Using Soft Robotics in Biotechnology

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Summary

Over the last six weeks teachers were immersed into a multifaceted world of engineering. Starting with mechanical and materials engineering, ending with computer and software-networking engineering. Teachers were educated on strain sensors, environmental sensors and micro-electrical mechanical systems (MEMS). Specifically in the electrical strain sensor group, teachers were exposed to the topic of using carbon nanotubes (CNT) in sensors due to their high conductivity and resistivity. Within the computer science aspect, teachers were introduced to Binary, Java, and Vivido for computer language. Ending our learning with Android mobile networking and how to use the Raspberry PI3.

Research Activities

- Buckypaper
- Carbon fiber plate
- Strain sensor testing
- Chemical vapor deposition machine
- CodingBat.com to practice 'if', 'and,' 'not'
- Compileonline.com for Java
- Raspberry PI3

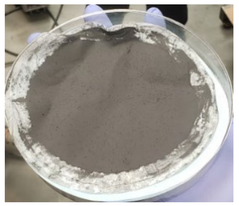


Figure 1: Buckypaepr

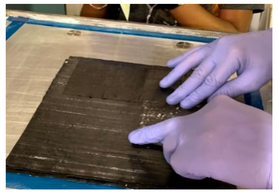


Figure 2: Carbon fiber plate

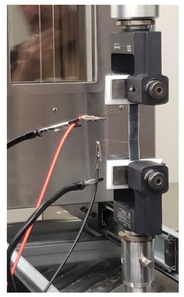


Figure 3: Strain sensor testing

Figure 4: Chemical vapor deposition machine

Figure 5: Raspberry PI3

Lesson Plan

Lesson Summary: Students will learn first how technology can be woven into biology. Students will then learn how soft robotics can be used to bring back mobility to humans and hopefully promote investigative thinking of what these robotics can do next.

Day 1: Biotechnology

1. Students complete pre-assessment
2. Review the topics of biotechnology and learn the basics of soft robotics technology.
3. Introduce the idea that soft robotics could be used to provide humans with the ability to grasp objects like
4. Begin the design (three groups with three different designs)

Day 2: Pouring the Elastomer

1. Using the designs students will construct their molds for the elastomers
2. Teacher will pour the first layer of elastomer

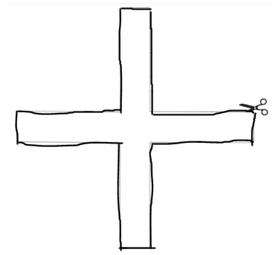
Day 3: Second layer of Elastomer

1. Teacher will pour second layer

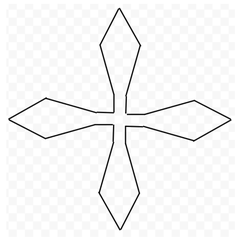
Day 4: Test product

1. Students will finish setting up their grippers for usage
2. Students complete post-assessment

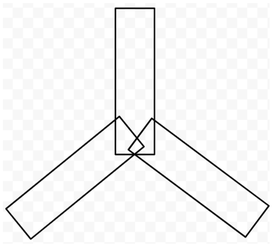
Examples of designs for the elastomers



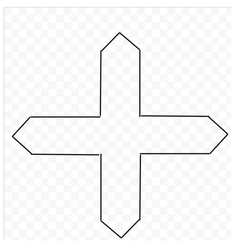
Design 1: Original elastomer mold



Design 2: Modified elastomer mold (four points narrow)



Design 3: Modified elastomer mold (three points)



Design 4: Modified elastomer mold (four points bold)

Lesson Learned and Assumptions

- Sensors can be built to react to thermal properties or electrical properties because of the resistivity of CNT and its ability to have a higher yield for conductivity.
- The construction of materials such as buckypaper or carbon fiber plates can be used to wrap our structures to enhance their strength.
- Soft robotics is a way to bridge the gap between biological organisms and artificial robots
- Currently, soft robotics can be applied in soft grippers, prosthetics, artificial bladder detrusor, heart sleeves and other applications.
- Focus can be utilized for surgical equipment thus reducing damage when operating inside the soft tissue of the human body.
- 3D printing can be applied to medical needs when looking at medical devices and cancer research
- Binary system for computers is just the tip of the iceberg as it relates to computer languages.
  - Java
  - Vivido
  - Python
  - Scratch.mit.edu
  - Android Studio

Implementation Strategy

- The Question Is….
  - Determine a question related to the current unit of study and write only the answer to that question on the board.
  - Ask students to write questions that could match the answer on sticky notes. Allow students to refer to notes or handouts, if necessary.
  - Have students stick their questions to the board, surrounding the answer. Alternatively, students could write the answer in their interactive notebooks and list questions under or around it.
  - allowing a teacher to see what the students understand about a given topic.
- Think-Pair-Share
  - students are given time to share their ideas with their table partners
- Relationship Building
  - teacher builds positive relationships with students to encourage learning in the classroom

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