

Engineering for Health

Overview

A video introduction shows how engineers improve a wearable insulin pump to make it more comfortable and convenient for people with diabetes. Student pairs then test improvements to walking aids, another kind of health device.

Guiding Question

How can tests help engineers improve their designs?

Objective

Students will be able to test whether a design improves a walking aid.

Background

The biomedical engineers who design health devices have two major goals. The first and most important is to meet medical needs. People with Type 1 diabetes do not produce enough insulin, a hormone that moves sugar from the bloodstream into cells that use it for fuel. Without insulin, cells starve. People with Type 1 diabetes must therefore inject insulin. However, too much insulin can cause too much blood sugar to leave the blood, leaving the body without enough fuel and causing symptoms such as headaches and fainting. Because of this risk, people with diabetes must continuously test their blood sugar and adjust their dose of insulin or food. Insulin pumps automatically monitor blood sugar and deliver insulin accordingly.

The second goal of biomedical engineers is to make devices comfortable, attractive, and convenient to use. Often, engineers have to sacrifice the second goal in order to meet the first. In the video, the original insulin pump is bulky, fragile, and inconvenient to wear. The engineers redesign the pump so it will not get in the way of activities. Improvements in materials and computer controls help

Time: 15–20 minutes

Grade Level: 3–5

Vocabulary

- Diabetes
- Test

Standards

NGSS 3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

NGSS 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

NGSS 3-5-ETS1-3

them meet both goals.

An important step in the engineers' process is real-world testing. People with diabetes use the prototypes and tell the engineers what works and what doesn't. Data from the tests helps the engineers continually improve their design.

Preparation

For this activity, the educator will need the following:

- Video: [Engineering for Health](#) (2:41)
- A way to show the video to students

For this activity, each pair of students will need the following:

- 1 copy of *Comfy Crutches* ([English](#) | [Spanish](#) | [Answer Key](#))
- 1 crutch, cane, or walking stick
- craft materials, various (foam, felt, cotton balls, paper, tape, etc.)

EiE® Connections

Learn more about the Engineering Design Process in the EiE Video Library.

Continue your classroom activities with this unit:

Engineering is Elementary®

- *Designing Knee Braces*

Museum of Science Connections

The *Engineering Design Workshop, Powered by MathWorks* includes real stories of people using the engineering skills of creativity, breaking down problems, and iteration. Access these videos online through the [Engineering Stories virtual exhibit](#).

Listen to the "[Can We Restore Mobility to Spinal Injury Patients?](#)" episode of the Pulsar podcast to learn more about how engineering and science interact with medicine.

Family Connections

Continue the learning at home with [EiE Families and STEM Events](#) or [Family STEM Activities](#) from MOS

Credits

The Engineering for Health video was developed with the generous support of MathWorks, Sophia and Bernard M. Gordon, Margaret and Jim Wade, and Jack Turner and Tee Taggart.

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Activity Instructions

These steps offer support for implementing the Engineering for Health video introduction and follow-up activity with students.

1. Tell students that today they will be thinking like engineers to make something that's comfortable to use. Ask students about times when they've had to wear or use something that's not comfortable, such as a heavy backpack or a helmet. Ask:

Q: What made the thing you wore uncomfortable?

A: Accept all responses.

Q: Why did you wear it, even if it was uncomfortable?

A: Accept all responses. Possible responses include that a backpack carries school supplies and a helmet keeps my brain safe if I fall.

2. Introduce the video Engineering for Health (2:41). The video shows how a groups of engineers, designers, and artists works closely with people with diabetes to make an insulin pump that is easier and more comfortable to use. Explain to students that diabetes is a disease that changes how the body absorbs sugar. Many people with diabetes need to take medicine called insulin to help them get energy from food. Some people with diabetes give themselves a shot of insulin each time they eat, while others wear a pump that automatically gives them insulin when they need it. Tell students that this pump is what the engineers in the video are working on. If students have personal experience with diabetes, they may or may not want to share about it.

watch video

3. After showing the video, discuss these questions:

Q: What are the problems with older insulin pumps?

A: Possible responses include that the tube catches on things and that it is uncomfortable.

Q: Why is it important for the engineers to work with people who have diabetes as they design the new pump?

A: Possible responses include that people who have diabetes know how the pump should work and what they need from it.

4. Tell students that they will work in pairs to improve another kind of health device: walking aids used by people with disabilities or injuries. Demonstrate or have a student demonstrate how the available walking aids (crutches, canes, or walking sticks) are used. Ask:

Q: What are some things that could be better about this walking aid?

A: Accept all responses. Possible responses include how comfortable it is, how easy it is to use, or how fast you can move with it.

5. Distribute the Comfy Crutches (English | Spanish) handout to each student pair, along with a crutch, cane, or walking stick. Give students access to craft supplies for building prototypes. Explain to students that they will improve the walking aids to make them more comfortable and easier to use and then test them and record the results.
6. Review why testing is important in engineering. Explain that to test is to try something out and see if it works. One or both partners should test the design for several minutes to see if the improved walking aid is comfortable, convenient, and easy to use. Point out that, under ideal circumstances, students would work with real users to test their designs.
7. Guide students to fill out the handout with the results of the test. Remind students of what the engineers say in the video at 2:24: "You need to fail to figure out what works and what doesn't." Tell students that a design that doesn't do well in testing is not a bad thing: it provides information about how to improve a device.
8. If time allows, have students improve their designs and test again.
9. After completing the activity, discuss these questions:

Q: What did you learn from your test that you did not know before?

A: Accept all responses.

Q: Why is it important for tests to be done by people who will use an object?

A: Accept all responses. Possible responses include that people who use it know what they need from the object and can point out how it does and does not work.

Q: How can tests help engineers improve their designs?

A: Possible responses include by pointing out problems or by showing engineers what works.

Glossary

Diabetes

a disease that changes how the body absorbs sugar

Test

to try something out and see if it works