Rockets

NATIONAL MUSEUM UNITED STATES ARMY

Your Mission: Build a rocket, and see how a chemical reaction works.

Materials:

- baking soda
- vinegar
- 2-liter plastic bottle
- duct tape
- 3 unsharpened pencils
- paper towels
- cork top
- Safety googles or sunglasses

Directions:

Building Phase: Complete your rocket-building and launch phases with parental supervision.

1. Gather your materials.
2. Tape three pencils to the top of the bottle with the erasers pointing up. These will make the rocket's stand. Make sure the pencils are even so that the bottle stands upright. Test by setting down the bottle so that the bottom faces upwards and the mouth faces downward.
3. Take your rocket and supplies outdoors, away from buildings, trees, and other people. Find a flat area. This is your launch pad.
4. Assemble your baking soda fuel pack. Cut a paper towel square in half. Separate the two layers. Pour two teaspoons of baking soda into the middle of a single layer of paper towel. Fold the towel to enclose the baking soda so that none spills out. Make sure the baking soda packet is thin enough to slide inside the mouth of the bottle.

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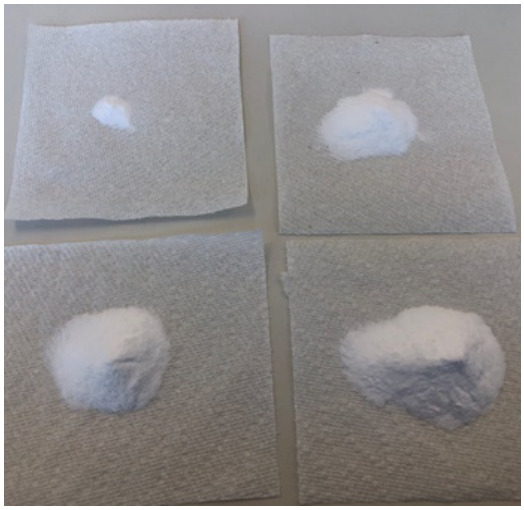

Directions:

Launching Phase: Complete your rocket building and launch phases with parental supervision.

1. Turn the bottle of your rocket upside down, so that the opening of the bottle is facing up. Pour approximately 1 cup of vinegar into the bottle.
2. Put on your safety goggles or sunglasses.
3. Carefully put the baking soda packet inside of the bottle. Leave the baking soda in the paper towel and don't pour loose soda into the bottle.
4. Quickly insert the cork into the mouth of the bottle. Don't press it in too hard, but make sure that it stays in the opening.
5. Turn the bottle so the pencil erasers are facing downwards. Shake the bottle 2-3 times. Place the bottle on the ground and step back several feet.
6. Watch your rocket fly! Try again! Change the amount of vinegar and baking soda. See if the bottle will fly higher or lower depending on how much of each ingredient you include in the rocket.

Rockets

Why do vinegar and baking soda make the rocket to fly?

Vinegar and baking soda react with each other in an acid-base reaction. This forms a gas that builds pressure before releasing from the bottle.

What causes the reaction?

Baking soda is a base, and vinegar is an acid in water. Adding the baking soda packet to the vinegar causes a chemical reaction. The baking soda and vinegar begin to change when they come in contact.The baking soda's molecular formula is $NaHCO_3$. The vinegar's molecular formula is CH_3COOH. The baking soda takes a proton from the vinegar. This changes the baking soda's chemical make-up, creating carbon dioxide gas to form inside the bottle. The new chemical compound causes the bubbling and foaming reaction that you see in the bottle. As the carbon dioxide gas builds up, it creates pressure inside the closed bottle. The pressure pushes the cork from the bottle's mouth. The gas release forces the rocket to fly up into the air.

What happened to the paper towel?

The paper towel slows down the reaction between the vinegar and the baking soda, but it doesn't change it. Without the paper towel, you wouldn't have time to put the cork in the rocket. Without the cork, the gas would quickly escape from the bottle, and pressure in the bottle can't build up. This pressure forces the cork out of the bottle, allowing the rocket to launch.

Try more experiments with the vinegar and baking soda!

- Mix the two in a bowl and watch the gas bubbles form.
- Spoon baking soda in a deflated balloon. Attached the balloon to the top of a vinegar-filled plastic bottle. Empty the baking soda into the bottle and see the carbon dioxide gas fill up the balloon.
- Try adding different amounts of vinegar and baking soda to your rocket. See if mixtures change how the rocket flies. Write down your observations below.

Rockets

Experiment Observations:

Think about your rocket experiments. Write down changes you made to your acid (vinegar) and base (baking soda) mixture. What happened to the rocket after you made these changes? Did the rocket fly higher or lower? Did it launch faster or slower? What would you change for next time? Can you use this information to make an educated guess about what will happen to your rocket next time?