Chemistry In Space

Educator Notes

Learning Objectives

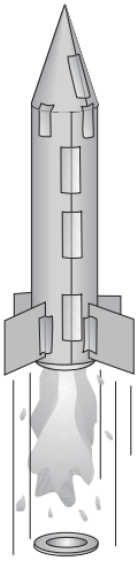
- Identify changes that occur in chemical reactions.
- Use an effervescent tablet to demonstrate a chemical reaction.

Safety

- This experiment should be conducted outside with students wearing goggles.

Introduce the Challenge

Astronauts conduct a variety of chemistry-related experiments aboard the International Space Station. In fact, chemical reactions play an essential role in launching astronauts and spacecraft into space. A film canister, an effervescent tablet, and water can demonstrate how a rocket engine works. An effervescent tablet contains both an acid and a base in solid form. When combined with water within a sealed film canister, the tablet dissolves, allowing the acid and base to react, creating CO2 (carbon dioxide gas). As more and more gas is produced, pressure builds within the canister until the lid can no longer contain it. The lid of the film canister then pops off. Due to Newton's third Law of Motion, the sudden rush of escaping gas from one end of the canister propels the canister in the opposite direction. In this lesson, students will use this chemical reaction to launch a model rocket. Learn more about chemical reactions with the Chemistry in Space STEMonstration. Go a step further and check out the STEMonstrations on Newton's Laws of Motion here: 1st Law, 2nd Law, and 3rd Law.



Background

This experiment involves a simple, but exciting, demonstration of a chemical reaction and Newton's Laws of Motion. The rocket lifts off because an unbalanced force acts upon it (First Law). This is the force produced when the canister can no longer contain the pressure of gas formed by the chemical reaction and the lid blows off. The amount of force is directly proportional to the mass of water and gas expelled from the canister and how fast it accelerates (Second Law). The rocket travels upward with a force that is equal and opposite to the downward force propelling the water, gas, and lid (Third Law).

Grades 3 to 12 Suggested Pacing

40-45 minutes

Materials

Each team of two will need:

- ☐ Heavy paper (60-110 index stock or construction paper)
- ☐ Plastic 35mm film canister*
- ☐ Student sheet
- ☐ Cellophane tape
- ☐ Scissors
- ☐ Effervescing antacid tablet
- ☐ Paper towels
- ☐ Water
- ☐ Eye protection

**Film canister must have an internal sealing lid*

Next Generation Science Standards

- 5-PS1-4
- MS-PS1-2
- HS-PS2-1

Career Corner

Chemists study atomic and molecular structures as well as how these structures interact with the world around them. Some of their duties include preparing reagents for lab use, conducting research, and instructing other scientists.

Learn more: My NASA Data

Facilitate the Challenge

Management

Divide students into pairs. It may be helpful to provide students with samples of rockets in various stages of completion to study as this will help some students visualize the construction steps. A single sheet of paper is sufficient to make a rocket. Be sure to tell the students to plan how they are going to use the paper. Let the students decide whether to cut the paper horizontally or vertically to make the body tube of the rocket. This will lead to rockets of different lengths for flight comparison.

Effervescent Tablet Rocket

- Wrap and tape a tube of paper around the film canister. The lid end of the canister will face downward.
- Tape fins to your rocket.
- Roll a cone of paper and tape it to the rocket's upper end.
- Put on your eye protection.
- Turn the rocket upside down and fill the canister one-third full of water.

Work quickly to complete the next four steps:

- Drop ½ effervescent tablet into the film cannister.
- Snap lid on tight.
- Stand rocket on launch platform.
- Stand back and wait for your rocket to lift-off.

Discussion

- How does the amount of water placed in the cylinder affect how high the rocket will fly?
- How does the temperature of the water affect how high the rocket will fly?
- How does the amount of the tablet used affect how high the rocket will fly?
- How does the length or empty weight of the rocket affect how high the rocket will fly?
- How would it be possible to create a two-stage rocket?

Assessment

- What evidence of a chemical reaction did you notice?
- Explain how Newton's Laws of Motion apply to this rocket.

Extensions

- Hold an altitude contest to see which rockets fly the highest. Launch the rockets near a wall in a room with a high ceiling. Tape a tape measure to the wall. Stand back and observe how high the rockets travel upward along the wall. Let all students take turns measuring rocket altitudes.
- What geometric shapes are present in a rocket?
- Use the discussion questions to design experiments with the rockets. Graph your results.

Chemistry in Space Student Instructions