation portion of the class took approximately 20 minutes. Kailey started out the presentation by introducing our team members and what we were going to talk about. Then she asked if anyone knew what an engineer was or what they did. When no one responded, we asked if anyone in the class had parents who were engineers, and approximately 4 or 5 people in each class raised their hand. Kailey then gave a brief generic definition of what it means to be an engineer. This definition explained to the students that engineering is a career that applies math and science to solve real world

problems and make materials, structures, machines and systems to meet a specific goal. She went into specific engineering fields and explained what they did. With each of these fields we also presented a PowerPoint slide that showed images of applications relevant to that discipline. These engineering fields and slides were: electrical with a slide showing transformers and electrical systems, civil with a slide showing bridges and buildings, nuclear with a slide showing Homer Simpson and a nuclear power plant, and chemical with a slide showing polymers and chemical processing.

After Kailey explained these engineering fields, Gina started to talk about biomedical engineering (BME). Gina used slides to show and explain the different areas of specialty within biomedical engineering. She would say the name and then ask the students if they could think of a device that the specialty might work with. The first area was biomechanical; she explained that it was similar to mechanical engineering applied to the medical world and after asking the class for ideas, told them biomechanical engineers also worked on prosthetics, joint replacements, and other mechanical devices. Next was bioinstrumentation. Gina explained that this type of biomedical dealt with electrical devices in the medical field such as pacemakers, x-ray machines and MRIs. For biomaterials, she told them that it dealt with things like artificial skin, polymers used in medical devices and artificial heart valves. Finally, she explained about healthcare systems engineering and how it deals with the operations and functions of hospitals in order to make them run smoothly and efficiently.

After Gina explained the different areas of BME, she went into more specifics about the program. This included the fact that there are 140 students in the program and that 39% of them are women. She told the class that BME is a new field that is constantly growing and providing new opportunities. Gina then talked about traits most biomedical engineering students possess: curiosity about how things work, interest in the medical field, interest in working with new technology, and the ability to communicate with others. Each of us then stated why we chose biomedical engineering. Kailey explained how she has always been interested in the medical field, but wanted an opportunity to do problem solving too. Tyler told the class about how he became interested in it after watching his grandmother go through hip replacement surgery and how he wanted to help make other people's lives better in a similar way. Anna explained that she tore her anterior cruciate ligament and meniscus, and became interested in the field as she went through the entire surgery and rehabilitation experience. Finally, Gina explained she was originally going for a degree in nuclear engineering because she was interested in radiation treatment, until she discovered that she was more interested in the medical aspect than the nuclear aspect, so she transferred to biomedical engineering.

Once the class knew about biomedical engineering, Tyler described our design project. He explained that in the BME program you get the opportunity to do a design project every semester. He then started to explain what our project was. First he asked the class if they knew what it meant to undergo a laparoscopic banding procedure. After the class shook their heads, he explained that it was also referred to as "getting your tubes tied", and that it prevented a woman from getting pregnant. Next, the class was asked if they knew what a laparoscopic surgery was. Once they gave their answer, it was clarified by

saying it is a procedure done to minimize healing time as well as evidence of the surgery, as it is minimally invasive.

Tyler then went into the specifics about the project. He explained the issues with the current product first. The current product is not reliable in the releasing of the bands that were used to create a blockage in order to prevent pregnancy. It also has a tendency to injure the patient's fallopian tubes. During this explanation, he demonstrated how the current device works doing a mock procedure and pointing out on the device how the woman's fallopian tube tissue often gets injured. The current device was then passed around the class so that the students could get a closer look. Next, Tyler explained how our device was trying to remedy these problems. This included designing a suction mechanism to grasp the fallopian tubes, which should be gentler on the patient, and a gradual turning mechanism to provide the surgeon more control over the release of the bands. We then showed the class our prototypes that we built for this project.

To complete the presentation, Anna went into the career prospects for a biomedical engineer and then explained the class activity. She explained that with a bachelor's degree in biomedical engineering there were lots of different opportunities for a person to pursue. While in college, students have the possibility to get a co-op or an internship and start doing real engineering before they even acquire a degree. This opportunity also provides the chance for the student to make money; these jobs usually pay much higher than a regular job a college student will be able to find. Anna also explained that students (both undergraduates and graduates) have a chance to work in research and learn from the biomedical engineering professors outside of the classroom.

She then went into what students can do with their degrees. She explained that they can go into job market and make great money straight out of college, with the average amount being $55,000 per year for the recently graduated biomedical engineer. She also explained that graduates can pursue a career in business by getting an MBA and assume a more managerial role in the work force. Anna also told the class about how there were other areas to further your degree too, such as law school to become a patent lawyer, graduate school to get a masters or PhD, or medical school to become a doctor. The class was then asked if they had any questions before the activity was started.

In Class Activity

After the presentation, Anna explained the activity the class would be working on: a card tower. The point of this activity was to try and make the students think like engineers, though not specifically as a biomedical engineer. It involved trying to balance material cost with the final product. The materials needed for this activity for each class were the following:

- A large bag of Jolly Ranchers © candies
- Three packs of small note cards
- Three packs of large note cards
- A stapler, filled with staples, for each group
- A yard stick with which to measure the height of the tower

The students were split into groups of three or four and asked to build a card tower with the materials supplied. They got one point for each jolly rancher the towers could support and ten points for every inch the tower was in height. The maximum amount of jolly ranchers that could be fit into a large cup, without spilling out of the top was the maximum amount of points allowed for this category. For each small note card, three points were deducted; for each large note card, five points were deducted, and for each staple, ten points were deducted. These values were put into an excel spreadsheet that was projected onto the screen. The team with the highest score at the end of the allotted time was the winner of the large cup full of jolly ranchers. A picture of one group working on their tower follows.

Special consideration had to be taken in order to ensure the towers were built on a stable surface. The desks in the classroom were too wobbly, so the towers were built on the lab stations in the back of the class. The entire point of the activity was to try and teach the students that an engineer has to balance a lot of aspects in any design, including cost and different design objectives. For this activity, the team that could build the tallest, strongest tower with the least amount of materials was the winner. The students seemed to really enjoy this activity and also found it challenging to try to account for so many aspects of the design at once. We believe it provided them a useful insight into what issues an engineer can face with any type of design.