Making a Catapult

Target Grade: K-12

Time Required: 10 minutes

Standards/Curriculum/Topics Covered By This Activity:
Next Generation Science Standards:

- K-PS2-1. Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.
- 3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.
- MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
- MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
- HS-PS2-1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

Central Focus:
Launch into engagement with this activity! Students will build their own miniature catapult! This activity can be used to teach kinetic and potential energy, simple machines, and forces. This activity includes an optional extension for students to explore the engineering design process, as well as experiment with the amount of force applied to the distance an object travels.

Key terms: work, levers, lever, machine, effort, activities

Background Information:
A simple machine is a device that can change the direction or the amount of force, making performing work easier. Simple machines use few parts. There are six types of simple machines: the inclined plane, lever, wedge, wheel and axle, pulley, and screw. Each of these types of simple machines allow for the performance of work with minimal effort, or force. In physics, work is defined as the product of force and displacement. In simpler terms, work has not occurred unless the object is moved. In this activity, the mini-catapult is an example of a lever simple machine. When someone pushes on the end of the catapult, they apply a force (or effort). The force is then multiplied to launch the object.

Materials:

- 8 Regular-Sized Craft Sticks
- 2 Large Craft Sticks
- 3 Rubber Bands
- Box Cutter

Instructions:

1. Stack 8 regular-sized craft sticks on top of each other.
2. Tie them off with a rubber band at the ends on each side, and set them out of the way.
3. Stack the 2 large-sized craft sticks on top of each other. Select one end.
4. On the end that you selected, cut small grooves on the sides of the sticks for a rubber band.
5. Wrap a rubber band around the end where the grooves were cut so that the grooves hold the rubber band in place.
6. On the other end opposite the grooves, slide one of the large craft sticks in between the first and second smaller craft sticks that were banded together previously, as shown in the pictures below.


7. Your catapult is now ready for use!

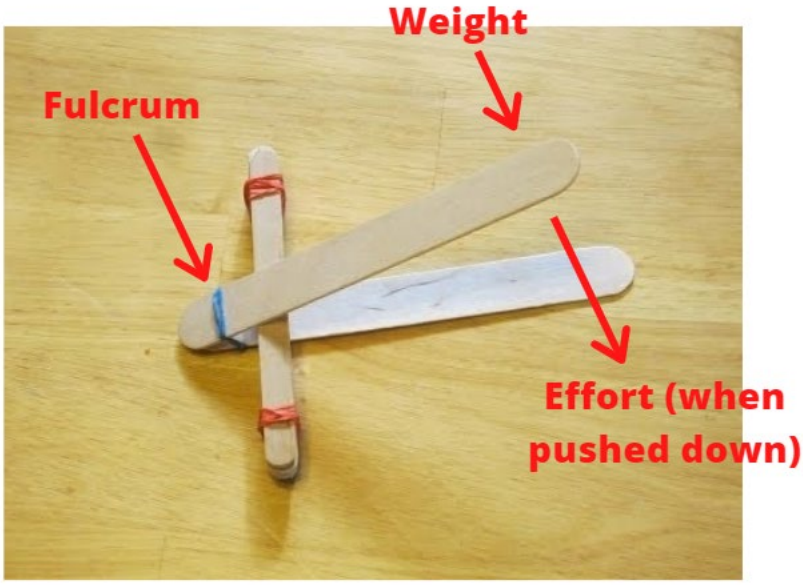
Optional Extensions:

1. Allow students to make various versions of the catapult. Students can then test the best design by determining which catapult launches the object the furthest.
2. Students can experiment with the amount of effort, or force, used when pushing down on the end of the catapult. Students can observe the best amount of force to launch further or higher.

Closure:

1. What type of simple machine is this? How do you know?
   A catapult is a lever simple machine. A lever changes the distribution of the weight, as seen in the catapult, as the weight is moved from the object being launched to the fulcrum, where the craft sticks are banded together. The weight is pivoted to send the object flying.

2. What are the different parts of this lever?



The fulcrum is a pivot point which moves the load. The weight, or load, is the object that you are trying to move (or fling) with the lever. The force is the pressure applied to the end of the craft stick.

3. What class lever is this? Why?
This catapult is a Class 1 Lever as the pivot is located between the effort and the load. In this case, the pivot is where the small, rubber-banded craft sticks meet the large craft sticks. The pivot allows the force from pressing on the craft stick to be transferred to the object, causing it to fly off the catapult.
4. How does this simple machine perform work? How does it make work easier?
A lever reduces the amount of force needed to lift an object, or in this case fling an object. A lever is able to do this by converting a small amount of force (pressing down on the craft stick) into potential energy. When you let go of the craft stick, the force is converted to kinetic energy, sending the object flying. The more force that is converted, causes more force to be applied on the object (and the further it flies!).