Fizzy Rockets

Teacher Copy

Lesson Focus

This lesson focuses on the concept of physical change versus chemical change. It also touches on three of the four forces of flight (thrust, drag, and gravity) and how changes in design can affect performance.

This lesson also covers Newton's third law of motion, which states that for every action (force), there is an equal and opposite reaction.

The history of rockets, National Geographic
Alka-Seltzer commercial

Grade Levels

9-12

Objectives

During this lesson students will:

- Build their own rocket (may be done with partners)
- Record observations
- Adjust design
- Communicate results

Materials

(Materials for a group of 20 students working in pairs)

1. 10 canisters
2. Tape
3. Scissors
4. Template sheet for nose cone, fins, and canister cover
5. Markers to decorate rocket (optional)
6. Pencils or pens
7. Water
8. 15 tablets of sodium bicarbonate (one-and-a-half per group)
9. Safety goggles

Pre-Lab Questions: Please use complete sentences with correct punctuation.

1. What are Newton's three laws of motion? Write them down or look them up.

   First: Objects at rest or in motion tend to stay at rest or in motion until acted upon by an outside force.

   Second: Describes how mass, acceleration, and force are related. f = ma

   Third: Every action has an equal and opposite reaction.

2. Read over the lab. Which law do you think applies and why?

   Third — the thrust of the air pushing down and out from the canister is what propels it upward.

3. Why should you wear goggles for this lab? *It is a chemical reaction.*

4. What is the difference between a chemical and physical change?

   A chemical change causes a change in the substance; a physical change only causes a change in state of matter or size.

5. What factors influence the rate of reactions?

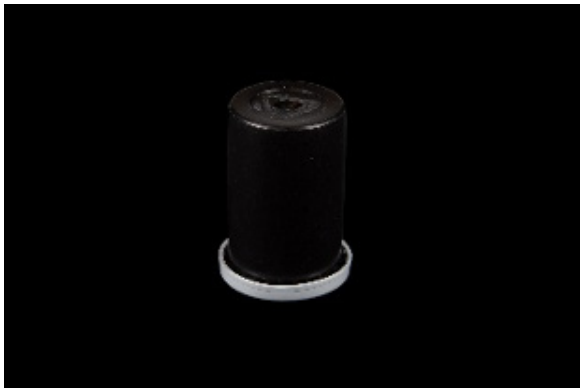
   Surface area, temperature, stirring, concentration, catalyst.

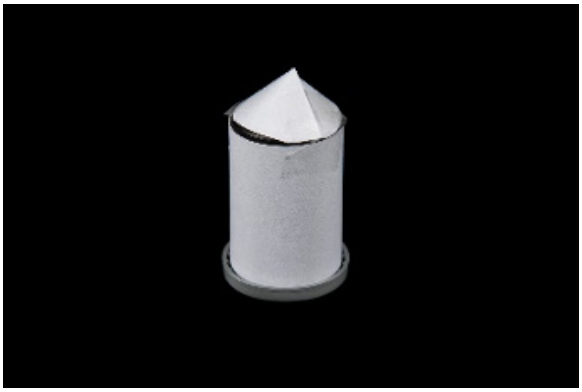
6. What are the four forces of flight and their definitions?

   Thrust: *The force that moves an aircraft through the air.*
   Drag: *The force that resists movement through the air, air resistance.*
   Lift: *The force that directly opposes the weight of an airplane and holds an aircraft in the air.*
   Gravity: *The force that holds all objects to the Earth.*

Procedure

1. Measure paper to cover the body of your film canister.





2. Use the template to create a nose cone.
3. Design your fins or use the template. Decide on the number of fins for your rocket.
4. Tape the paper body, nose cone, and fins onto the canister. Do not block the base or extend fins past the base. The canister lid has to be able to detach from the canister.

5. Hold the rocket upside-down and fill halfway with water.
6. Drop the tablet into the water and quickly snap on the lid.
7. Set the rocket on its base and step away.

Independent variable: the variable that is changed.

Dependent variable: the variable being measured in response to changes to the independent variable.

Teacher note: You can set up this experiment in many ways. Below is one example.

Hypothesis: I think the canister will go (higher or lower) with (one or half) of a tablet because _____

_____

_____

Data

Sample Data Table

Alternative: Measure height with an analog altitude calculator and graph results.

Number of trials can be for group or individual, depending on number of tablets available.

Trial	Full tablet	Half tablet
1		
2		
3		
4		
5		

Present your conclusion to your peers. Was your hypothesis supported? How did your data support that conclusion? How could you change this experiment in the future?

Questions

1. This is the equation from this lab. Is this equation balanced? *(yes)* Fill in the chart.

   Alternative: Have students balance equation.

   $3NaHCO_3 + C_6H_8O_7 \Rightarrow C_6H_5Na_3O_7 + 3CO_2 + 3H_2O$

	Before	After
Na	*3*	*3*
H	*11*	*11*
C	*9*	*9*
O	*16*	*16*

2. Is this lab based on a chemical or physical change? Why?

   This lab shows a chemical change because the substances that we are starting with are different from the substances we end with.

3. How could you increase the height of the flight?

   Answers will vary — increase the reactants, use a lighter canister, adjust the wing shape, etc.

4. What provides the thrust for this rocket? *The chemical reaction.*

Extension

Look at the evolution of rockets. Use a variety of sources, including print and digital. Suggest a design change to improve the current form.

Alignment to Curriculum Frameworks

NGSS Engineering Practices

- Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects.
- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: Decide on types, how much, and accuracy of data needed to produce reliable measurements; consider limitations on the precision of the data (e.g., number of trials, cost, risk, time); and refine the design accordingly.

Common Core State Standards – ELA

- WHST.9-12.7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
- WHST.11-12.8. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
- WHST.9-12.9. Draw evidence from informational texts to support analysis, reflection, and research.