NASA Foam Rocket Activity

Objectives

- Build a foam rocket.
- Modify fins of rocket to achieve the greatest velocity and distance.
- Calculate velocity of rocket given the time and distance traveled.
- Based on data collected, determine which design is best.

Suggested Grade Level

5^{th} – 12^{th} grades

Subject Area

Science
Math
Engineering

Nebraska State Standards

Science

SC.8.1.1.B Develop a model.

SC.HSP.1.1.A Generate and interpret mathematical and graphical representations to describe the relationships between position, velocity, acceleration and time.

Mathematics

MA 8.3.3 Measurement: Students will perform and compare measurements and apply formulas.

MA 8.4.1 Representations: Students will create displays that represent data.

MA 8.4.2 Analysis & Applications: Students will analyze data to address the situation.

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National Science Content Standards

Unifying Concepts and Processes

- Evidence, models, and explanation
- Change, constancy, and measurement

Science as Inquiry

- Abilities necessary to do scientific inquiry

Physical Science

- Position and motion of objects
- Motion and forces

Science and Technology

- Abilities of technological design

National Mathematics Content Standards

Number and Operations
Measurement
Data Analysis and Probability
National Mathematics Process and Standards
Reasoning and Proof
Communication
Representations

Time
Several class periods.

Background
The flight of a foam rocket is dependent on several factors including the design of the fins, the amount of thrust achieved from the stretched rubber band (how much the rubber band is stretched) and the angle of launch. The flight of the foam rocket is similar to that of real rockets, even though its thrust only last for a few seconds of its flight. Just like a real rocket, the foam rocket's flight is affected by gravity and friction (drag) caused by the atmosphere.

The launching of the foam rockets is an excellent example of Newton's third law of motion. When the rubber band returns to its original size by contracting it produces a thrust that propels the foam rocket forward while it produces an opposite and equal force on the launcher. Student will use a large paint stick as the launcher. While in flight, it is the fins which stabilize the foam rocket and keep the rocket pointing in the desired direction.

How far the foam rocket travels is dependent on gravity, the launch angle, its initial velocity and the drag of the atmosphere.

Materials
½ inch foam pipe insulation 30-cm long
1 rubber band - #64
2 9" red plastic plates for each set of fins
Duct tape
Scissors
Zip ties
String
Large paint stirrer

Foam Rocket Construction
1. Using scissors, cut one 30-cm length of foam pipe insulation for each student.
2. At one end, cut four equally spaced slits. The slits should be about 12 cm long. This is where the fins will be placed.
3. Cut a piece of string 30-cm long and tie the ends together.
4. Loop the string through one end of the rubber band.
5. Open the piece of foam pipe insulation and lay the string/rubber band inside with the rubber band extending from the top of the "rocket" about 5-cm.

6. Carefully remove the paper strip and press the sides of the rocket body together.
7. At the top of the rocket, carefully wrap a zip tie around the body of the rocket 5-cm from the end. Pull as tight as you can. Snip off the excess.
8. Cut your two fins from the red plastic plates. Fins should be notched so that they will slide together (bottom of one slides over top of the other.)
9. Slide the nested fins into the slits cut at the bottom of the foam rocket body.
10. Wrap a zip tie around the bottom (under the fins) and carefully tighten being careful not to over-tighten and cause a warp in the fins. Also make sure that the string is extending out and centered in the bottom of the foam pipe rocket body.

Lesson

- Using the foam rocket that the students have constructed, go over each part of the rocket and its function. (I use a lab sheet that has a diagram of a rocket on it. As we go over each part of the rocket, students record the information on the sheet.)
- Identify lift and drag and how they affect the flight of the rocket.
- Discuss thrust and Newton's 3rd Law; action – reaction forces.
- Have students think about what role gravity plays in the path of the rocket and what other factors that may affect the flight of the rocket and distance traveled.
- Model how to "load and launch" the foam rockets using the wooden paint stick. Review where to record the data collected.
- Have students launch their rockets and record distance and time as well as the flight path of the rocket (did it go straight? Curved right or left?) three times.
- Students will modify the fins of their rockets and re-launch recording their data in the data table.
- Students will create a graph of their data to better review and analyze their data.
- Discuss how changing the shape of the fins affect the flight of the rocket.

Assessment – Evaluation

Have student teams submit their completed data sheets with conclusions.

Resources

NASA Education: https://www.jpl.nasa.gov/edu/teach/activity/foam-rocket/
NASA Air Rockets Diagram: https://www.grc.nasa.gov/www/k-12/rocket/rktstomp.html
NASA Rockets Educator Guide:
https://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Rockets.html