Catapults

Overview: Turns out the ancient people could teach us a thing or two about energy when they laid siege to an enemy town. Although we won't do this today, we will explore some of the important physics concepts that they have to teach us.

What to Learn: Energy can be found in many forms. Identify what kinds and where each type of energy are working in this experiment, and you'll be ready to move on.

Materials

- 9 tongue-depressor size popsicle sticks
- four rubber bands
- one plastic spoon
- ping pong ball or wadded-up ball of aluminum foil (or something lightweight to toss, like a marshmallow)
- hot glue gun with glue sticks

Lab Time

1. Stack seven popsicle sticks and secure them together with rubber bands. Twist them around a few times so they stay securely. Do this on each end.
2. Grab two more popsicle sticks, stack them, and secure one end with a rubber band. The other end will stay open. We'll slide our fulcrum into the open end.
3. Slide the open end over the seven stacked sticks, and secure the whole thing by crossing a rubber band over the end of the two stacks.
4. Attach the spoon to the end of the upward-facing stick with hot glue or an extra rubber band.
5. Take the aluminum foil and scrunch it into a ball. Place the ball on the spoon, press it down, and release!

Catapult Observations

1. What part of the catapult stores the most potential energy? Why is this?

2. Where is the kinetic energy transferred to in this catapult?

3. How would you make a catapult's projectile travel farther? Explain.

Troubleshooting: These simple catapults are quick and easy versions of the real thing, using a fulcrum instead of a spring so kids don't knock their teeth out. After making the first model, encourage kids to make their own "improvements" by handing them additional popsicle sticks, spoons, and glue sticks (for the hot glue guns).

If they get stuck, you can show them how to vary their models: glue a second (or third, fourth or fifth) spoon onto the first spoon for multi-ammunition throws, increase the number of popsicle sticks in the fulcrum from 7 to 13 (or more?), and/or use additional sticks to lengthen the lever arm. Use ping pong balls as ammo and build a fort from sheets, pillows, and the backside of the couch.

Reading

We're utilizing the "springy-ness" in the popsicle stick to fling the ball around the room. By moving the fulcrum as far from the ball launch pad as possible (on the catapult), you get a greater distance to press down and release the projectile. (The fulcrum is the spot where a lever moves one way or the other – for example, the horizontal bar on which a seesaw "sees" and "saws".)

Exercises Answer the questions below:

1. How is gravity related to kinetic energy?
    a. Gravity creates kinetic energy in all systems.
    b. Gravity explains how potential energy is created.
    c. Gravity pulls an object and helps its potential energy convert into kinetic energy.
    d. None of the above
2. If you could use your catapult to launch your ball of foil into orbit, how high would it have to go?
    a. Above the atmosphere
    b. High enough to slingshot around the moon
    c. High enough so that when it falls, the earth curves away from it
    d. High enough so that it is suspended in empty space
3. Where is potential energy the greatest on the catapult?

Answers to Exercises: Catapults

1. How is gravity related to kinetic energy? (Gravity pulls an object and helps its potential energy convert into kinetic energy.)
2. If you could use your catapult to launch your ball of foil into orbit, how high would it have to go? (high enough so that when it falls back down the earth is already curving away)
3. Where is potential energy the greatest on the catapult? (when the spoon is pressed down all the way)