Build a Better Body

Summary

In this activity, students will use the engineering design process to build a functioning prosthetic lower leg. They will work in teams to design the prosthetic using the given materials. Once it is built, they will test their designs and discuss how they could improve them next time.

After completing this activity, students should be able to:

- Explain prosthetics and the need for them
- Describe how parts of a body work together to serve one function
- Describe how the musculoskeletal system works in conjunction with a prosthesis
- Apply the engineering design process.

Setting the Stage

Before the students start working, initiate discussion about the topic using some of the following open-ended questions.

1. How do you get out of bed in the morning? (in reference to what body parts you use)
2. What are those body parts made of?
3. For someone who has lost a limb, what may be some common things they struggle with?
4. What can engineers do to help with this struggle?
5. What are prosthetics?
6. How can prosthetics make life easier for amputees?
7. What do you think are the most commonly needed prosthetics?

Materials

- Measuring device (yard stick, ruler, etc.)
- Building materials can be anything you may have available, such as:
    - Leg structure - PVC pipe, toilet plunger, cardboard tube, wooden dowel rod (thick)
    - Comfort piece - sponge, bubble wrap, corrugated cardboard
    - For clothing – material for pants, jeans, socks, towel
    - Attachment piece – string, rope, etc.
- Scissors
- Duct tape
- Engineering Notebook Pages

Procedure

Set-up

1. Each team should draft a design of their prostheses on paper.

2. Provide students with building materials. Each team should be able to choose their leg structure, comfort piece, clothing, and attachment piece.
3. Using the materials that they choose, students should design their prosthetic leg.
    a. Height of the protheses is based on the team member who will test it.
    b. Protheses must have all four parts (leg structure, comfort piece, clothing, attachment piece)
    c. Four parts must all remain connected during testing

Figure 1. Picture of example prostheses

Testing

1. The chosen team member will wear the prostheses, walking 5 steps and bending it at the knee to show the integrity of the design.
2. Then the team members will explain each part of the prostheses and what function it serves. (Teachers can use this as a connection to the standards and what parts of the body serve these functions.)
3. As groups are communicating their ideas, students may evaluate other designs to see which group chose the best leg structure, comfort piece, clothing, and attachment piece.
4. To wrap up the lesson, students will collaborate with their teammates about ways to improve the design next time.

Follow-up Questions

1. How did your prostheses perform?
2. Which materials functioned best in your design? Which material was worst?
3. What would you change to improve the performance of your prostheses?
4. Now that you've built one, what problems would bioengineers face when building prostheses?
5. Bioengineering video on health innovation at Clemson: https://youtu.be/EQjN4Uy9Li8

Vocabulary

- **amputate** – to cut off by surgical operation
- **prosthetic** – an artificial body part
- **bones** – structures that make up the skeletal system
- **joints** – places where two or more bones meet
- **tissue** – a group of cells with the same structure and function
- **ligament** – serves to connect bones at a joint
- **smooth muscle** – involuntary muscle (controls the movement of internal organs)
- **skeletal muscle** – voluntary muscle (attached to bones; aid in body movement)
- **tendon** – thick tissue attached to bones or muscles
- **bioengineering** – the application of the engineering process to find innovative solutions to challenges in biology, healthcare, and medicine