Bombs Away! A Ping Pong Catapult

https://www.sciencebuddies.org/science-fair-projects/project-ideas/ApMech_p008/mechanical-engineering/ping-pong-catapult (http://www.sciencebuddies.org/science-fair-projects/project-ideas/ApMech_p008/mechanical-engineering/ping-pong-catapult)

Last edit date: 2018-04-26

Experimental Procedure

Safety Note: The catapult is designed to be safe, but it can hurt you if you are not careful! Never launch a ball at other people. The launch arm can move very fast (especially when using two or three rubber bands), so *always* make sure your fingers and other body parts are safely out of the way before you launch the ball.

1. Watch this video to learn how to set up your catapult:

Video instructions for using your ping pong catapult.
https://www.youtube.com/watch?v=pIEjwMhnAGo (https://www.youtube.com/watch?v=pIEjwMhnAGo)

2. Set up the catapult and the target as shown in Figure 3.
    a. The recommended distance from the middle of the catapult disk to the middle of the target is 8 feet (ft.).
    b. Shoe boxes and buckets make good targets.
    c. The catapult clamp may scratch furniture, so you might want to use padding such as a paper towel when attaching the catapult.
    d. Make sure the catapult and the target are at roughly the same height.

Figure 3. Using a tape measure, set up the catapult and the target 8 ft. apart. Make sure they are at about the same height.

3. Insert the pin with the ring attached through the hole in the catapult base, lined up with a hole in the disk. This sets the launch angle (don't worry, you can always change this angle later). Figure 4 shows you how to do this in steps A through D.

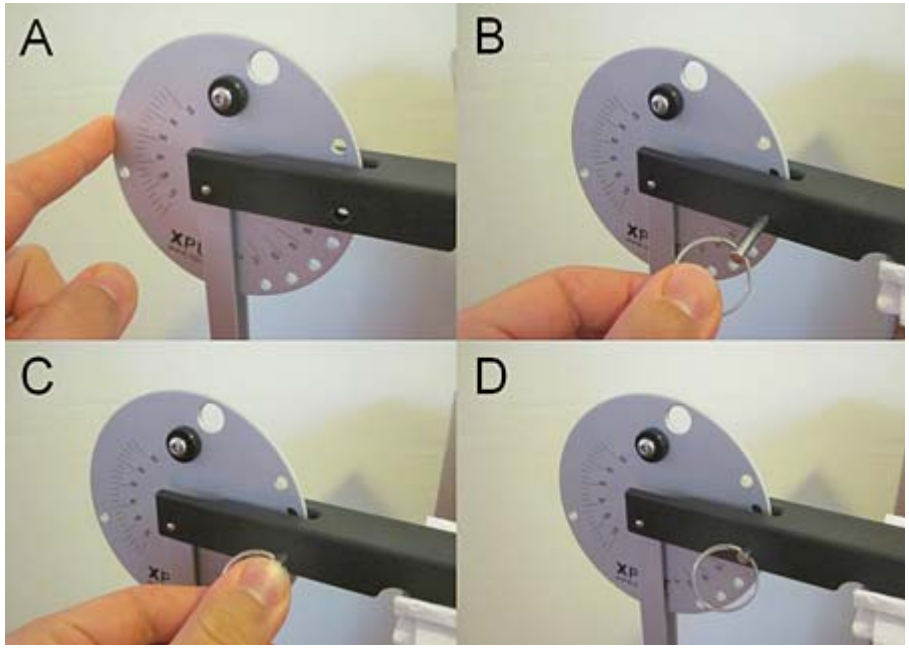

Figure 4. Insert the pin with the ring into the catapult base to set the launch angle. Make sure the hole in the catapult base is lined up with a hole in the disk.

4. Attach at least one rubber band (for safety reasons, no more than three) to the pins on the launch arm by threading it through the hole on the catapult's disk. Figure 5 shows you how to do this—ask an adult if you need help.

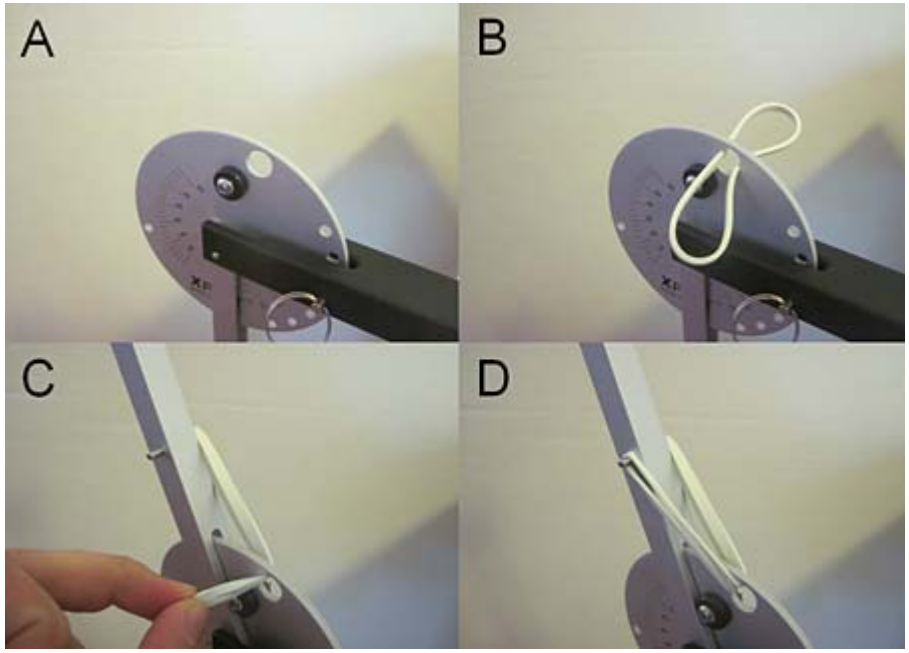

Figure 5. Attach the rubber bands to the catapult. Each rubber band goes through a hole at the top of the disk, and then attaches to short pins on opposite sides of the launch arm.

5. You are almost ready to launch! First, you will need to understand how to measure the launch angle and pull-back angle from the markings on the catapult disk. Remember that the pull-back angle is how far back you pull the launch arm before you let go and launch the ball, and the launch angle is the direction the ball is going when it is launched. Refer back to Figure 2 in the Introduction tab if you need to understand the angles. Figure 6 shows you how to measure them on the catapult.

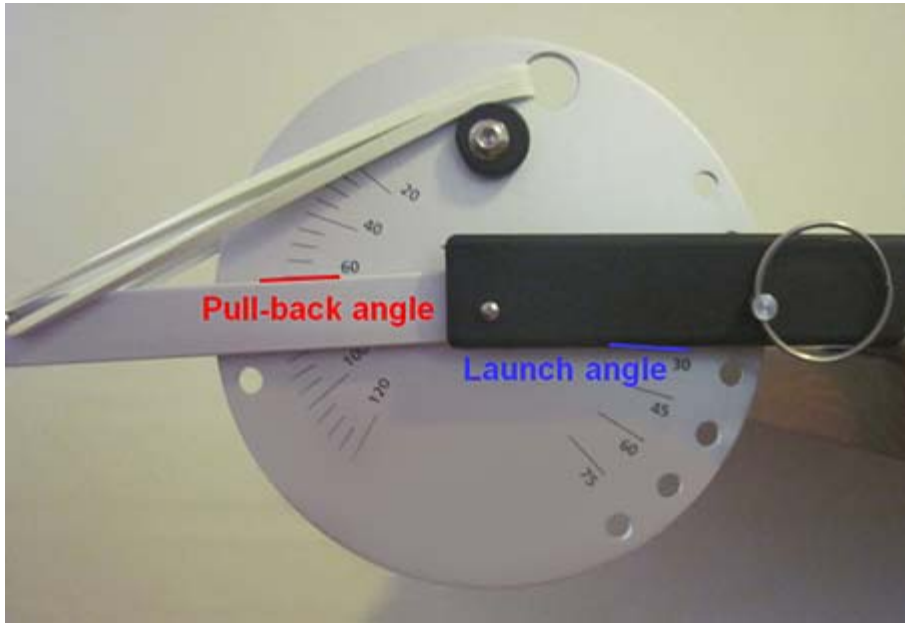

Figure 6. Measure the pull-back angle by reading the tick mark that lines up with the top of the launch arm (on the left). In this picture, the pull-back angle is about 60 degrees. Measure the launch angle by reading the tick mark that lines up with the bottom of the catapult base (on the right). In this picture, the launch angle is 30 degrees.

6. Aim for the target, and fire away! Remember there are *four* things you can change: the type of ball, the number of rubber bands, the launch angle, and the pull-back angle. However, if you start changing multiple things at once, you no longer have a fair test (http://www.sciencebuddies.org/science-fair-projects/science-fair/doing-a-fair-test-variables-for-beginners) and your results may be too confusing to interpret. So, for starters it makes sense to keep three things the same and only change one thing at a time.
    a. For example: you could pick the orange ping pong ball, one rubber band, and a launch angle of 75 degrees. Then you can experiment with different pull-back angles without changing anything else, and find out what pull-back angle works best to hit the target.
7. Go back to the Questions outlined in the Background tab, and try to use those to help you hit the target.
    a. For example, do you think adding more rubber bands will make the ball go farther or less far?
    b. Maybe you find that your ball is always falling a few feet short of the target. If so, go back and pick another variable to explore. For example, should you make the pull-back angle bigger or smaller if that happens?
8. See if you can find different combinations of settings that enable you to hit the target. Are some settings more reliable than others? An easy way to measure this is to take ten shots at the target with the same settings and count how many hit the target.
    a. Note that, depending on the material of your target, the ball may be more likely to bounce out (for example, a hard metal pot instead of a softer cardboard shoebox). But you can still count bounce-outs as a "hit."
    b. Also, the catapult may move or wiggle slightly if you launch the ball really hard. If you notice that you are missing your target far to the left or to the right, it is fine to adjust the clamp and re-aim your catapult.
9. Write down your results in a table similar to Table 1. This shows just one example of how a data table could be used to keep track of results for a certain test.

Number of successful shots out of 10			
Ping pong ball, 45 degree launch angle			
Pull-back angle	**1 rubber band**	**2 rubber bands**	**3 rubber bands**
30 degrees			
45 degrees			
60 degrees			

Table 1. A data table such as this could be used to keep track of the results of your experiments with settings. In this example, two things (the type of ball and the launch angle) are kept the same. Change the pull-back angle and the number of rubber band, one at a time. Then fill in each empty cell with the number of successful shots out of ten for that setting.

10. Have you found some methods that are more successful at hitting the target than others? Why do you think this happens?

Frequently Asked Questions (FAQ)

FAQ for this Project Idea available online at https://www.sciencebuddies.org/science-fair-projects/project-ideas/ApMech_p008/mechanical-engineering/ping-pong-catapult#help (http://www.sciencebuddies.org/science-fair-projects/project-ideas/ApMech_p008/mechanical-engineering/ping-pong-catapult#help).