Cardboard Trebuchet

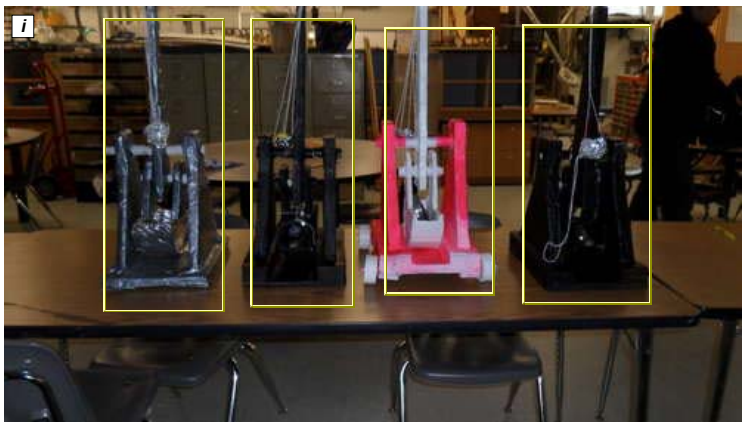
intro Cardboard Trebuchet

Welcome to our Instructable! We will be creating a Cardboard Trebuchet!

This was done as a engineering class project, and we had a set of rules to go by.

1. The trebuchet had to be made entirely of cardboard. For the parts that allow movement, PVC piping, string, and aluminum foil were allowed.
2. The trebuchet had to be waterproof! For this, we were allowed to do this by any means necessary, without inhibiting the function of the trebuchet.
3. The trebuchet must fit within a box with the dimensions 18in x 18in x 18in
4. The minimum distance the trebuchet must throw to is 30ft.

AN IMPORTANT SAFETY NOTE
While working with any tools, safety is of the utmost importance. That is why, while working on this project and any other, you must wear eye protection. You must also be sure that you keep long hair tied back and keep things off of around your neck.
Following these basic safety procedures will ensure a safe working environment while working on this project.



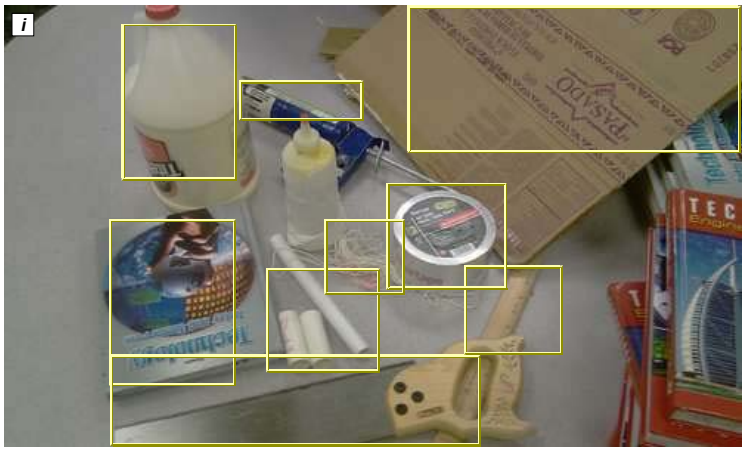
step 1 Gathering the Materials and Tools

Materials List:

-Cardboard (35 sq ft)
-PVC Piping. 15 inches (40 cm) long with a 7/8-inch outer diameter and 5/8-inch inner diameter.
-PVC Piping. 15 inches (40 cm) long with a 1-inch outer diameter and a 7/8-inch inner diameter.
-Wood Glue. Recommended at least 1 gallon (4 Liters)
-Two tubes of Caulk. Recommended latex acrylic with silicon.
-Stiff yet flexible single strand copper wire. 3 inches (8 cm) should be difficult to bend with fingers.
-String. 2 yards (2 meters)
-Aluminum Foil, Aluminum Tape, or equivalent.
-Weatherproof spray paint of your choosing.
-15 Hot glue sticks.
-2 to 2.5 lbs (1 kilogram) of miscellaneous nuts and bolts for weight (or equivalent).

Tools List

-Saw. We recommend a band saw for making precise cuts. Any saw will do.
-Hand saw.
-Sandpaper. 120 Grit.
-2 pairs of pliers. You have to bend some metal with these. Two are used for proper grip.
-Caulk Gun
-Hot glue gun
-Scissors
-Ruler
-Pen
-Wood file
-Box Cutter or Razor Knife
-Drill (We used a drill press)
-1-inch (or however large the outer diameter of the larger PVC pipe is.) drill bit or hole saw.



step 2 SAFETY FIRST

For safety reasons please follow all these tips.

When working with tools wear goggles.
When painting wear a mask and goggles.
When using a hand saw wear gloves.
When using power tools make sure your surroundings are clear and you have no lose clothing, jewelry or hair.
When using the Trebuchet never fire at people, stand clear And wear goggles.

Also use common sense and be careful.

step 3 Laminate Cardboard

Laminate cardboard by cutting specified sizes and layering together with wood glue to create cardboard stock following the sizes listed. It is recommended that you put some form of weight on the top of the cardboard to prevent it from warping or bowing. We used old textbooks.

Stock 1 (Quantity 1):
12 x 22 x 0.5 inch (30 x 56 x 1.3 cm)

Stock 2 (Quantity 1):
22 x 6 x 7/8 inch (56 x 15 x 2 cm)

Stock 3 (Quantity 1):
11 x 15 x 2 inch (28 x 38 x 5 cm)

Stock 4 (Quantity 2):
17 x 12 x 1.25 inch (43 x 30 x 3 cm)

step 4 Cutting the Stock

After stock has hardened and dried, use a saw to cut out the pieces listed below.

Use stock 1 to cut out both sides of the weight basket.

Use stock 2 to cut out the arm of the trebuchet.

Use stock 3 to cut out the base of the trebuchet (ignore the notch cut through the middle for now).

Use stock 4 to cut out the sides.

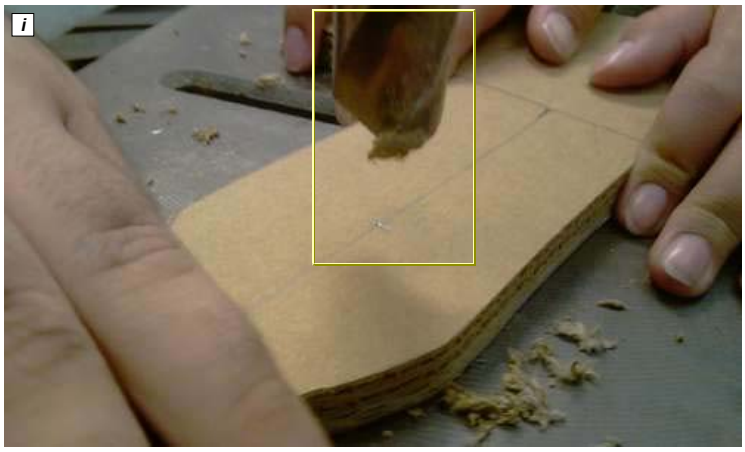
step 5 Make notches in the base

Make the notches in the base.

-Cut 1.5 inches into the long side of the base (both sides).
-Cut half of each notch into the removed side and the other half into the remaining base.
-Glue the previously removed sides back on to the base to complete the main base.

step 6 Drill Holes

Drill holes into the sides, the arm, the wheels, and the weight basket as shown in their respective PDF files.
Use clamps and keep fingers clear while drilling.



step 7 Cut the PVC pipes

Cut the larger outer diameter PVC piping into three pieces at 3 inches long, two pieces at 1.5 inches long, and one piece at 1-¼ inches long. Also, cut the smaller outer diameter PVC piping into two pieces; one at 9 inches in length, and the other at 4 1/8 inches in length. Sand all PVC piping until smooth.

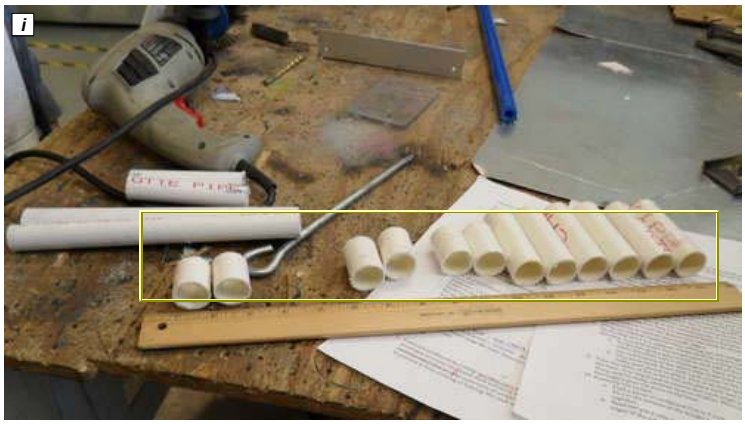
step 8 Gluing the PVC pipes in place

Using hot glue, glue the PVC piping into the holes in their respective parts.

-For the weight basket, glue the PVC piping that is 1.5 inches long into each hole, making sure that the piping is centered within the hole.

-For the arm, we will be calling the thinner end the top and the wider end the bottom. Glue the 1-¼ inch long PVC pipe into the hole that is closest to the bottom. Glue the 3-inch long PVC pipe into the remaining hole. Ensure that they are centered within the hole.

-For the sides, glue the remaining two 3 inch PVC pipes into each hole, ensuring that they are centered within the hole.



step 9 Groove the base

Use a handsaw to cut the groove into the base as shown in the PDF file. Use the wood file to smooth any rough edges.

step 10 Connect the sides to the base

Take the sides of the trebuchet and place each one inside each slot made into the base. It is important to ensure that each angle is the same on the sides. Steep next to steep, shallow next to shallow. When you do this, you want to thoroughly glue the arms to the base.

step 11 Making the weight basket

-Find a piece of cardboard that is 3 inches wide and 14 inches long. This is the bottom of the weight basket and connects the two sides together.

-Bend the piece into an arc so that the edges line up with the outer edges of the sides that make up the basket. See pictures for reference.

-Using hot glue, glue this all together into place. While gluing, be careful of alignment. Our first model was a little crooked.

step 12 Apply the caulk

Apply caulking to the edges of the sides, arm, wheels, and basket where the corrugation of the cardboard is visible. Apply liberally and smooth. It is best to apply with fingers. Allow to dry.

step 13 Waterproof with glue

Liberally coat the entire base and sides with wood glue. Make sure you have an even coat all over, yet use a lot. Be sure to place the base on something disposable, as the gluing process gets very messy.

step 14 Extra waterproofing through paint

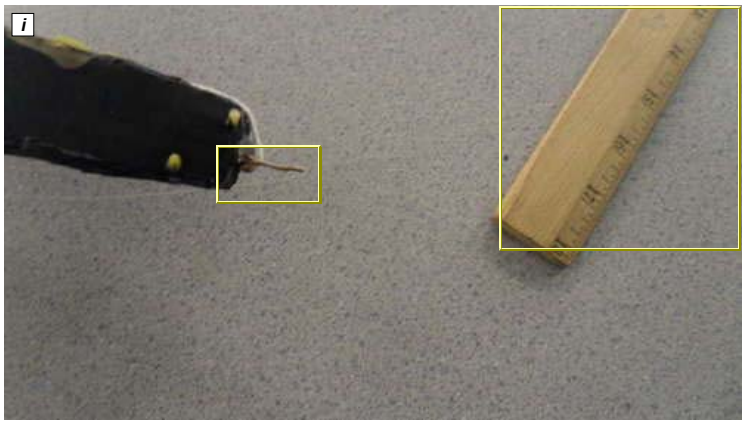
Using spray paint, paint the arm and weight basket thoroughly. (Apply several coats. Must be completely covered with thick layers of paint.)

step 15 Decoration time!

Once the base has dried, apply a decorative coat of paint. The color is up to you.

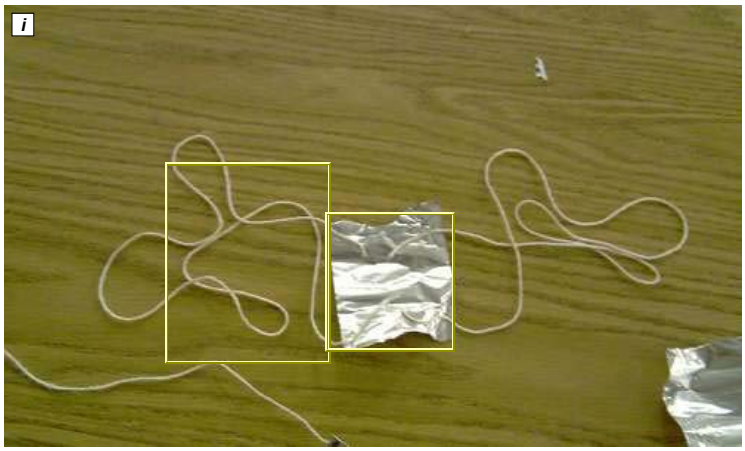
step 16 Main assembly

Once everything is dry, assemble the trebuchet as shown in the provided images.
To create the hook in the top of the swing arm, put a small loop 1" from the end of the copper wire. Insert the longer end into the small end of the swing arm and glue it in place.



step 17 Projectile Basket

Cut 2 pieces of 32" string.
Make a 2" square of aluminum foil or aluminum tape.
Secure one end of string to each of the four corners of the basket, leaving one inch of string overlapping into the basket.
See pictures for clarification.



step 18 Firing and Fine Tuning

Hook one loop of the string on the basket to the loop in the copper wire in the swing arm. Loop the other end around the piece of copper loosely. Pull down on the projectile basket with a ball inside and pull through the center of the trebuchet (between the sides) as far as it can go. When ready to fire, let go of the projectile basket.

With the proper amount of weight in the basket, the trebuchet should throw the ball around 30ft. If the path of the ball falls too short, while standing behind the trebuchet (opposite side from where the ball flies), bend the copper wire back towards you if it's too late in releasing, and bend it forward away from you if its too early in releasing.

Also, the distance the ball goes largely depends on the amount of weight that is in the weight basket. More weight = further distance.