Helping Hand

OBJECT

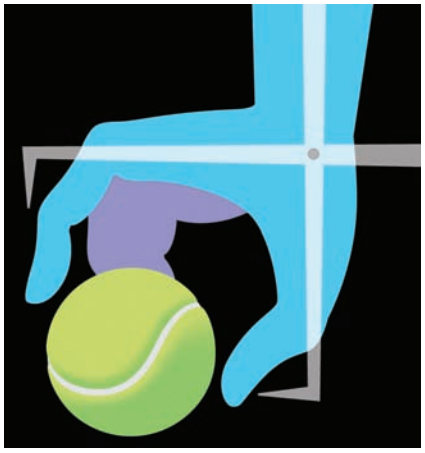
While exploring levers and mechanical squeezing systems, students learn that engineers help others "by design."

GRADE LEVEL

Middle to high school

THE CHALLENGE

Students (1) follow the design process to build a grabber that can reach at least two feet; (2) develop a way to open and close the grabber's jaw; and (3) figure out how to connect the "jaw" to a stick.



DISCUSSION

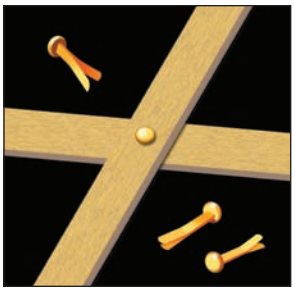
Engineers dream up creative, practical solutions and design and build things that not only change the world but also make a difference to one person at a time. Testing reveals things about a design and about the materials. Kids can use this information to improve a design. When engineers solve a problem, their first solution is rarely their best. Instead, they try different ideas, learn from mistakes, study the problems and then redesign.

MATERIALS *(per person or team)*

- 4 brass fasteners
- corrugated cardboard
- hole punch
- objects to pick up (e.g., tennis balls, cotton balls, plastic soda bottles, and paper cups)
- 2 rubber bands
- sandpaper
- scissors
- string
- tape (duct or masking)
- 4 toothpicks
- 4 wooden skewers
- yardstick (or long paint stirrers for 5-gallon buckets, a thin wooden slat, or lath 2–3 feet long)

BRAINSTORM AND DESIGN

To start students thinking about what they need to do to make a squeezing motion, have them brainstorm answers to the following:



1. Using these materials, what can you build to grab objects that are two feet away from you?
2. How will your grabbing device open and close so it can grip an object and let it go?
3. How will you attach your grabber to the end of the stick?
4. How will you control your grabber when it's at the end of the stick?

Tell kids that the arms of their grabbers act as levers. A lever is a rigid bar that pivots around a fulcrum (the brass fasteners).

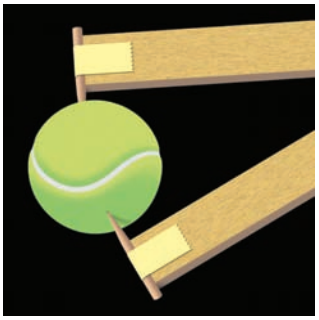
BUILD, TEST, AND REDESIGN

Discuss their ideas, have them sketch their designs and begin building. Then test it by trying to pick up different objects. Remind students: When you test, your design might not work as planned. Tell students they must redesign so their grabbers work every time.

Helpful Hints:

- Grabbers have a weak grip—Increase their force: change the strength of your jaw's grip by adjusting the length of the lever arms and the fulcrum's position.
- Grabbers keep dropping things—Make sure that the jaws close enough to actually hold something. Also see if the jaw's gripping surface is big enough and shaped right to have a firm grip.
- Grabbers bend or twist—Reinforce them with something stiff. Also, check if the jaw's arms are longer than necessary—short arms don't bend as easily as long ones.
- Grabbers don't work at the end of the stick—Make sure the string, rubber bands, and moving parts aren't getting stuck. Also, move the jaws with your hands. If they don't work the way they should, readjust the parts.

FURTHER EXPLORATION



- Build a grabber that can pick up two objects at once.
- Add a second motion to your grabber, such as making the stick that holds the jaws able to bend like an elbow or extend another two feet and then retract.

ENGINEERING IN ACTION

There's something unique about four-year-old Michael—he has four hands! Born with six inches of his left arm missing, Michael wears a standard prosthetic (i.e., artificial) hand. It has some limitations—Michael can pick up and hold things but can't squeeze or press very hard. Michael's father wanted him to be able to do more with his prosthetic hand and have some fun in the process. With this in mind, he contacted engineers at the Open Prosthetics Project. Together, they built Michael two more hands—hands unlike any you've seen! One is a dinosaur puppet. Michael grips things by controlling its jaws. The other is a fishing rod. Michael uses it to catch fish as well as to reel in stray toys. Michael's father continues to think up and build more hands for Michael. "Once you have the training," he says, "you can conceive, design, and build whatever your imagination pictures."

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