



Subject Area(s) Science & technology

Associated Unit Engineering

Associated Lesson What is engineering

Activity Title Rocket Cars

Grade Level 6 (5-7)

Activity Dependency What is Engineering

Time Required Two 1 hour periods

Group Size (“Divide the class into teams of four or five students each.”)

Expendable Cost per Group US\$ 2.00

Summary

Students are going to act as mechanical engineers in this activity. Students will design a rocket car based on materials given to them. The goal is for students to use their intuition to design the cars without the aid of the teacher initially. If students are having trouble, help should be provided.

Engineering Connection

This activity is about the procedures that mechanical engineers use to build various things. This activity will also bring into play the laws of motion. Also students will learn about speed and velocity and the ways to go about calculating it.

Keywords Newton’s laws of motion, Rocket Cars, Design, Building, Testing, Velocity

Educational Standards

- Science: A.1, A.2, E.8, F.3, F.4, F.5, G.1, G.3, E.2, E.1

Pre-Req Knowledge

No pre requisites

Learning Objectives

After this activity, students should be able to:

- Describe the basic procedures engineers follow to build something
- Describe Newton's laws of motion

Materials List

Each group needs:

- 1 16 oz water bottle
- 4 16 oz water bottle caps
- 1 balloon
- 8 straws
- 1 shish kabob skewer

Introduction / Motivation

A rocket that goes into space is simply a chamber filled with pressurized gas. A small opening called a nozzle allows the air to escape, causing thrust that propels the rocket. You can demonstrate this when you blow up a balloon and let it go without tying it off. The balloon will fly through the air as all the air inside escapes. A man named Sir Isaac Newton laid the foundation for the modern science of rocketry near the end of the 17th century. Newton developed two law's. Newton's Laws of Motion are essential to rocket flight. Here are two of them:

1. "*Objects at rest will stay at rest and objects in motion will stay in motion in a straight line unless acted upon by an unbalanced force.*" In other words, the forces pushing a rocket up must be stronger than the force of gravity pulling it down.

2. *"For every action there is always an opposite and equal reaction."* When an action takes place, like gases escaping from the rocket, a reaction follows - the rocket rises in the air.

The principles of rocketry apply to more than flying rockets; they also apply to rocket cars. With this project you will make a "rocket car" that is powered by pressurized gas (air in a balloon!). The teacher should be familiar with Newton's Laws, as well as how to build these cars.

Vocabulary / Definitions

Thrust – A reaction force described by Newton's laws of motion.

Procedure

1. Cut a drinking straw into two pieces as long as the water bottle is wide. Use strips of tape to attach them to the bottle - one near the front and one near the back. The axles for the wheels will run through these straws, so line them up carefully so the wheels won't be crooked.

2. Use a hammer and a small nail to poke holes through the center of four bottle caps. Cut two pieces of a wooden skewer about an inch-and-a-half longer than the pieces of straw you taped to the bottle. Push one end of each skewer through the hole in the center of a bottle cap. If the cap doesn't fit snugly on the skewer, use some modeling clay to hold it in place. Next, thread the skewers through the straws on the bottle and attach the other wheels to the other ends. Make sure your car rolls smoothly.

3. Stretch out a large balloon by blowing it up and then letting the air out of it a few times. Next, make a nozzle. The size of the nozzle is very important. If it is too small, the air can't escape with enough force to propel the car forward. If it is too big, the air will escape too fast and the car won't go very far. Create the nozzle by taping four drinking straws together. Insert the straws into the mouth of the balloon and seal the opening by wrapping a strip of duct tape around it several times.

4. To mount the balloon/nozzle on the car, use a knife to cut two perpendicular slits (to make an X) in the top of the car about 4" back from the mouth of the bottle. Thread the nozzle through this opening and out through the mouth of the bottle. Leave about an inch of the nozzle sticking out of the mouth.

5. Find a hard surface, like a long table, linoleum floor, or sidewalk. Blow up the balloon through the straws at the mouth of the bottle. Pinch the base of the

balloon to prevent the air from escaping too soon. Set the car down, let go of the balloon, and watch it go!

The air in the balloon is gas under pressure. The air pushes against the balloon, causing it to expand, but the balloon is also pushing back on the air. The pressure of the balloon pushes the air right out through the nozzle, which creates thrust that propels the car forward.

Keep track of how long the car rolls and how far it goes. Try it several times, then try changing the design to see if you can get it to go farther or faster. How will it work if you only use three straws for the nozzle? What if you use a bigger or smaller balloon? Does the car go farther on linoleum or the sidewalk? Why do you think this might be? Will the car go farther if you start it at the top of a ramp?

Decorate your car and have races with siblings or friends. Try to figure out why one car goes faster or farther than another, and keep experimenting to make your design better!

Before the Activity

- Gather materials.
- If you don't want students working with scissors precut the straws for them.

With the Students

1. Divide the class into groups of four to five students each.

Safety Issues

- Use eye protection (goggles or safety glasses) during this activity.
- Care should be taken with scissors.

Troubleshooting Tips

- If air comes out of balloon slowly, use fewer straws.
- If car does not roll freely, make sure that the skewers are not rubbing the side of the bottle.

Assessment

Pre-Activity Assessment

- To assess the activity, the teacher should have the students keep a log, and write down their design process, as well as have them come up with ideas to make their cars better.

Activity Embedded Assessment

The teacher should understand how to calculate velocity based on length and time. Students should then calculate the velocity of their cars

Owner

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