

Rubber Band Cannon

Introduction

What determines how far a cannonball will fly? How does the launch angle of a cannon affect its range? Explore some of the variables that influence projectile motion using a Rubber Band Cannon.

Concepts

- Projectile motion
- Scientific method
- Variables

Background

Several factors affect how far a projectile will travel. The two most important variables are the launch angle and the magnitude of the initial force that sets the object into motion. In order to determine how a single variable affects a projectile's horizontal distance, experiments need to be designed to test each variable independently. This is done by making observations under controlled conditions where only one variable at a time is changed. Controlled experiments make it possible to separate or isolate the factors that are responsible for a given observation in a complex series of events. In this activity, students examine how launch angle affects the horizontal distance traveled by a rubber band.

Materials

- | | |
|--|-------------------|
| Box, cardboard, empty | Rubber band |
| Pencil | Scissors |
| Protractor cutout, paper | Tape measure |
| Ruler, clear plastic, hole at end, 12" | Tape, transparent |

Safety Precautions

Wear safety glasses or goggles during this experiment. Do not aim the Rubber Band Cannon at anyone. Cannon firing should be conducted in an open area such as a gymnasium, or outside.

Procedure

1. Cut out the paper protractor from page 4.
2. Using transparent tape, secure the paper protractor to the cardboard box so that the 0° line is about 2.5 cm from the bottom of the box (see Figure 1). *Note:* A shoe box is ideal for this activity.
3. Using a sharp pencil, poke a hole through the paper protractor and into the box at the point where the 90° and 0° lines intersect. Push the pencil about halfway into the box (see Figure 2).
4. Locate the hole on the end of a ruler. Slip the hole on the end of the ruler onto the pencil (see Figure 3). This completed setup will now be referred to as the "Rubber Band Cannon."

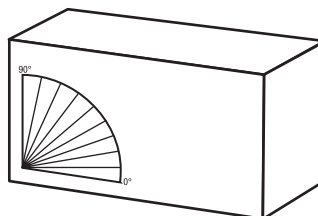


Figure 1.

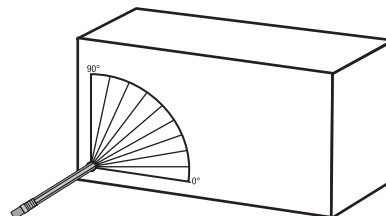


Figure 2.

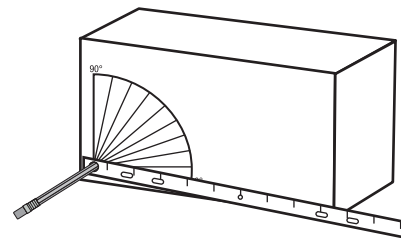


Figure 3.

5. Lift up the free end of the ruler so that its center is over the 10° mark on the protractor. Secure the ruler at this angle with a piece of transparent tape (see Figure 4).
6. Place the Rubber Band Cannon on the floor and hold it in place with your hand. Use your free hand (or help from a partner) to place a rubber band on the end of the ruler. Pull the rubber band back to the 12-cm mark on the ruler. Do this by pinching the rubber band between the thumb and index finger as shown in Figure 5.
7. Making sure the area in front of the Rubber Band Cannon is clear, quickly release the rubber band to launch it from the cannon. One lab partner should fire the cannon while the other becomes the spotter. The spotter should watch where the rubber band first hits the ground.
8. Use a tape measure to determine the horizontal distance traveled by the rubber band. Measure from the front end of the ruler to the front end of the rubber band. Repeat steps 6 and 7 for three more trials (a total of four trials).

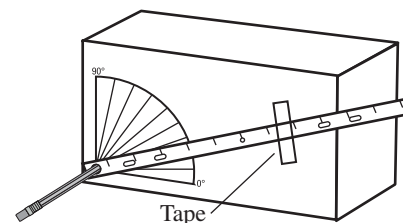


Figure 4.

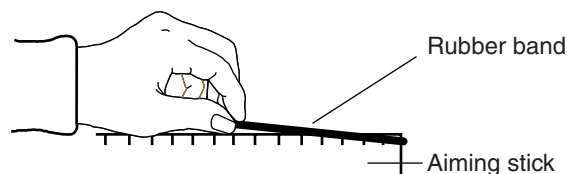


Figure 5.

9. Repeat steps 5–8 for launch angles of 30° , 45° , 60° , and 80° . Be sure to consistently pull the rubber band back to the 12-cm mark on the ruler. To change the angle, first remove the tape securing the ruler in place. Position the ruler so its center is at the new launch angle, and then re-secure the ruler with tape.
10. Analyze the data to determine which launch angle resulted in the greatest horizontal distance traveled by the rubber band.

Disposal

The materials may be saved for future use.

Tips

- This activity may also be used to show how the force applied to stretch the rubber band can have an effect on the horizontal distance traveled. The students can test this by keeping the launch angle constant while altering the stretch distance of the rubber band.
- For further concept development, try the Flinn Scientific Canada *Rubber Band Cannon Student Laboratory Kit* (Catalogue No. AP6624). This kit includes reproducible student handouts, valuable Teacher Notes, rubber bands, and enough Rubber Band Cannons for eight groups of students. All materials are reusable.
- The distances traveled by the rubber bands typically have a wide range. They are significantly affected by air resistance and air currents. Additional trials can be performed for each experiment. High and low values can be ignored when calculating the average values. Several practice launches should also be performed until students are comfortable with a launch technique.
- In this activity students will fire rubber band projectiles over several meters. Be sure that all safety precautions are followed during the activity. Safety glasses or goggles must be worn at all times by everyone.

Sample Data Table

Launch Angle	Stretch Distance	Launch Distance				
		Trial 1	Trial 2	Trial 3	Trial 4	Average
10°	12 cm	126 cm	128 cm	138 cm	152 cm	136 cm
30°	12 cm	268 cm	280 cm	280 cm	279 cm	277 cm
45°	12 cm	288 cm	289 cm	278 cm	283 cm	286 cm
60°	12 cm	217 cm	183 cm	194 cm	238 cm	208 cm
80°	12 cm	86 cm	140 cm	110 cm	89 cm	106 cm

Materials for the *Rubber Band Cannon* are available from Flinn Scientific Canada Inc.

Catalogue No.	Description
AP6624	Rubber Band Cannon—Super Value Laboratory Kit
AP4685	Ruler, Transparent, 12"
AP1818	Rubber Bands, Medium, 750/pkg.

Consult www.flinnsci.ca or your *Flinn Scientific Canada Catalogue/Reference Manual* for current prices.

Protractor Master

