# Make a Cranberry Catapult

OVERVIEW: In this engineering design lesson, students work in small groups to create a simple catapult, measure the distances their catapult can fling a cranberry, and graph and compare results.

GRADES: 3-5

MATERIALS:
5 wide craft sticks for each group of students
1 plastic spoon for each group
1 spool for each group
6 rubber bands for each group
8 fresh cranberries for each group
1 copy of the Cranberry Catapult chart below for each student
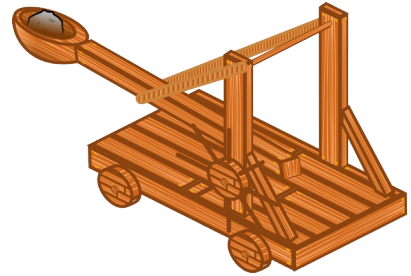
BACKGROUND:
A catapult is a type of simple machine called a lever. A lever is a bar centered on a turning point called a fulcrum that's used to raise or move objects. Levers make it easier to lift heavy things. A catapult is a first class lever, with the fulcrum in the middle of the force and the load. Other examples of a first class lever is a seesaw, scissors, and a hole punch.

In a catapult, the bar pivots on the fulcrum to launch an object. The lever magnifies the force you apply to it, making it easier to lift or launch the object.

In ancient times, catapults were used to throw heavy objects like stones and spears at enemy fortifications, such as over castle walls. Some catapults could throw stones weighing up to 350 pounds over 300 feet. Catapults were especially common in the Middle Ages and were one of the most effective mechanisms in warfare. The earliest catapults date back to at least 700 BC.

A slingshot is also a type of catapult. A slingshot is a Y-shaped stick made of wood or metal with an elastic attached to the top, used to shoot small stones.

PROCEDURE Part 1:
Make the Catapult
Tell students that today they are going to be given a design challenge. They are going to work in groups to make a simple catapult that will fling cranberries into the air. Explain to students what a catapult is and how it was used in the Middle Ages. Show pictures of a catapult and slingshot (below.)

Divide student into groups of four. Tell students they are going to be given these materials to make a catapult.

The materials they can use to make the catapult include:

5 wide craft sticks for each group of students
1 plastic spoon for each group
1 spool for each group
6 rubber bands for each group
8 fresh cranberries for each group

Explain to students that the spoon will be the lever of the catapult that launches the cranberry.

(For younger students, the teacher may want to demonstrate how the spoon acts as a fulcrum by placing a cranberry in the bowl of the spoon, pushing the bowl back, and letting the cranberry fly. For older students, you may want to see if they can figure this out with their groups.)

CHALLENGE RULES:
- Listen carefully to ideas from everyone on your team. Think about the best design before you begin to build.
- You may only use the materials provided, but you do not have to use all the materials provided.
- You must complete your design in the time given.

TIME SCHEDULE:
Teacher will set a timer and notify students when to move on to the next step.
- 5 minutes to brainstorm ideas as a group.
- 5-10 minutes to plan out the design. (As soon as everyone in the group approves a design, you can move on to the next step.)
- 15 minutes to create and test the catapult

Show students where they are able to test their catapults so the cranberries do not hit anyone or interfere with other groups. Tell them it's okay if someone has brace (hold down) the catapult down in order for it to work.

Teacher tells the groups to begin work and announces when it is time to move on to the next step.

If any group has particular trouble designing the catapult, you may want to show them pictures of the two catapult examples below.

PROCEDURE Part 2
Fling the Cranberries with the Catapult
Now that the catapults are constructed, groups of students will use them to launch the cranberries and record the distance. Each student should have two turns to toss the cranberries. Two of the students should stand back to be ready to pinpoint where the cranberry lands, and the other student should use a ruler or yardstick to measure the distance.

If you are using rulers, show students how to mark and measure the distance if it is longer than one foot. Tell students to measure to the nearest one-half inch, but you may want older students to measure within the nearest ¼ inch. If so, tell students to change this number on the catapult worksheet.

Students record the distance of each of the eight cranberries on the chart below.

EVALUATION: Completed Cranberry Catapult worksheet

EXTENSIONS: Compare graphs of each group and make a whole class graph of each group's longest catapult throw. Which catapult was able to toss cranberries the longest distance? How did the catapult design help this to happen?
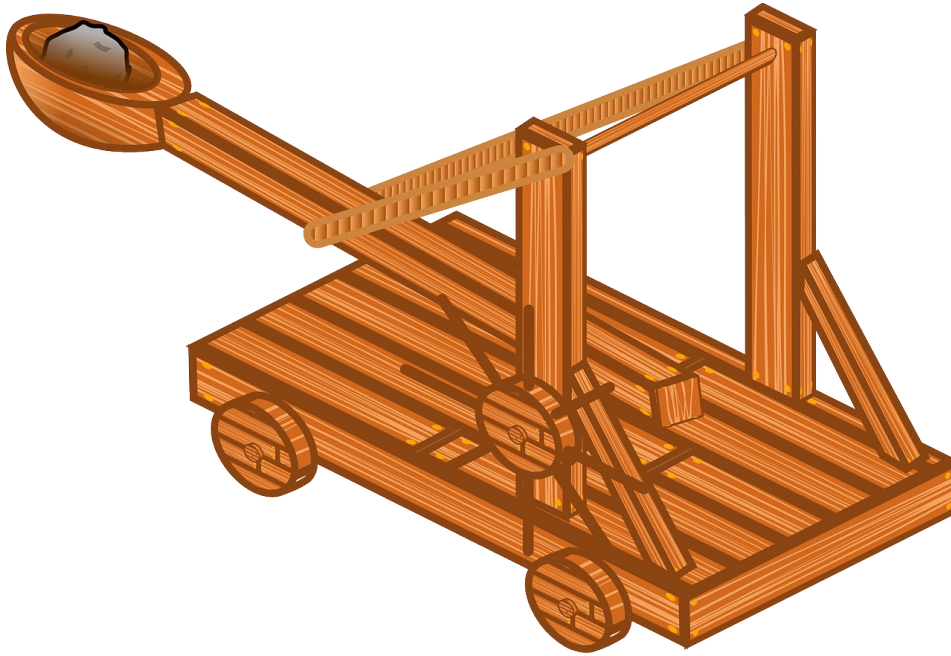
Use your cranberries to conduct the Cranberry Bounce Test, lesson available *here.*

NEW JERSEY LEARNING STANDARDS:

Science: 3-5-ETS1-1   3-5-ETS1-2   3-5-ETS1-3

Math: 3.NF.A MD,B,3,4   4.NF.B,C MD.A,B   5.NF.A MD.A,B

Types of Catapults

Cranberry Catapult

Now that your group has built your catapult, you will use it to launch each of your eight cranberries and record the distance they travel. Each person in your group should have two turns to launch cranberries. Two people in your group should stand back to be ready to pinpoint where the cranberry lands, and the last student should use a ruler to measure the distance. Measure the distances to the nearest one-half inch.

Record the distance for each of your eight cranberries on the chart below.

When you have recorded the distances for all eight cranberries, answer the questions about your data below.

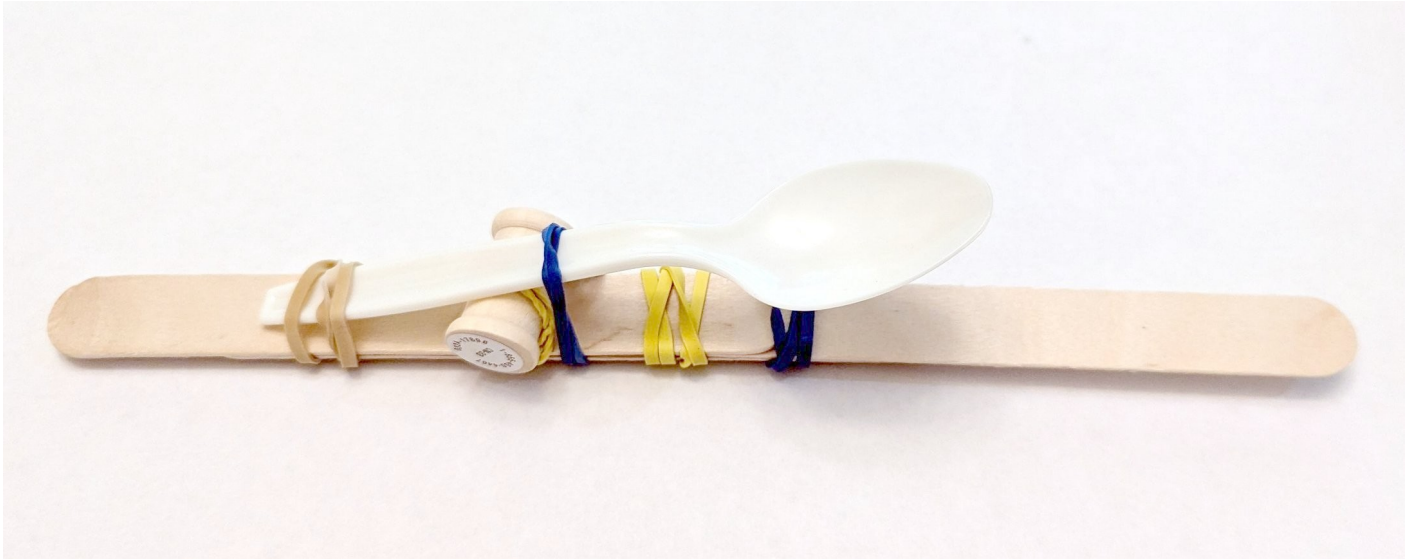|	Distance		Distance
Cranberry 1		Cranberry 5	
Cranberry 2		Cranberry 6	
Cranberry 3		Cranberry 7	
Cranberry 4		Cranberry 8	

What was the shortest distance you recorded? _____

What was the longest distance you recorded?_____

What is the difference between the shortest and longest distances?_____

What is the medium (middle number) of the distances you recorded?_____

With your group, make a graph of your distances from throws 1 to 8.

CATAPULT EXAMPLE 1

CATAPULT EXAMPLE 2