

Cautionary and Warning Statement

- This kit is designed and intended for educational purposes only.
- Use only under the direct supervision of an adult who has read and understood the instructions provided in this user guide.
- Read warnings on packaging and this user guide carefully.
- Safety glasses required.
- Do not aim at people.
- Always exercise caution when using sharp tools.

How a Trebuchet Works

If you've ever read about what life was like during medieval times, you'll know there were wars during this period in which fighting was much more hands on and weapons were far less sophisticated than today.

The invention of the trebuchet put a twist on what people knew as a catapult. Both machines were used to fling huge rocks that would break down the walls of a castle and let invaders inside. Instead of throwing weight on one end of the catapult's lever to propel the rocks forward, the trebuchet has a sling that swings from the bottom to the top of the machine, giving it more momentum and projectile force.

Materials Included

- Basswood sheets with laser-cut pieces
- Design template for bending paper clips
- 1" x 12" basswood strip
- 1/4" x 4-3/4" basswood strips (4)
- 1/8" x 3" brass tube
- 5/32" x 1/2" brass tube
- 1/4" x 1" flexible tubing
- Large paper clips (2)
- Strip of ripstop nylon
- 36" piece of nylon string
- 1/8" brass washers (2)
- 2 lever arm end caps (1-1/2" x 2" punch out piece)

Items Required (not included)

- White glue or CA glue
- Hobby knife
- Needle-nose pliers
- Safety glasses
- Felt-tip marker
- Sandpaper
- Ruler
- Scissors
- Mass plates (required for launch; Pitsco product #58676)
- Modeling clay (to make projectiles)

Building the Base

1. Punch out the trebuchet body pieces from the basswood template. The two small base pieces fit at the bottom of the Y-shaped side pieces. Glue them onto the bottom of one side piece.
2. Glue the other side piece on top and let dry. These will form a flat square on the bottom that will be the base.

Steps 1-2



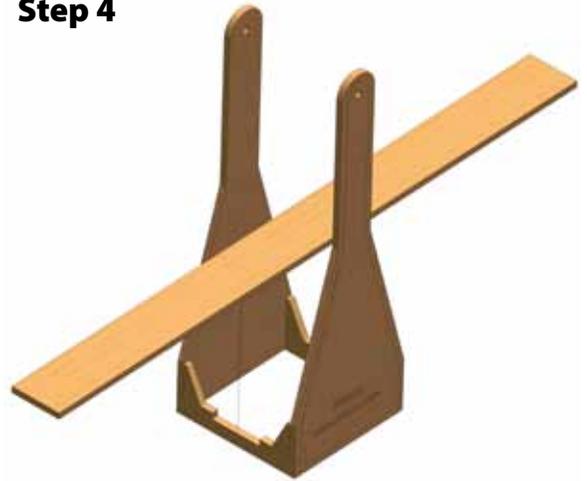
3. Locate the 1" x 12" strip of basswood. Measure and mark 4-3/4" from one end.

Step 3

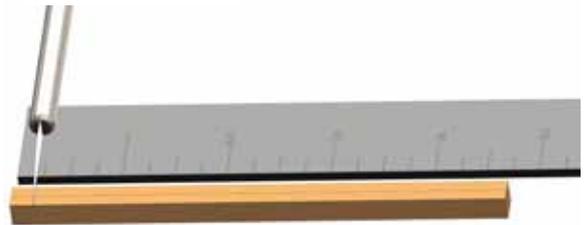


4. Glue the strip into the precut notches of the small base pieces so that the mark lines up with an outside edge of the base. The strip should be centered over the base.
5. After the basswood strip is dry, locate the four 1/4" x 4-3/4" strips; these will be base supports. Take two of them and cut a shallow notch (1/16" deep) 1/4" from one end.
6. Line up the notched strips so they fill in the gaps between the bottom of the basswood strip and the square base on one side. The notches go toward the end of the long strip and will create small holes when placed against the basswood strip. Without cutting notches, place the second pair of base supports on the other side.
7. Using needle-nose pliers, straighten one of the paper clips. Using the cutter on the inside of the pliers, cut a 2-5/8" piece off the paper clip and bend that piece into a triangular shape like that shown above "Trigger" on the template.
8. Slide the ends of the triangle through the holes at the front of the basswood strip (formed by the notches in the small strips) so the triangle forms a hook.

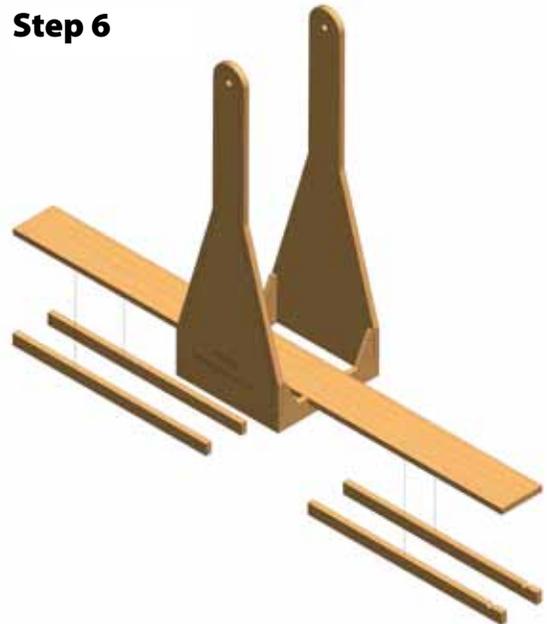
Step 4



Step 5



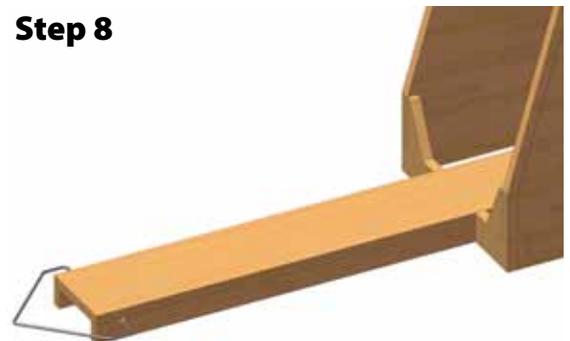
Step 6



Step 7



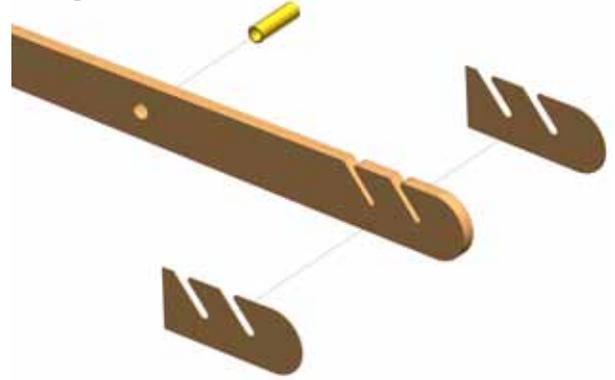
Step 8



Building the Lever Arm

1. Find the long basswood piece with the rounded end. This is the **lever arm**. The two diagonal cuts at one end are identical to the small end caps on the separate 1-1/2" x 2" piece. Glue the end caps to each side of the lever arm's curved end. The curved end caps may extend a little past the lever arm, but make sure the diagonal cuts are lined up.

Steps 1-2

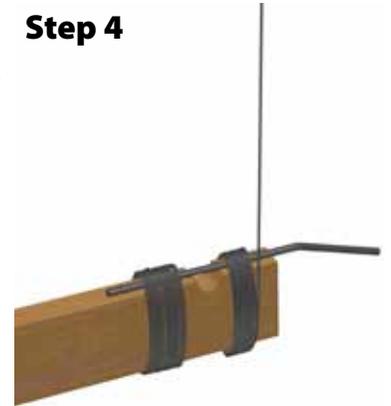


2. The lever arm has a small hole near its center; locate the short brass tube. Center the tube in the hole and glue it in place so it doesn't spin.

Step 3



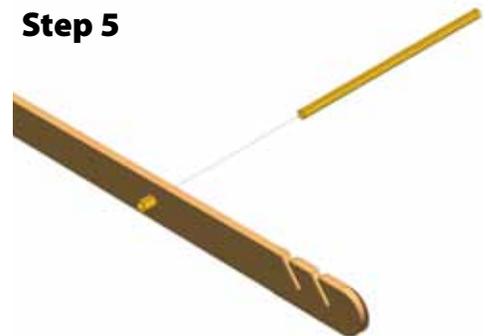
Step 4



3. Take what is left of the paper clip and cut off 1-1/4" with the needle-nose pliers. Bend the piece with the pliers to match the shape where the template says "Hook." Make sure both ends are smooth; remove any burrs with sandpaper. This will be the **hook**.

4. Line up the hook against the square end of the lever so that it is over the notch and hanging over the end of the lever about 1/2". Glue the hook to the arm. Let it dry for a few minutes, locate the 36" piece of string, and cut off 12". Holding the (nearly dry) hook in place, wrap the string around it so the hook is bound to the lever arm. Put a layer of glue over the string so it does not come unwound. Be sure not to glue the notch.

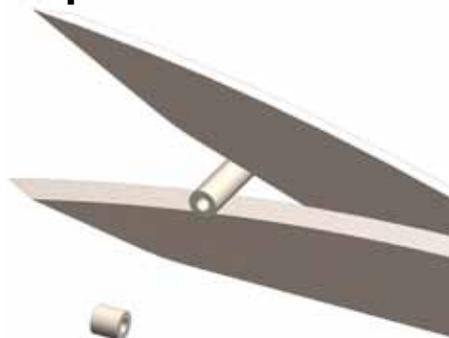
Step 5



5. Locate the long brass tube, and slide it through the short brass tube glued into the lever.

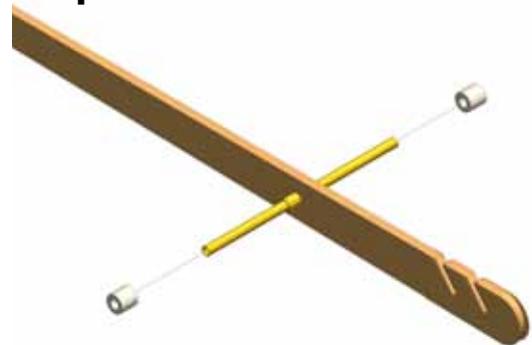
6. Using scissors, cut the flexible tubing into four 1/4" pieces.

Step 6



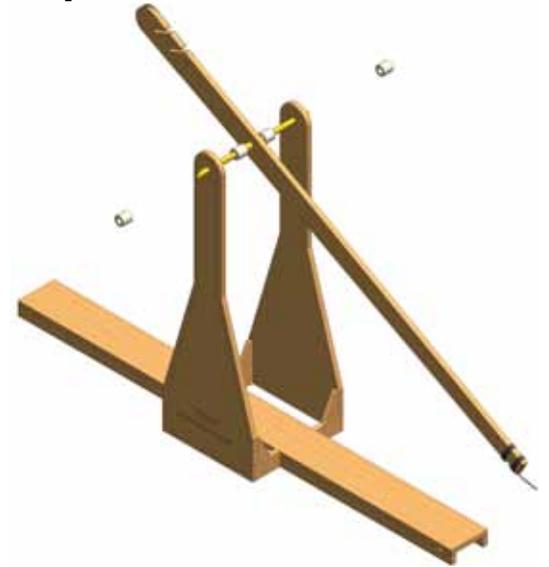
7. Slide a brass washer onto each end of the long brass tube, and push one of the tubing pieces onto either end.

Step 7



- Put each end of the brass tube through the holes in the side pieces of the base. Be sure the hook is on the same end as the trigger and the diagonal cuts are facing upward.
- Push the last two flexible tubing pieces onto the outside ends of the brass tube to connect it to the sides. Be sure the lever can swing freely.

Steps 8-9



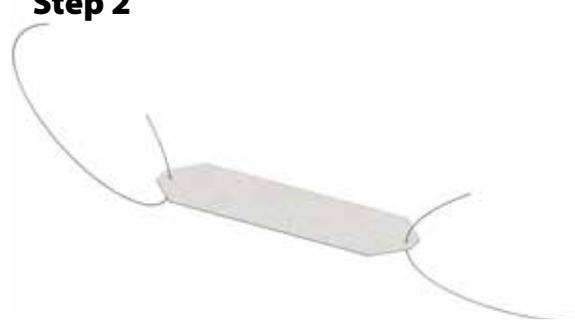
Building the Sling

- Locate the piece of nylon and the remaining 24" of string. Trim each corner of the ripstop nylon at an angle, and use a hobby knife to punch a tiny hole into each end.
- Cut the string in half. Tie a piece to each end of the nylon strip through the holes. This will be the **sling**.

Step 1

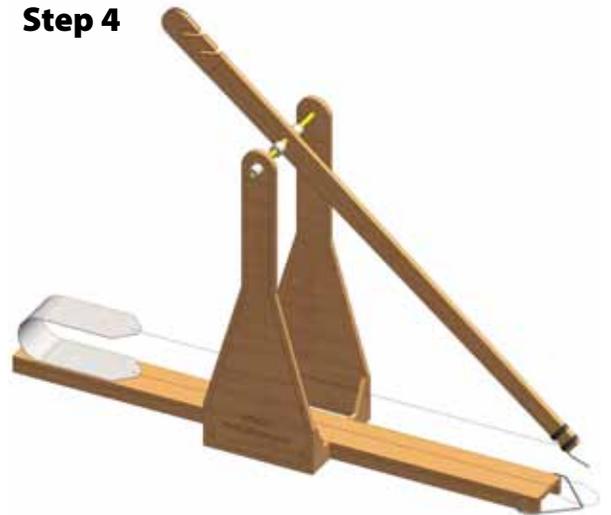


Step 2



- Take the free end of one string and tie it into a secure loop.
- The free end of the second string should be carefully threaded through the hole created by the hook on the square end of the lever arm. Tie this end into a knot so it stays connected to the arm. Use a dab of glue to make sure the knot doesn't come loose.

Step 4



Note: It is very important that the strings are the same length. They should each be close to 8" so that the sling isn't lopsided.

Adding the Counterweight

- Straighten the second large paper clip. Look at the area on the design template labeled "Weight support," and bend the clip into a narrow, upside down U-shape with sharp corners. Be sure the loop of the U is narrow enough to fit through the center holes of the mass plates.
- Place the mass plates on the weight support.

Steps 1-2



- Slide the clip onto one of the diagonal cuts in the lever arm. The weight will provide resistance in order for you to pull downward on the square end of the lever arm.

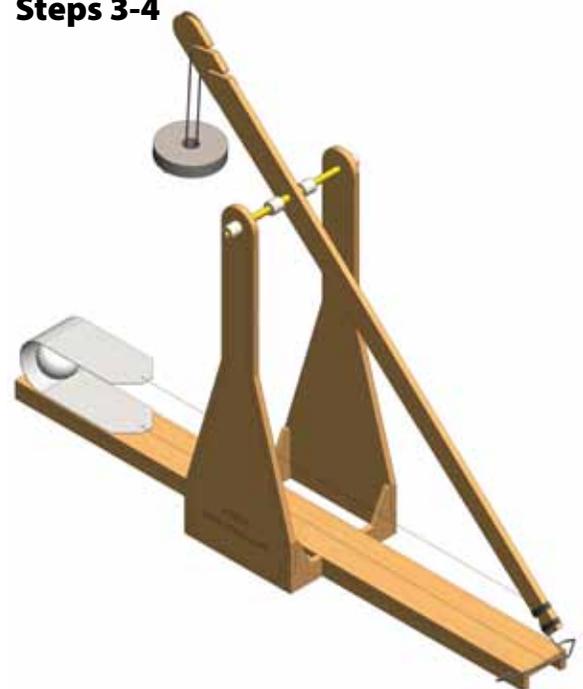


Operating the Trebuchet

- Loop the free end of the string over the hook.
- Raise the trigger and put the hook under it.
- Gently lay the sling along the long basswood base piece inside the trebuchet body.
- Find your projectile and tuck it inside the nylon material. It's a good idea to start with 100 grams of weight for every gram of clay.
- Pull down on the trigger to release the lever and fling the clay across the room.



Steps 3-4



Your trebuchet is ready to attack! The trebuchet can pitch ammunition many feet away, so be sure to only use non-damaging materials.

Experiment with different amounts of mass, lengths of string, and angles of the hook to fling the balls higher or farther. To set the scene, build protective walls or set up a target.

Caution: Before firing the trebuchet, safety goggles or glasses should be worn by everyone in the room.

Activity Idea

Using the built Trebuchet Kit, students will launch small balls of clay while using various numbers of mass plates. Students measure the resulting ranges and graph them.

Preparation

Set up a firing range by rolling out a 30-foot length of two-foot-wide white paper (Pitsco Range Paper) or a similar type of paper. Tape this down so it doesn't move. If many students do this experiment with their individual trebuchets, be sure they each have a clay ball that has the same mass (for example, 10 grams of clay).

You will also need a measuring tape and a student to watch the landing and record the results.

Testing Different Numbers of Mass Plates

Add four mass plates to the trebuchet and set the model at one end of the paper. Place the clay ball into the sling and set the trigger. Launch the ball and record the result in the table below. Repeat this twice more with the same number of mass plates. Then, average the three ranges and record this average in the Average range column.

Number of mass plates	Trial 1 range (cm)	Trial 2 range (cm)	Trial 3 range (cm)	Average range (cm)
4				
6				
8				
10				
12				
14				

Repeat this process for the other numbers of mass plates. After all tests have been completed, predict the range of a teacher-specified odd number of mass plates. After making your prediction and writing it down, test this number of mass plates and answer the questions below.

What was the range?

Was your prediction accurate?

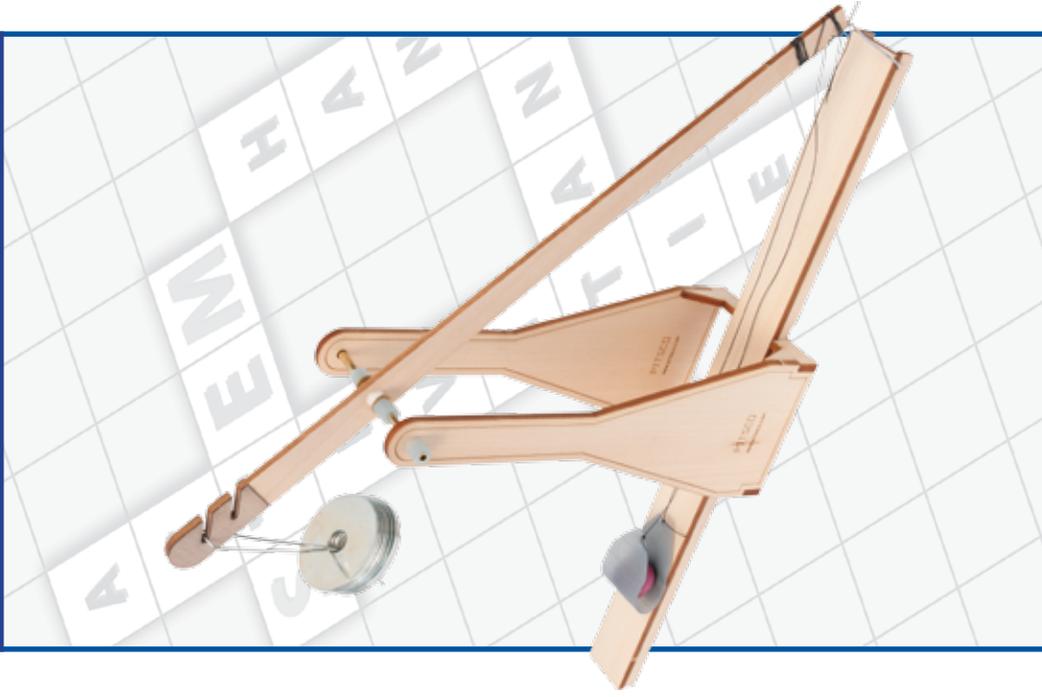
What did you learn about the connection between the amount of mass used and the resulting range?

What do you think would happen if you changed the mass of the clay ball?

Want more activities?

You can find more activity ideas at shop.pitsco.com. Search for Trebuchet Kit, click on it, and then click the Activities tab.

Trebuchet Kit



User Guide

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