



## Curiosity Guide #202

### Levers

Accompanies Curious Crew, Season 2, Episode 2 (#202)

#### Trebuchet Trials

Investigation #1

#### Description

Discover how to make objects fly a long way with a classic Class 1 lever!

#### Materials

- Small trebuchet made of wood, cardboard, Popsicle sticks, or PVC pipe, constructed from plans found on the Internet
- Lightweight objects to launch, such as ping pong balls, cork, chisel erasers, and marshmallows

#### Procedure

- 1) Locate trebuchet plans on the Internet. Gather the required materials. Build the trebuchet.
- 2) Launch lightweight objects and record what happens. This is your initial trial.
- 3) Make adjustments to the trebuchet to increase the launch range. Test the trebuchet after each modification.
- 4) Changes in design to try:
  - The height the counterweight has to fall
  - The height of the fulcrum
  - The mass of the counterweight
  - The length of the load arm
  - The length of the sling
  - The mass of the payload

- 5) Experiment to see which combination of attributes results in the objects flying the greatest distance. Record trials of the significant changes you make to the design of your trebuchet.
- 6) Identify the different parts of the lever that make it operate.

### My Results

### Explanation

The trebuchet is an example of a first class lever. It was used as a siege weapon in the Middle Ages to attack castles. The range, or distance an object could be launched, was important in ancient warfare.

Builders of trebuchets wanted the load arm of the trebuchet to quickly swing up and launch projectiles that were attached in a sling.

They discovered that the load arm should be offset and far away from the fulcrum, and they learned to use a large counterweight force with rocks. When the force arm was raised and weight was added, the potential energy of the arm increased. When the weight was released, the arm pivoted on the fulcrum. The arm transferred the energy to the sling on the load arm, and the projectile was released.

Designers of trebuchets can make projectiles, or payload, fly farther and faster by adjusting the various working parts of the trebuchet, including the mass of the payload. Modifying the length, height, and mass of the working parts results in changes to how fast, how far, and how high the payload goes.

**Something else to try:** Have you ever ridden on a seesaw? That is a great example of a Class 1 lever because the fulcrum is in the middle. Here's a little seesaw challenge for you. Try getting on it with a friend or parent who is bigger than you are. Your parent will go down and you will go up. Now figure out who needs to move where on the beam so that the seesaw lever can balance. Have fun and keep experimenting!

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