

## CHALLENGE 1

# KICKING MACHINE



## YOUR CHALLENGE

Build a machine that kicks a Ping-Pong ball into a cup lying on its side 12 inches away. Use either (1) a pendulum, (2) a rubber band, or (3) a combination of the two to do this.

## MATERIALS\*

- Balls (Ping-Pong and golf)
- Corrugated cardboard
- Paper clips
- Paper cups
- Popsicle sticks
- Rubber bands
- Ruler
- Scissors
- String
- Tape (masking or duct)
- Thin metal wire (optional)
- Wooden skewers

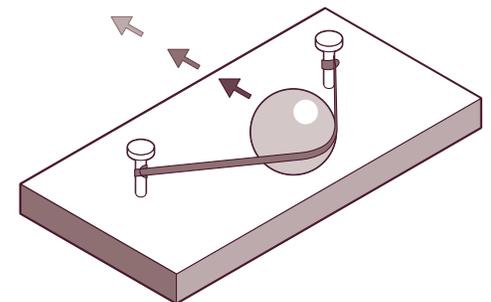
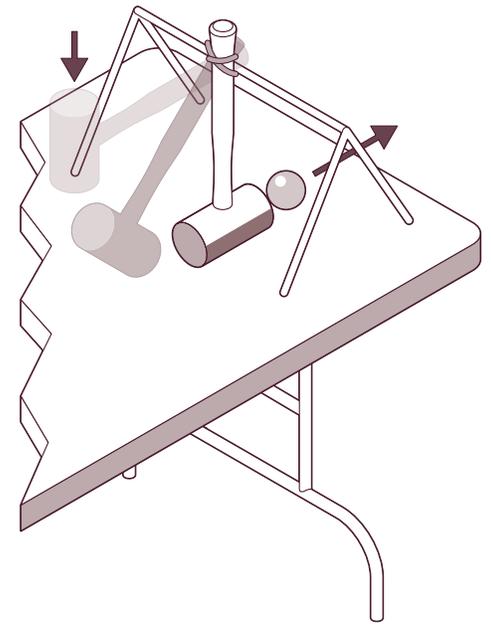
\* For information on where to get these materials, see page 6 or visit [pbskidsgo.org/designsquad/engineers](http://pbskidsgo.org/designsquad/engineers).

## BRAINSTORM AND DESIGN

Before you begin designing your machine, brainstorm answers to the following questions. Record and sketch your ideas in your design notebook.

- Will my machine use a pendulum or rubber band (or a combination) to send a ball into the cup?
- How will I stop the machine from launching the ball before I'm ready to release it?
- How will the machine be triggered when I'm ready to launch the ball?
- How will I make sure the pendulum or rubber band launches the ball straight enough and with the right amount of force so it goes into the cup?

Think about how to create different release points for the pendulum or rubber band so you have more control over a launched ball. Also consider how to determine the right amount of energy to store up before making your shot.



## BUILD, TEST, AND REDESIGN

When you lift a pendulum or stretch a rubber band, you increase its potential energy. **Potential energy** is energy that is stored. When you release the pendulum or rubber band, its potential energy is turned into **kinetic energy**, the energy of motion. Many machines have this in common—they turn potential energy (e.g., fuel, electricity, muscle power, springs, or weights) into kinetic energy that can be used to do a task (in this case, launch a ball).

Once you've built your machine, test it. Lay a cup on its side 12 inches away and see if you can get the ball in. When we made our machine, we had to debug some problems. For example, the ball bumped into parts of our machine and went in unexpected directions, and the stretched rubber band bent our frame. It was also hard to get the pendulum and rubber band to stay pulled back. If things like this happen to you, figure out a way to fix the problem so that your machine works every time.

When you lift a pendulum or stretch a rubber band, you increase its potential energy.

# KICKING MACHINE

## TAKE IT TO THE NEXT LEVEL

- Move the cup so it's 24 inches from your kicking machine.
- Build a ramp and see if you can shoot the ball up and over the ramp.
- Build a machine that can launch two balls at once or that can launch balls at different speeds.

### INSIDE THE ENGINEERING

#### SWEET DELIVERY

Building machines that make tasty—and sometimes far-out—ice cream flavors is just the kind of challenge Pete Gosselin loves. He's head engineer for Ben and Jerry's® ice cream. Pete's the guy who designs the machines that make different flavors and mix the right amounts of candy, filling, or swirl into each container. And you thought getting a ball into a cup was a challenge! Some days, it's, "We want every container to have half a pint of cherry ice cream with cherries and fudge flakes and half a pint of chocolate ice cream with fudge brownies. Now on the brownie side, make sure there are at least three but no more than four brownie bites. Oh and by the way, these babies need to roll off the production line at 200 pints a minute." To make some flavors, Pete tinkers with the factory's existing machines. For others, he has to design special machines. His biggest challenge: to design a machine that makes a flavor with a core of fudge and caramel wedged between chocolate and caramel ice cream. The way Pete sees it, "The world is full of problems and possibilities. And technology has a huge influence on making our lives better, whether the challenge is addressing global warming or making delicious food."

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## TAKE IT ONLINE

Want to make life easier? See how simple machines bring mechanical advantage to the rescue! Download *Not So Simple Machines* from Intel's *Design and Discovery* hands-on engineering program.

➤ [intel.com/education/designanddiscovery](http://intel.com/education/designanddiscovery)



Photo: Mika Tomozak

The *Design Squad* cast made a kicking machine for a professional soccer player. This soccer-ball launcher uses electric drills to spin wheelbarrow wheels to send soccer balls flying.



Watch *Design Squad* on PBS (check local listings). Download more challenges at [pbskids.org/designsquad](http://pbskids.org/designsquad).



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