

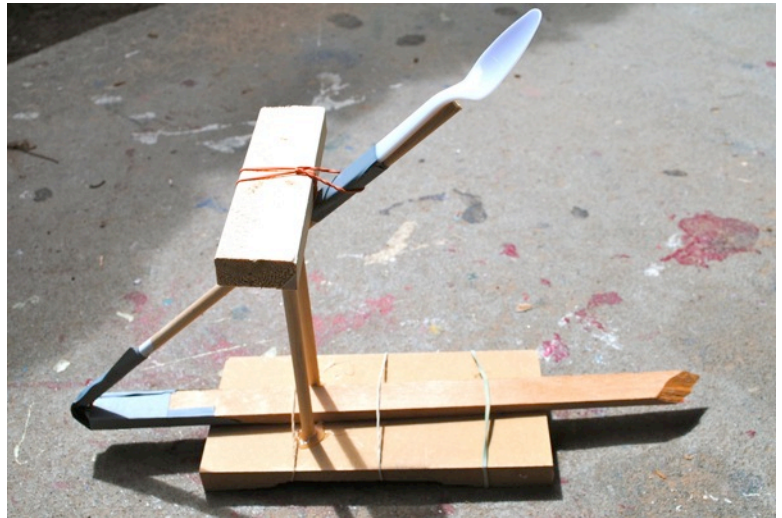
Catapult

Category: Physics: Force & Motion,
Balance, Center of Mass

Type: Make & Take

Rough Parts List:

1	Baseboard
1	Long, narrow, and flat piece of wood like a paint paddle
1	Spoon
4	Rubber bands
1	Small piece of wood
24"	5/16" Dowel
	Duct tape
	Drill



Video: <http://youtu.be/E-qjiFSvtL4>

How To:



Drill 2 holes into the baseboard.



Drill 2 holes into smaller piece of wood.



Cut dowels into 2- 6" pieces and 1- 12" piece.



Insert the 2-6" dowels into the holes in the small piece of wood.



Wrap 3 rubber bands around the baseboard.



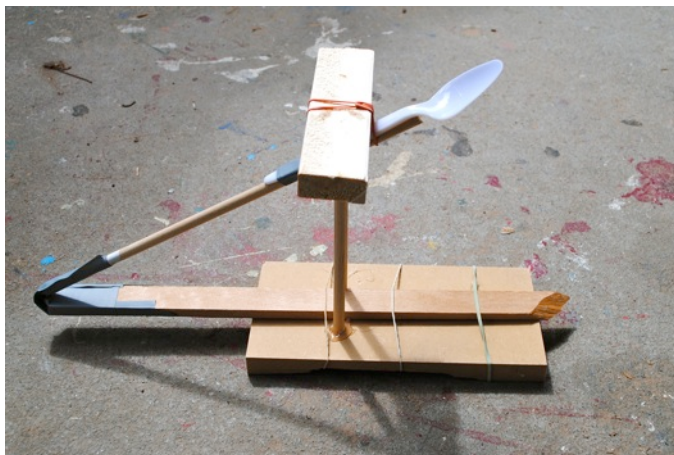
Insert dowels into the holes in the baseboard.



Attach a spoon to the end of the 12" dowel.



Attach the other end of the 12" dowel to the flat piece of wood.



Place the flat piece of wood between the two dowels and under the rubber bands.



Loop a rubberband around the small wood piece and behind the spoon to make the catapult.

Fine Points:

→ The 2 holes in the baseboard and the smaller piece of wood should be the same distance apart.

Concepts Involved:

- The catapult arm is a lever. For this catapult the fulcrum, or pivot point, is at one end. The force is given to the lever in the middle with the rubber band. The resistance happens at the other end where the bean sits.
- This is called a third class lever. A first class lever is like a see-saw, with the fulcrum in the middle. A second class has the fulcrum at one end, but the force is given at the other end.
- The catapult will shoot different distances according to what angle it releases the object and the mass of the object being thrown. According to theory, the farthest it will shoot is when the object is released at 45 degrees.

Focus Questions:

1. What could you do to make the catapult shoot farther?
2. Would it shoot farther with a longer arm, or a shorter one?
3. How would you hold or set the catapult to make it shoot straight up?
4. How would you hold or set the catapult to make it shoot as far as possible?
5. Gather lightweight objects such as Styrofoam and pom-poms, mid-weight items such as little paper balls and heavyweight objects including beans and pebbles. Compare the flight path of all items thrown at the same angle. Which items flew highest? Furthest?

Elaboration:

A lever is one of the three basic simple machines, the other two being the pulley and the inclined plane. The three parts of a lever are the force arm, the resistance arm and the fulcrum or pivot point. A first class lever has the fulcrum in the middle. An example is a seesaw. One kid is the force, the other is the resistance (doesn't matter which is which). If the kids are the same weight and the same distance from the fulcrum, the seesaw will balance perfectly. If one is heavier than the other, they will have to move to different positions at different distances from the fulcrum to make the seesaw balance.

Second and third class levers have their fulcrum at one end of the arm. Second class levers have the resistance in the middle and the force at one end. An example is a wheel barrow. The fulcrum is at the wheel, the resistance is the rocks in the wheel barrow, and the force is where your hands are holding the handles. Second class levers can multiply force; you can lift a lot more weight with a wheel barrow than you can with just your arms. But you have to lift farther.

A third class lever has its resistance at the end and the force in the middle. This project is an example of a third class lever, and so are brooms and fishing poles if you hold one end solid and move the hand in the middle. Third class levers multiply distance; with both brooms and fishing poles, you can make small motions with your middle hand and get large motions at the ends. But you have to give more force.

Links to k-12 California Content Standards:

Grades k-8 Standard Set Investigation and Experimentation

Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other strands, students should develop their own questions and perform investigations.

Grades k-12 Mathematical Reasoning:

1.0 Students make decisions about how to approach problems:

1.1 Analyze problems by identifying relationships, distinguishing relevant from irrelevant information,

sequencing and prioritizing information, and observing patterns.

1.2 Determine when and how to break a problem into simpler parts.

2.0 Students use strategies, skills, and concepts in finding solutions:

2.1 Use estimation to verify the reasonableness of calculated results.

2.2 Apply strategies and results from simpler problems to more complex problems.

2.3 Use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams, and models, to explain mathematical reasoning.

2.5 Indicate the relative advantages of exact and approximate solutions to problems and give answers to a specified degree of accuracy.

3.0 Students move beyond a particular problem by generalizing to other situations:

3.1 Evaluate the reasonableness of the solution in the context of the original situation.

3.2 Note the method of deriving the solution and demonstrate a conceptual understanding of the derivation by solving similar problems.

3.3 Develop generalizations of the results obtained and apply them in other circumstances.

Grade 2 Standard Set 1. Physical Sciences:

The motion of objects can be observed and measured.

1.a Students know the position of an object can be described by locating it in relation to another object or to the background.

1.b Students know an object's motion can be described by recording the change in position of the object over time.

1.c Students know the way to change how something is moving is by giving it a push or a pull. The size of the change is related to the strength, or the amount of force, of the push or pull.

1.d Students know tools and machines are used to apply pushes and pulls (forces) to make things move.

Grade 3 Standard Set 1. Physical Sciences (Energy & Matter):

1.c Students know machines and living things convert stored energy to motion and heat.

1.d Students know energy can be carried from one place to another by waves, such as water waves and sound waves, by electric current, and by moving objects.

Grade 8 Standard Set 2. Forces:

Unbalanced forces cause changes in velocity.

2.a Students know a force has both direction and magnitude.

2.e Students know that when the forces on an object are unbalanced, the object will change its velocity (that is, it will speed up, slow down, or change direction).

2.f Students know the greater the mass of an object, the more force is needed to achieve the same rate of change in motion.

Grade 9-12 Physics Standard Set 1. Motion & Forces

Newton's laws predict the motion of most objects.

1.b Students know that when forces are balanced, no acceleration occurs; thus an object continues to move at a constant speed or stays at rest (Newton's First Law).