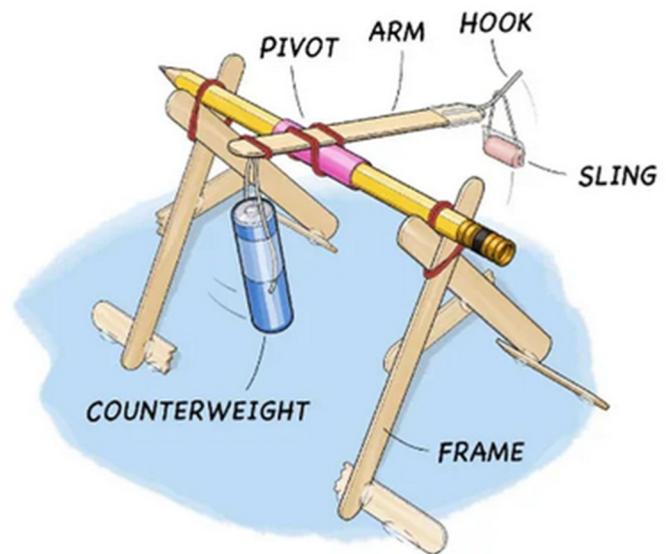
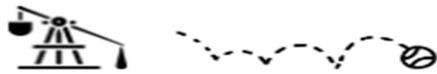


Miniature Trebuchet

Develop your medieval engineering skills using popsicle sticks and household items for some flinging fun

Materials

- Piece of corrugated cardboard, about one foot by one foot
- Popsicle sticks
- Scissors
- Pencil
- Jumbo or "milk shake" straw
- Glue (A hot glue gun is best if available, but use caution and adult assistance when using hot glue.)
- Tape
- Rubber bands
- String
- Paper clip
- AA battery



Build your own miniature medieval launcher--and see how physics and engineering can help you get the best distance! Credit: George Retseck

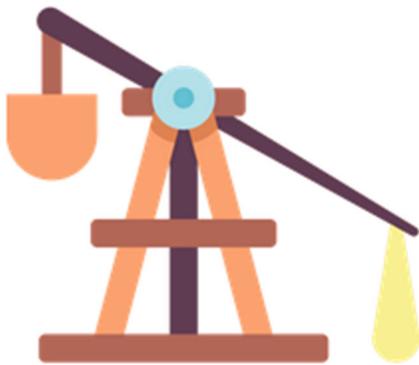
Trebuchets are a medieval war machine used to hurl destructive projectiles at objects. They use gravitational potential energy and action/reaction mechanics. When the counterweight is raised up, it stores gravitational potential energy. When the counterweight falls, it converts the potential energy into kinetic energy of the projectile.

Instructions

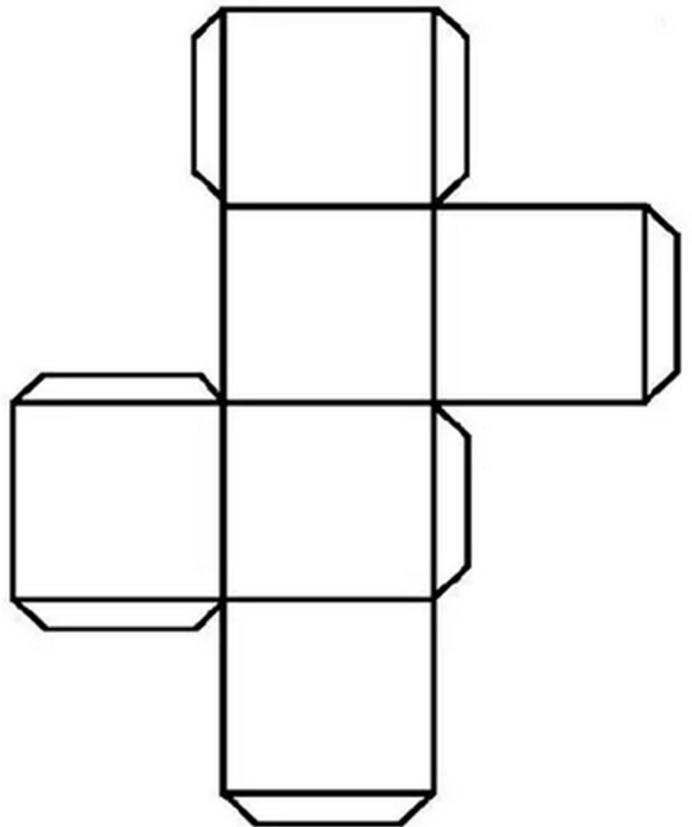
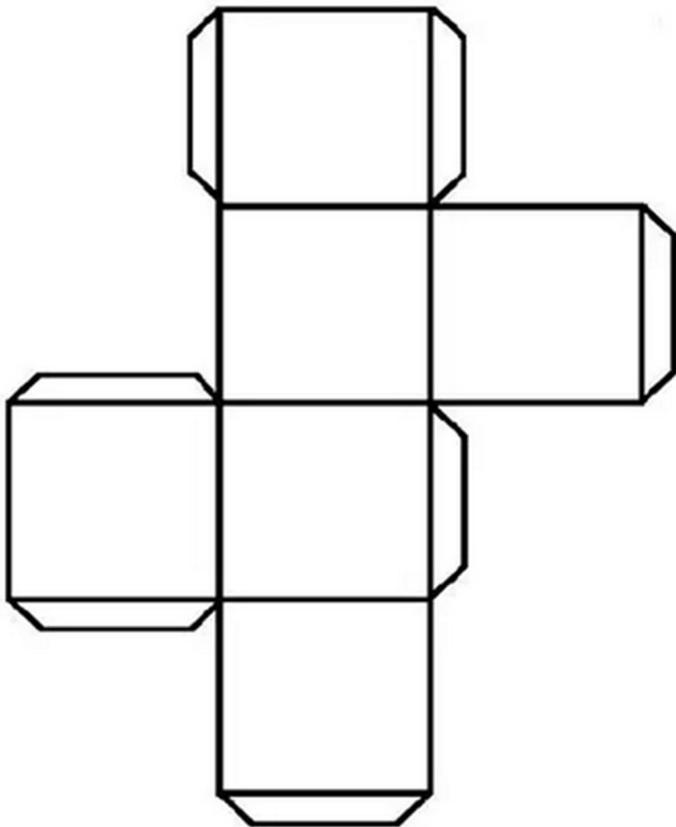
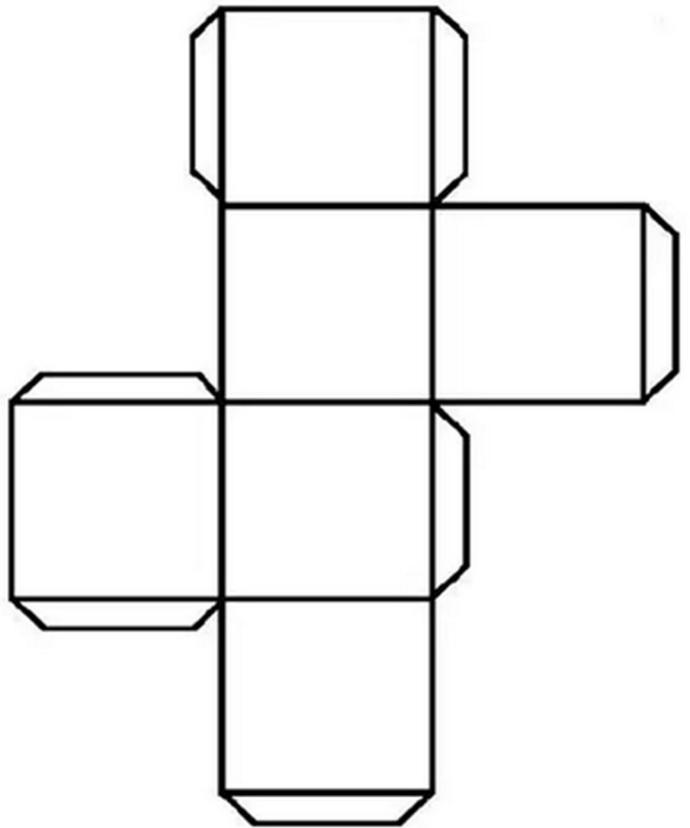
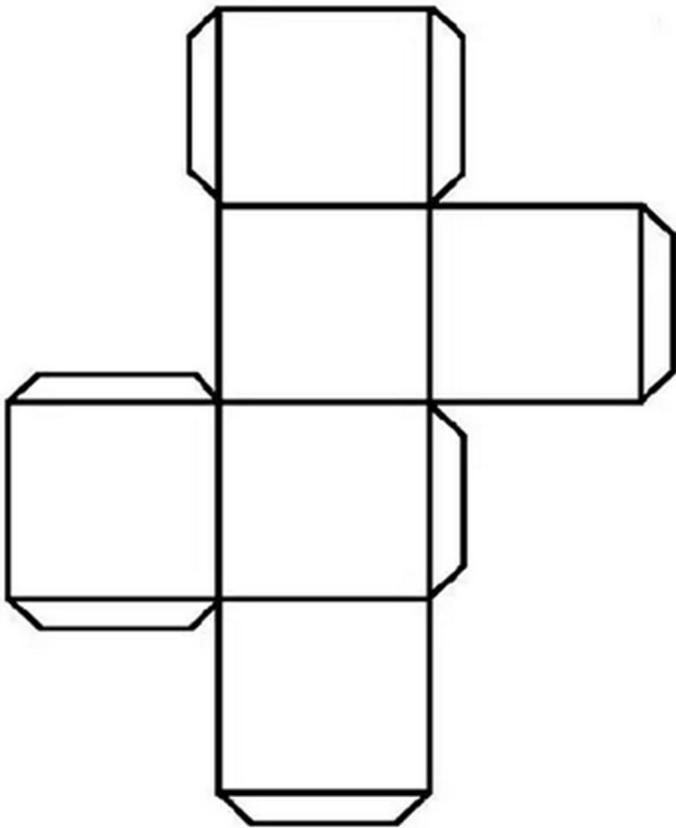
- 1) Safety first. Never, ever aim your projectiles at people or animals. A toy may seem harmless, but even a small projectile can cause eye injuries. Also, you will be working with hot glue. If you are unfamiliar with hot glue safety, ask an adult for help.
- 2) To build your trebuchet, you will build a frame that looks almost just like a swing set. It will have two "A-frame" shaped pieces on the sides and one crossbar on the top. To do this, use two full length popsicle sticks to make the uprights of the frame. Leave a small notch at the top. Secure using hot glue. If you are not comfortable with hot glue, school glue would also work, but you will have to incorporate drying time.
- 3) After you have assembled the uprights, you will need a cross bar for added strength. Break a popsicle stick in half using your fingers, or cut it in half using sturdy scissors. Use one half of the popsicle stick for each frame's cross bar. Again, attach with the glue of your choice to make the shape of an "A."
- 4) Cut slots in your cardboard base that will allow the bottom of your A to be inserted. You will glue these into the cardboard.

Instructions (continued)

- 5) If you feel it is necessary, you can also add supports to the bottom of your A-frames. You can do this by gluing two halves of a popsicle stick to either side of the frame, as shown in the photo.
- 6) Now, you will build the Trebuchet's arm. Carefully cut two small notches on either side of the end of a popsicle stick. These notches will help hold on the counterweight.
- 7) Attach a small loop of string to your battery (counterweight) using string and tape or rubber bands. Hang the counterweight on the popsicle stick notches. If your notches aren't deep enough, now is the time to make adjustments.
- 8) Unbend one end of a paperclip so it is almost, but not quite, straight. Attach the flat portion of the clip to the Trebuchet arm opposite that of your counterweight. This will hold the sling which in turn holds the projectile.
- 9) Remove the eraser from the pencil and attach a small loop of string to it with tape. This is your projectile. Conversely, you could use something else as a projectile, but it will need a loop of string attached to be able to be properly flung by the trebuchet.
- 10) Cut a small section of mile shake straw, about 1 inch long, and tape it to the popsicle stick arm perpendicularly. It should be attached closer to the counterweight than it is to the hook.
- 11) Slide the pencil into the straw attached to the trebuchet arm.
- 12) Place the pencil in between the two V notches of your A-frame pieces. Secure it with rubber bands. This forms a cross bar and completes the trebuchet frame. The straw and pencil form a pivot and should allow the arm to rotate freely. Do not use glue so you can make adjustments as needed.
- 13) Test out your trebuchet's function before loading a projectile. Are your joints secure? Does it seem sturdy or does it need reinforcement with glue, tape, or rubber bands?
- 14) Once you are satisfied with your construction, you are ready to launch some projectiles. Use the included target, or build some paper blocks to knock down.
- 15) Tinker time. What kind of adjustments can you make to alter the trajectory and distance of your projectile? What happens when you shorten or lengthen the arm? What about different counterweights or projectile types? What about sling length? Hook shape?



Use these templates to make some paper cubes. You can use your trebuchet to knock them down!



Use this target to work on your accuracy.

