

# HELPING HAND



## YOUR CHALLENGE

Design and build a device that lets you grab different objects and drop them into a container that's at least two feet away from you.

## BRAINSTORM & DESIGN

Look at your materials and think about the questions below. Then sketch your ideas on a piece of paper or in your design notebook.

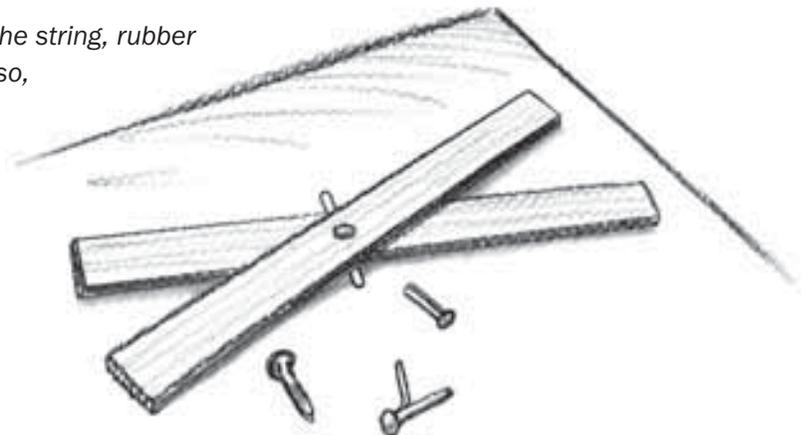


1. Using these materials, what can you build to grab objects that are two feet away from you?
2. How will your grabbing device open and close so it can grip an object and let it go?
3. How will you attach your grabber to the end of the stick?
4. How will you control your grabber when it's at the end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

## BUILD, TEST, EVALUATE & REDESIGN

Use the materials to build your grabber. Then test it by trying to pick up different objects. When you test, your design may not work as planned. When engineers solve a problem, their first solution is rarely their best. Instead, they try different ideas, learn from mistakes, and try again. Study the problems and then redesign. For example, if your grabber's jaws:

- have a weak grip—*Increase their force. Each arm of the jaw is a **lever**—a bar that pivots around a **fulcrum**. In this case, the fulcrum is the brass fastener. Change the strength of your jaw's grip by adjusting the length of the arms and the fulcrum's position. (See illustration.)*
- 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.*
- 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.*
- 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.*



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### MATERIALS (per person)

- 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)

# TAKE IT TO THE NEXT LEVEL

- Supersize me! Build a grabber that can pick up two objects at once.
- Smooth moves! 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.

## MAKE IT ONLINE

**Blast me a marshmallow, would ya?**

Build an air-powered marshmallow launcher out of plastic pipe and marshmallows. See how on Make Magazine's project page at [makezine.com/designsquad](http://makezine.com/designsquad).

## 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."



Watch the **DESIGN SQUAD Water Dancing** episode on PBS or online at [pbs.org/designsquad](http://pbs.org/designsquad).



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