Mini Catapult
Distance and Accuracy Activity

Lesson Skill/Mathematics Concept: Computation, measurement
Using tape measures and targets, students will calculate distance of a projectile and evaluate the accuracy of the catapult they construct.

Vocabulary:

- **Angle**: An angle is defined as a figure that is formed from two lines that meet at a common place. The sides of a triangle are examples of lines that form an angle.
- **Accuracy**: The quality or state of being correct or precise.
- **Average Distance:** The typical distance of a group of things.
- **Distance**: A numerical description of how far apart objects are. In physics or everyday usage, distance may refer to a physical length or estimation based on other criteria (e.g. "two counties over").
- **Height**: The measurement from base to top.
- **Force**: strength or energy as an attribute of physical action or movement.
- **Projectile**: A missile designed to be fired from a rocket, gun or catapult
- **Launch**: Set an object in motion by pushing it.

Estimated Time: *60 minutes*

Materials List:
Items needed per team of 2 or 4 students

- 9 craft sticks (include extras for each team so the students can add height to their catapult to see if it effects distance)
- 6 – 8 rubber bands
- a plastic spoon
- Styrofoam balls, cotton balls, cap erasers or other items to launch
- a long measuring tape per team, at least three feet in length
- masking tape for a starting line for catapults
- targets
- String or paper for making a wall

Goal: Students will learn about averaging measurements, recording distances and factors that affect accuracy by building and testing their own mini catapult.

Note: This activity has been tested successfully with middle school students. For a visual guide on how to build a catapult go to http://www.discoverycube.org/blog/kara-noel-how-to-make-a-mini-catapult

Background Information: ***A Brief History of Catapults***

The catapult is the most recognized military device of ancient times and the source of continued fascination and popular appeal, the catapult represented a major shift in the conduct of warfare. This is the first machine of war. Variations of the design allowed a variety of machines and missiles to be built and used for particular battlefield conditions or military tasks. Catapults were important weapons of war before guns and cannons were invented. A catapult was a simple machine. It was used to throw heavy objects at the enemy with great force. Do you think we use catapults today? Yes, we do! Modern day catapults launch planes off of aircraft carriers.

Directions:

1. Tell students they are a team of engineers who have been given the challenge to design their own catapult out of everyday items. The catapult should be designed to launch a Styrofoam ball so it can land on a target from as far a distance as possible. The catapult that can accurately hit the target from the greatest distance is the winner. Students may use the materials which have been provided, *but the rubber bands may not be used to power the arm or slingshot* the marshmallow/cap eraser/cotton ball- whatever it is that you've been given to launch."

Steps for giving each student a task in building their first catapult:

1. Student #1 stack 5 craft sticks. Student #2 will wrap a rubber band tightly around one end of that stack while student #1 holds the stack. Student #3 will wrap another rubber band around the other end of the stack. (Science Note: You can experiment with different sized stacks!)
2. Student #4 will take 2 more craft sticks and wrap a rubber band on one of the ends.
3. Student #1 will insert the 5-stick-bundle between the 2-stick-stack and stretch a rubber band crisscross to connect the two pieces. (Science Note: The closer the bundle is to the wrapped edge, the more LEVERAGE the catapult will have)
4. Student #2 will use 2-4 rubber bands to attach the plastic spoon to the end. (Science Note: Experiment with how far up or down on the craft stick you place the spoon.)
5. The teacher will now explain that they are ready to test their first catapult, but first they must get ready to measure the distance that the projected item will travel.
6. Teacher will use masking tape to create a starting line. The class could have one starting line or there could be different starting lines around the room for each team to use. Make sure that each team has enough room to project an item and measure the distance the item travelled without getting in the way of another team.
7. Teacher may demonstrate how the task will be performed. When it is their turn, each student will have to hold their teams catapult down behind the starting line before they launch. Each student will get three turns. Each student will record his or her own measurement. The other students will measure the distance for the student and tell them what to record.

8. All students will get to launch an item for distance 3 times. **After** each student has had a chance to launch three times, the teacher will direct the students to return to their desks to average their launch distances. (Teacher will reteach how to average as necessary.) Students will calculate the average of their 3 recorded distances and record onto individual data charts.
9. Students will then rebuild the catapult with two more craft sticks in the stack or crossbeam of the catapult and then each will try three launches again! Record data.
10. Repeat the rebuild with two *more* craft sticks in the stack or crossbeam of the catapult and then try the launches again. Record data.
11. ***Teacher must monitor to make sure that students are measuring the distance as accurately as possible and to ensure that students aren't launching items at others!***

Steps for Catapult #2

1. Students identify the catapult that launches an object the farthest.
2. Complete the Catapult Task #2 directions and worksheet to experiment with flight accuracy.

Catapult Performance Task #1 Name:_____

Ask/Problem: Build your first catapult and then test launch a projectile and record the **distance** it travelled in inches.

Design 1 A base of 5 craft sticks	Launch			What was the average distance that your item travelled in feet and inches?
	1	2	3	
You have 3 tries to launch. Record your distance after each attempt.				

Examine your original design. Predict what will happen if more craft sticks are added to the base of the catapult. How might this affect the distance the object will travel after it's launched?

Design 2: A base of 7 craft sticks	Launch			What was the average distance that your item travelled in feet and inches?
	1	2	3	
You have 3 tries to launch a projectile. Record your distance after each attempt.				

Design 3: A base of 9 craft sticks. Record your distance after each attempt.	Launch			What was the average distance that your item travelled in feet and inches?
	1	2	3	
You have 3 tries to launch a projectile. Record your distance after each attempt.				

Reflection:

Which design projected your object the farthest? _____

Why do you think that happened?_____

Catapult Performance Task #2 Name:_____

Identify which catapult and object can be launched farthest. _____
Use *that* catapult for this next set of tasks.

Best Design	Launch			What improves the performance of a launch?
	1	2	3	
You have three tries to launch a projectile with your best design. Record your distance after each attempt in inches.				

Accuracy: How far away from the target did your projectile land?	Launch			What caused the accuracy to change?
	1	2	3	
You have three tries to hit a target. Record your distance away from the target (how far did it miss?)				

Height:	Launch			How did design features affected the results?
	1	2	3	
You have 3 tries to launch a projectile over a "wall". Record the results (yes/no).				

Reflection:

Which student/team had the best accuracy? _____

Why?_____

Which student/teams cleared the wall? _____

Why?_____