



## Pop Rocket Variables

### Objectives

Students will:

- Choose a variable to manipulate related to the “fuel” for their pop rocket.
- Identify independent, dependent, and control variables.
- Make and test a hypothesis.
- Collect data and make conclusions.

### Suggested Grade Level

4<sup>th</sup> -8<sup>th</sup>

### Subject Areas

Science

### Timeline

60 minutes

### Standards

- MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
- MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.

### 21<sup>st</sup> Century Essential Skills

- Critical thinking/Problem solving
- Collaboration and Teamwork
- Obtaining/evaluating/communicating ideas

### Background

Students often have a difficult time distinguishing between independent (factors that can change the outcome) and dependent (factors that remain constant) variables. In order to cement this concept, they need a lot of repetition and practice performing experiments with these variables.

Students will use Alka-seltzer tablets to create a pop rocket. The sodium bicarbonate and anhydrous citric acid reacts with hot water. Gas is released from this chemical reaction allows the rocket to “pop.” Students will observe and identify the variables that affect the

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results. This lesson is designed to be completed before students build a pop rocket. They can take their results and use the information when actually designing their pop rocket.

### **Vocabulary**

Variable, independent, dependent, control, hypothesis

### **Materials**

- Alka-seltzer®
- Cups
- Graduated cylinders
- Heat source for water
- water
- Stop watches

### **Lesson**

1. Explain to students that they will be using Alka-Seltzer® and water as the fuel for their pop rocket engines. Go over the ingredients that are in Alka-Seltzer.
2. Ask students to explain what happens when Alka-Seltzer® is added to water. They should notice the formation of bubbles or fizzing. This is the production of CO<sub>2</sub> gas during a decomposition reaction between the Alka-Seltzer® and water. The gas will build up in the film canister (engine) eventually causing enough pressure to pop the lid off and send their rocket into the air.
3. Have students brainstorm variables that could be made either to the ingredients in the rocket or the amount of ingredients in order to change the amount of time that pressure is built up in the rocket. Students may suggest crushing up the Alka-Seltzer® first, raising the temperature of the water, using different amounts of water or Alka-Seltzer®.
4. Help students recognize that these are independent variables. Students will need to choose a variable and test it against a control. For example, students may choose the amount of Alka-Seltzer® necessary. In that case they will need to keep the temperature and amount of water consistent in each experiment.
5. Have students conduct five trials on each variable. They will test ¼ tablet, ½ tablet, and a whole tablet, recording the reaction times of each 5 times. Students will then need to graph their data and make conclusions about their findings.
6. Have students will need to complete a table, graph, and analysis. They can share these results with the class or turn them in for evaluation.

### **Extensions**

- Use the NASA Educators Rocketry guide and build the pop rockets. Each student in a group could launch their rocket under the different variables and continue to collect data on the effects.

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- Experiment with other chemical reactions, like baking soda and vinegar or coke and Mentos.

**Resources**

NASA Educators Rocketry Guide, Pop Rockets

<http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Rockets.html>