

Build a Film Canister Rocket: Engineering Design Challenge

Overview

Design and launch a film canister rocket that will fly at least one meter into the air using a specific ratio of reactants as fuel. Combine your knowledge of chemical reactions, stoichiometry, and the law of conservation of mass to create and analyze your rocket.

Focus on Engineering Practices

SEP 1 Asking Questions and Defining Problems

SEP 3 Planning and Carrying Out Investigations

SEP 6 Constructing Explanations and Designing Solutions

Materials Per Group

- Sodium bicarbonate, NaHCO_3 , 5 g
- Vinegar, 15 mL per trial
- Balance, 0.1 g precision
- Film canister with cap
- Manila folder
- Markers, colored (optional)
- Meter stick
- Paper clips (optional)
- Scissors
- Spatula
- Tape or glue
- Timer
- Tissue paper (optional)
- Tray, large
- Weighing dish or paper

Safety

Sodium bicarbonate may be harmful if swallowed. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Wash hands thoroughly with soap and water before leaving the laboratory. Please follow all laboratory safety guidelines.

Develop a Solution

1. **SEP Define the Problem** In your own words, briefly define the problem.

2. **SEP Identify Criteria and Constraints** List criteria and constraints you have identified or that your teacher has provided.

Criteria	Constraints

3. **Conduct Research** Go online and research the reaction between sodium bicarbonate and acetic acid (vinegar).

4. **SEP Design Your Solution** Using the materials provided, decide on the best design for your rocket.



5. **SEP Carry Out an Investigation** Once you have determined the amount of sodium bicarbonate to use, determine if it is the limiting reagent, is in excess, or is the exact amount.

6. **SEP Test Your Solution** When the group is ready to test rockets, the canisters must be launched from a sink or a large tray set on the floor. Every test must be announced. Shout “Fire in the hole” as soon as the canister is capped to alert the class of the impending explosion. Record your observations.

7. **SEP Evaluate Your Solution** Review your group’s criteria and constraints. Based on your data, do you consider your rocket successful? Why or why not? Be specific and use evidence to support your claims.

8. **SEP Refine Your Solution** Compare your rocket with the rockets your classmates produced. How might you improve your design to better meet the criteria and constraints?