

Teacher Information

Antacid Tablet Race

Objective:

To investigate methods of increasing the power of rocket fuels by manipulating surface area and temperature.

Description:

Students compare the reaction rates of effervescent antacid tablets under different conditions.

Science Standards:

Science as Inquiry
Physical Science - Properties of objects and materials
Science and Technology - Abilities of technological design

Science Process Skills:

Observing
Communicating
Measuring
Collecting Data
Inferring
Predicting
Interpreting Data
Making Graphs
Hypothesizing
Controlling Variables
Investigating

Mathematics Standards:

Mathematics as Communication
Mathematical Connections
Estimation
Measurement
Statistics and Probability

Management:

This activity should be done in groups of two or three students. The specific brand of effervescent antacid tablets used for the experiment is not important, but different brands should not be mixed during

the experiments. Give student groups only two tablets at a time. Make sure they know how to fill in the stopwatch graphs on the student pages. Although there is little eye hazard involved with the experiment, it is valuable for students to get in the habit of wearing eye protection for experiments involving chemicals.

Background Information:

This activity enables students to discover methods of increasing the rate that rocket propellants release energy. When rocket propellants burn faster, the mass of exhaust gases expelled increases as well as how fast those gases accelerate out of the rocket nozzle. Newton's Second Law of Motion

Materials and Tools:

- Effervescent Antacid tablets (four per group)
- Two beakers (or glass or plastic jars)
- Tweezers or forceps
- Scrap paper
- Watch or clock with second hand
- Thermometer
- Eye protection
- Water (warm and cold)



states that the force or action of a rocket engine is directly proportional to the mass expelled times its acceleration. Consequently, increasing the efficiency of rocket fuels increases the performance of the rocket.

Students will discover two methods for increasing the efficiency of rocket fuels by using antacid tablets. The first experiment measures the relationship between the surface area of a tablet and its reaction rate in water. Students will learn that increasing the surface area of a tablet by crushing it into a powder, increases its reaction rate with the water. This is a similar situation to the way a rocket's thrust becomes greater by increasing the burning surface of its propellants.

Expanding the burning surface increases its burning rate. In solid rockets, a hollow core extending the length of the propellant permits more propellant to burn at a time. This increases the amount of gas (mass) and acceleration of the gas as it leaves the rocket engine. Liquid propellants spray into the combustion chamber of a liquid propellant rocket to maximize their surface area. Smaller droplets react more quickly than do large ones, increasing the acceleration of the escaping gases. (See page 20 for more information.)

The second experiment measures the reaction rate of tablets in different water temperatures. Tablets in warm water react much more quickly than tablets in cold water. In liquid propellant rocket engines, super cold fuel, such as liquid hydrogen, is preheated before being combined with liquid oxygen. This increases the reaction rate and thereby increases the rocket's thrust. More information about this process appears on page 20.

Assessment:

Conduct a class discussion where students explain how this experiment relates to the way rocket fuel burns. Collect and review completed student pages.

Extensions:

- Try a similar activity relating to the surface area of rocket fuels using small pieces of hard candy. Take two pieces of candy and crush one. Then, give the whole candy piece to one student and the crushed candy to another student to dissolve in their mouths. Which candy will dissolve first?



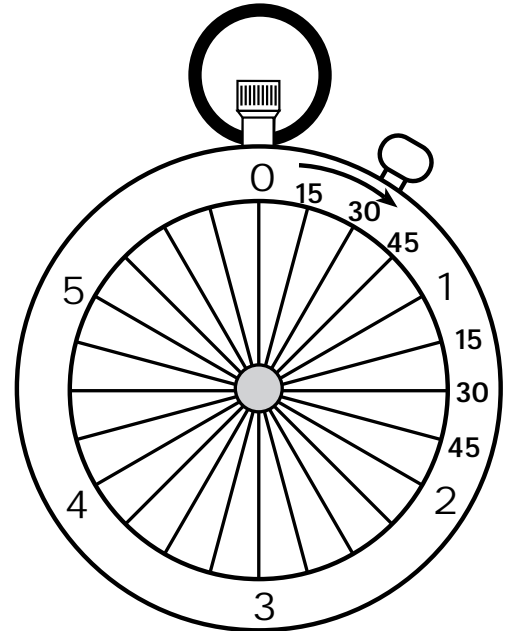
Antacid Tablet Race Experiment 1

Team _____
Members: _____

Jar 1 Results

Your Prediction: _____ seconds

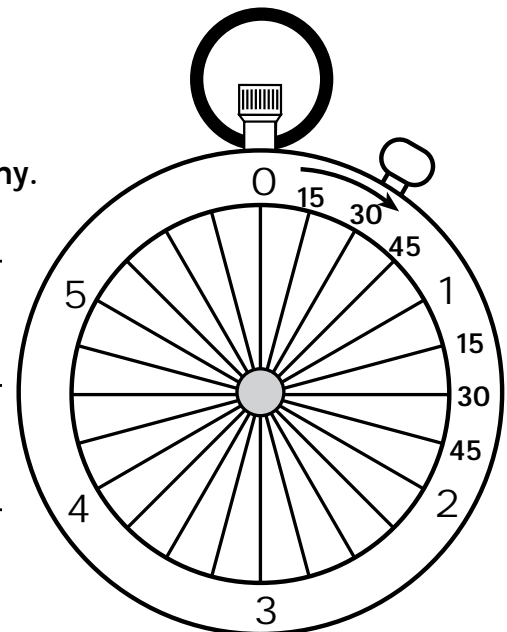
1. Fill both jars half full with water that is at the same temperature.
2. Put on your eye protection.
3. Predict how long it will take for the tablet to dissolve in the water. Drop a tablet in the first jar. Shade in the stopwatch face for the actual number of minutes and seconds it took to complete the reaction. The stopwatch can measure six minutes.
4. Wrap another tablet in paper and place it on a table top. Crush the tablet with the wood block.
5. Predict how long it will take for the crushed tablet to dissolve. Drop the powder in the other jar. Shade in the clock face for the number of minutes and seconds it took to complete the reaction.



Jar 2 Results

Your Prediction: _____ seconds

Describe what happened in the experiment and why.



Experiment 2

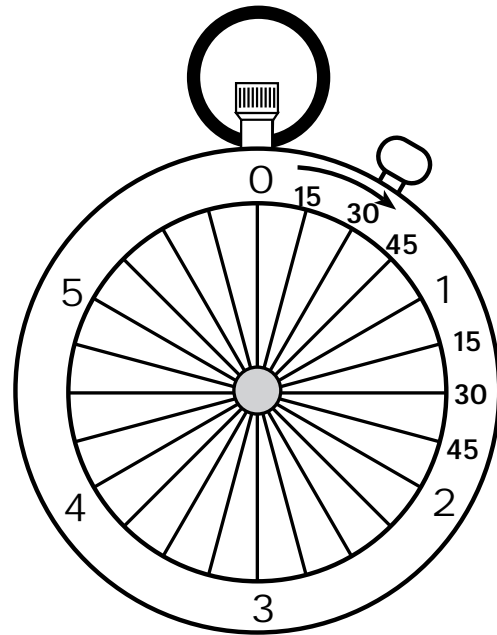
1. Empty the jars from the first experiment. Put warm water in one jar and cold in the other.
2. Measure the temperature of the first jar. Predict how long it will take for a tablet to dissolve. Drop a tablet in the jar. Shade in the clock face for the actual number of minutes and seconds it took to complete the reaction.
3. Measure the temperature of the second jar. Predict how long it will take for a tablet to dissolve in the water. Drop a tablet in the jar. Shade in the clock face for the actual number of minutes and seconds it took to complete the reaction.

Describe what happened in the experiment and why.

How can you apply the results from these experiments to improve rocket performance?

Jar 1 Results

Your Prediction: _____ seconds



Jar 2 Results

Your Prediction: _____ seconds

