BAKING SODA BOTTLE ROCKETS MIDDLE SCHOOL LEVEL 2

A rocket is a missile or craft that is propelled by the thrust from a rocket engine. Rocket engines work by action and reaction and propel rockets forward by releasing exhaust in the opposite direction at high velocity. Harnessing the gas from the reaction of baking soda and vinegar, we will build enough carbon dioxide pressure to launch our bottle rockets sky-high. Decorate and innovate your ship before flight. Will it have wings and propellers, or do you prefer stripped-down aerodynamics?

EDUCATIONAL STANDARDS:

NGSS CONNECTION:

MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

COMMON CORE CONNECTION: ELA/Literacy

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

Mathematics

6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems.

6.SP.B.4 Display numerical data in plots on a number line, including dot plots, histograms, and box plots.

6.SP.B.5 Summarize numerical data sets in relation to their context.

MP.2 Reason abstractly and quantitatively.

6.EE.A.2 Write, read, and evaluate expressions in which letters stand for numbers.

7.EE.B.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.

7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.



6.RP.A.1 Understand the concept of ratio and use ratio language to describe a ratio relationship between two quantities.

7.RP.A.2 Recognize and represent proportional relationships between quantities.

8.F.A.3 Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.

DOK:

Level 3: Strategic Thinking Level 4: Extended Thinking

*** This project makes a great culmination project (assessment component for various standards)

MATERIALS NEEDED:

- Baking soda
- Vinegar
- Empty plastic bottles
- Straws
- Cork
- Duct tape
- Markers
- Decorative materials
- Paper towels

DIRECTIONS:

- 1. Tape 4 straws to the top of the bottle to be used as legs for the rocket to stand on while launching.
- 2. Decorate the rocket in any way you can imagine.
- 3. Fill the bottle halfway with vinegar.
- 4. Scoop a spoonful of baking soda in the center of a square of paper towel and roll it up. Twist the ends to close the baking soda in.
- 5. Place the paper towel into the bottle, but don't drop it in the vinegar yet. Let the neck of the bottle hold the paper towel.
- 6. Put a cork in the mouth of the bottle.
- 7. Turn the bottle upside down and let it stand on its legs.

OBJECTIVE:

Students will be able to combine their knowledge of chemistry and physics to design and construct a rocket and propellant system.

ESSENTIAL QUESTIONS:

- How might we create a safe propellant for our rocket?
- How might we make the propellant more efficient?
- What factors affect the motion of our rocket?

ENGAGE:

- 1. Show students a video of a rocket launch
 - a. <u>Space X Launch</u>
- 2. Tell students that they will be tasked with designing and constructing a bottle rocket
- 3. They will need to use their knowledge of chemistry and physics to design and launch a successful rockets
- 4. Require of students
 - a. Design a rocket that will provide the highest launch height
 - i. Provide evidence that their design is engineered for the optimal height (they will need to conduct experimentation)
 - ii. Provide an efficient and safe propellant
 - 1. Baking soda/vinegar
 - 2. Water pressure
 - 3. Air pressure.
 - 4. etc.

EXPLORE:

- 1. Allow students time to design rocket
- 2. Experiment with rocket and design
- 3. Allow students to experiment with safe propellants

EXPLAIN:

- 1. Allow time for students to construct explanations of the motion of their rocket
 - a. How does it work?
 - b. Discussion can be around motion and forces and/or energy
- 2. Explain their propellant system and its efficiency
- 3. Research

ELABORATE:

- 1. Students will continue to make iterations to their design and present their final components.
- 2. Students may produce a presentation to explain their experimental processes for their rocket design, and propellant system.

EVALUATE:

- 1. Students' rocket designs
- 2. Their explanations from evidence to support the description of the rocket's motion
- 3. Their use of chemistry to design a propellant
 - a. Did the substances undergo a chemical or physical change
 - b. What evidence is used to support whether it is a physical or chemical change.
 - c. How does your mixture work as a propellant
 - d. Why choose this propellant over other options









- A. On the 100th anniversary of the Statue of Liberty on July 4, 1986, more than 100 tons of simple baking soda was used to clean the interior copper walls.
- B. December 30th is National Bicarbonate of Soda Day.
- C. Baking soda was first used by the Ancient Egyptians as early as 3500 B.C. in the embalming process of mummies.
- D. Baking soda is used in fire extinguishers because it produces a soapy foam which is able to douse flames.