Stomp Rockets

Teacher Copy

Lesson Focus

This lesson focuses on the concept of 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

Estes rocket launch video

Grade Levels

6-12

Objectives

During this lesson students will:

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

Materials

Materials for a group of 20 students working in groups of four

1. Stomp rocket launcher
2. 5 rocket bodies
3. 5 fins from template worksheet (paper or card stock)
4. 5 cotton balls
5. 5 rolls of clear tape

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. What things have to be considered when constructing a rocket? Which would fly the highest: an Estes rocket or a compressed air rocket? Why?
3. What is apogee? *The highest altitude a rocket achieves before it starts to fall.*
4. Why should you wear goggles for this lab?
5. How was the Estes rocket ignited versus the air compressed?
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 the airplane in the air.*

   Gravity: *The force that holds all objects to the Earth.*

Preparation

1. Build the launch pad based on these great instructions from Science Toy Maker: https://sciencetoymaker.org/air-rockets/make-air-rocket-launcher/
2. If desired, pre-roll enough rocket tubes for each group.

Procedure

Our procedure has been adapted from Science Toy Maker; see the full version with pictures: https://sciencetoymaker.org/air-rockets/make-air-rockets/

1. Students should decide how many fins they want for their rocket, what type of fin, and fin placement.
2. Draw one fin type on the template worksheet.
3. Cut out fins and tape fins to the rocket.
4. Close the top of the rocket by pushing down one side of the tube 1.5 cm from the top. Push the opposite side down the same amount, so they are both horizontal.
5. Push down one of the two remaining sides, and then the final side. When finished, you should have a flat top to your rocket.

6. Use a cotton ball and four more pieces of tape to soften the top of the rocket. The final form should be a rounded nose cone.
7. Slide the rocket completely down the vertical pipe. When everyone is clear and when your instructor gives the signal, launch by stomping on the middle of the soda bottle.
8. Students can use a stopwatch to time their rocket and record the length of time it is in the air, or measure and calculate the height using a clinometer.

Data

Independent variable: the variable that is changed. _____

Dependent variable: the variable being measured. _____

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

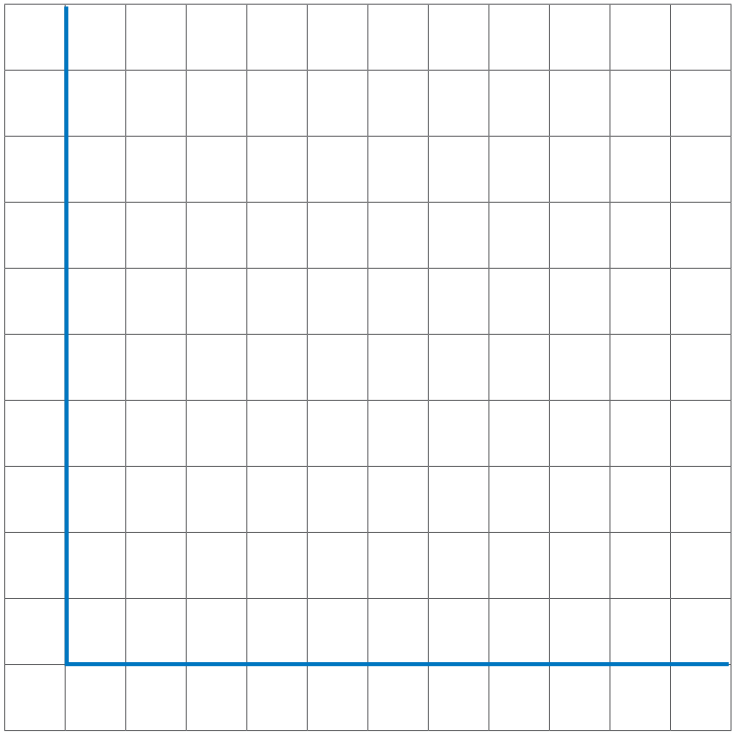
Hypothesis: I think the rocket with (fin number) will go (higher or lower) because _____

_____

Number of trials can be for group or individual.

Sample Data Table Trial	Number of fins	Height in meters
1.		
2.		
3.		

Graph your data here for number of fins versus height of flight



Present your conclusion to your peers. Was your hypothesis supported? What did your data say? If you could do this experiment again, how would you change it?

Questions

1. What variables worked best for changing the height the rocket flew?
2. What goes on the x-axis and y-axis?
3. What could you do that would make your rocket better?
4. How do the four forces of flight affect your rocket?
5. What provides the thrust for this rocket? *The compressed air.*

Alignment to Curriculum Frameworks

NGSS Engineering Practices

- MS-PS2-2. Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how much data is needed to support a claim.

- MS-PS2-5. Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation.
- MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects.

Common Core – ELA

- RST.6-8.3.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.