1. Overview of BME 402 Outreach Presentation

Presentation Content

Our outreach presentation consisted of a lecture-style Power Point presentation with the incorporation of videos to elicit student interest and engagement. The presentation was done at James Madison Memorial High School in Madison and was given in front of two Physics classes. The classes consisted of mostly high school juniors and seniors, but a handful of sophomores as well. Each presentation lasted a full class period (approximately 50 minutes). We were asked to present for the full class period, but had no other constraints placed upon our outreach.

Due to the range of grade levels, the presentation gave a broad view of engineering without being too specific for students of a particular year. For example, if the presentation was to be done for seniors only, the presentation would have likely included more information on starting college as a prospective engineer, and how to approach college with the knowledge of going into an engineering major. Instead, the presentation gave a broad overview of the types of courses all engineers take, and what courses specifically BME students will take.

Most students in these higher-level physics classes already have college in their future, so the lecture was designed to encourage and stimulate an interest in pursuing a college degree in an engineering-based discipline. The presentation focused on educating students on what Engineering is (and particularly Biomedical Engineering), why Engineering is important, the career available in BME, and the focus of each track. We also discussed the design project we have been working on, followed by a brief exercise in the design process that involved students working through criteria when making a materials selection. This exercise was modeled after a decision we made during our time working on the project. Of the 50 minutes lectures, approximately 35 minutes were allotted to the slides that discussed engineering and BME, their importance, and what areas of BME are available for students to study. About 10 minutes were given to going over our project design process. This section included the activity/guided exercise. The remaining 5 minutes was for general questions at the end of the presentation – this time proved useful and beneficial, as several students had questions not just about engineering and BME, but college and attending UW in general.

Student Engagement

Because of the age of the students, we did our best to keep them as engaged as possible by relating the information as much as possible to things they have experienced or are familiar with. The use of YouTube videos to demonstrate engineering concepts in our presentation really helped this aspect of the presentation.

Our efforts to keep students as engaged as possible really added to the entire experience for all parties involved. Whenever we asked for input or for audience participation, we received responses from a number of different students. Very few students seemed to be totally uninterested in the presentation. The presentation served its purpose, as most students seemed to take away an understanding of engineering, and particularly BME, from the lecture.

Our outreach presentation could have been improved by incorporating a more hands-on activity. While the exercise we went through really demonstrated the thought process and discussion behind as well as the requirements of the design process, students really did not get an opportunity to enact their designs. Perhaps an exercise could have been implemented in which students broke into groups of three or four and worked through a mock engineering design problem. This would have given students the opportunity to work together as a team to accomplish a goal, very similar to the experience BME design students have. This could have also given students a better understanding of engineering as a whole.

2. Presentation

Overview on the Importance of Engineering

Our presentation lasted approximately 50 minutes. Each team member spoke for about 7-10 minutes. Our slides and our dialogue was supplemented with YouTube videos that corresponded with our discussion that allowed us to further provide evidence or give examples that reiterated our lecture slides.

We started our presentation introducing ourselves, describing who we were, where we went to school, and why we were giving the presentation. This was followed by a short overview of what we were going to talk about. We also wanted to make sure students knew they could ask questions, so highly encouraged them before we started our presentation.

We began our presentation by asking students what they thought engineering was. Understanding that some students might have a parent/sibling/relative/neighbor who was an engineer or in school to be an engineer, we opened the floor for any suggestions or input as to what the definition of 'engineering'. After students gave input, the definition of engineering from Wikipedia was shared. While this is a more than adequate definition, we broke the definition into simpler terms – that is, using math, science and technical skills to solve problems, and to design and test solutions to those problems.

We next asked students what types of things engineers work on. This is a very open-ended question as most things we come into contact with have some sort of engineering behind them. Some student responses were cars, construction, and energy. After student input, we showed our slide with examples including transportation, building and structure design, and renewable energy. In transportation, a segway, space shuttle, and Toyota Prius were shown. Students were asked the MPG of the Prius – several students knew the answer (~50) – and then were asked to compare that to a Hummer (~15). For Building/structures, the Golden Gate Bridge was shown along with the tallest building in the world, the Burj Khalifa in UAE. Students were asked if they had ever been to Chicago or have seen the Willis (Sears) Tower; the Burj Khalifa was compared to this building as being almost twice as tall. Renewable energy examples included wind and solar power.

Next, we presented the 13 engineering majors UW offers and gave a brief description of a few, and the specific problems they might work on in a professional career.

To give students the understanding of the importance of engineering, we next went over NAE's list of Top 10 Engineering Achievements of the 20th Century. Students were first asked what technologies that have been instrumental over the last 100 years and might be on this list. Students gave many correct answers – including electricity, cars, planes, computers, and telephones. After students guessed a few answers, we revealed the entire list. After going over them all, we posed the question "Where would our society be and what would our lives be like without the work of engineers?"

To continue on the importance of engineering, we showed a YouTube video of the 1940 Tacoma Narrows Bridge collapse in Washington. This was a very remarkable bridge in regards to the movements it made prior to collapsing. This video was shown to prove the point that as great as engineers' work is, when engineering goes wrong the outcome can be disastrous and sometimes deadly.

Next, we moved on to talking about the process of becoming an engineer. An overview of the core engineering courses was given. We also mentioned the opportunities available for engineers to participate in internships or co-ops, and how engineers are continuous learners throughout their entire careers.

Overview of Biomedical Engineering

After talking about the basics of engineering, we moved to talking specifically about Biomedical Engineering, and gave the Wikipedia definition for BME. This was supplemented by the typical courses BMEs take, including advanced biology and physiology, but also courses that are specific to the different tracks, like biomechanics. After giving the courses, a list of the different areas of BME was given with a short description of each. Each area was then discussed in greater detail. This process included a definition or description of each area along with an example or two of devices/products in that field.

Biomaterials were first discussed. A definition of a "biomaterial" was given, followed by three examples. Examples included a contact lens, a hip implant, and a ball-and-cage heart valve replacement. The important idea conveyed by the presentation was that it is impressive that engineers can design products to be effective in the body, as the body tends to reject foreign objects.

Bioinstrumentation was the next area of focus. A brief description was given, followed by three specific examples. These included a blood glucose monitor for diabetes patients, a pulse oximeter, and an electrocardiogram. The non-invasive features of these devices were pointed out.

The next area of discussion focused on biomechanics. A brief description was given followed by two examples. Students were asked if they were football fans, and if they recognized the picture that was shown to them. Several students were familiar with the picture of the quarterback for the New England Patriots, Tom Brady (widely considered to be one of the best quarterbacks in the history of the NFL), tearing the ligaments in his knee in a game a few years ago. The discussion of biomechanics was supplemented with two YouTube videos. The first video dealt with motion capture, and showed a gymnast in a motion capture suit performing a gymnastics move followed by a computer generated reconstruction. Students were asked if they had seen the recent box office hit Avatar or played video games like Madden NFL – these entertainment sources utilized similar motion capture technology to create life-like computer images. The second YouTube video showed the fluid mechanics of blood through a stented and non-stented artery.

Medical Imaging was next and last area of BME discussed. A picture of an MRI and an X-ray were shown. After mentioning these technologies, students were asked to think about how medicine has evolved with these advances, and how prior to this field many doctors depended on investigational surgeries to make a diagnosis.

The potential of biomedical engineering was next displayed and emphasized with a description and YouTube video detailing the Brainport Vision device, which allows blind people to “see” through electrical stimulation of their tongue. Students were very impressed with this example, particularly with the video, which shows a blind man rock climbing using the device.

The last few slides of our presentation went over our project. It was very similar to the beginning of a mid- or end-of semester presentation, detailing background and motivation for the project, along with a simple overview of the solutions we came up with and utilized in our final design.

The final portion of our presentation involved the activity/guided exercise, which is detailed below.

3. Design Process Activity/Guided Exercise

The last part of our outreach presentation was an overview of the design process and an activity to get students thinking about all of the considerations engineers must make during the design process.

We used as a model for the exercise our experience of materials selection of the mouthpiece for the spirometer. Students were presented with the question: “Which mouthpiece should be used? The permanent, reusable mouthpiece or the disposable cardboard one?” Students were then asked what considerations had to be made when making this decision. Students gave great examples, including ergonomics and how it feels in contact with the patient, transmission of disease, and the impact on the environment each one would cause. We then listed the main factors we considered when making this decision. Finally, students were asked which one they would use if they were working on this project and why. Students gave great answers, with some leaning in both directions for different reasons.

The final point made about the design process was that a simple choice in an engineering design may be much more involved and requirement much more thinking than originally planned, but all of the thought must be made to produce an adequate solution to the problem being addressed.