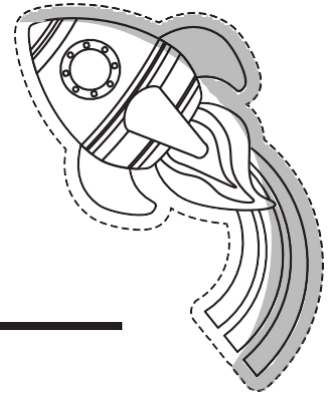


ACID/BASE ROCKET

Use a simple baking soda and vinegar reaction to launch your rocket. Who knew that baking soda and vinegar had that much power? Children can construct individual rockets or make them in groups of 2 or more. Suitable for ages 7yrs +



What you need to make one

- An empty plastic bottle
- 3 pencils (unsharpened is best)
- Waterproof tape / Duct tape
- A cork that fits the soda bottle
- Paper towels
- Baking soda
- Vinegar - at least one large bottle



Instructions

1. Prepare bottle & tape

Use the scissors to cut about 30 cm of the strong tape from the roll. Duct tape is probably the best choice, but you can use electrical or heavy masking tape as well. Stick one end of the tape to the middle of the bottle but don't wrap it around the bottle, yet.

2 Attach pencil legs

The pencils will be the legs of the rocket. Hold one pencil onto the bottle so about 5 cm of it extends beyond the opening of the bottle and keep it in place with the tape. The pencils need to be equidistant from each other around the bottle and extend past the opening the same distance. Wrap the tape over the second pencil and then the third. Make sure the rocket is stable and points straight up on its three pencil legs.

3 Add vinegar

Turn the bottle right side up and use the funnel to pour in some vinegar. You want the bottle to be about half-full.

4 Prepare delivery packet

Grab a single paper towel from the roll. If there are multiple layers in the towel, separate them so you have just one thin layer. Keep the other layer(s) for upcoming launches. Tear the single layer into thirds or fourths and save the pieces for more tests.

5 Add baking soda

Scoop a heaping tablespoon (1 T) of baking soda and dump it into the center of the piece of towel you tore off. Fold and wrap the towel around the baking soda so it's a snug bundle but don't tear the towel if you can help it. The bundle needs to be small enough to fit through the opening of the bottle so shape it like a miniature hot dog. The paper towel acts as a time release. This way, you will have enough time to step away from the rocket before it explodes.



6 Take it all outside

Grab the bottle, the bundle of baking soda, the stopper, and take it all outside. DON'T do the next step inside - please! Your parents and teachers will appreciate your thoughtfulness, you'll have less to clean up, and everyone will be impressed with the launch.

7 Launch

Outside where you can make a mess safely and clean it up with a hose, you need to think about how to do the next five steps kind of all at once to achieve a successful launch.

You need to:

1. Push the paper towel-wrapped baking soda into the bottle
2. Snugly twist the cork or rubber stopper into place in the opening of the bottle
3. Give the rocket a quick, hard shake
4. Set the rocket upright on the pencils
5. Stand back!

Make sure you are in an open, outdoor area. The rocket will shoot up quite fast and high so remove any obstructions and warn anyone around you before you launch it. Please make sure an adult is around as the rocket takes off very suddenly and forcefully.



The science bit

What happens when you mix vinegar with baking soda? There's a lot of bubbling and foaming! The bubbles and foam you see are filled with carbon dioxide gas (CO₂) that's being released by an acid/base reaction. Vinegar is acetic acid dissolved in water and baking soda is a base called sodium bicarbonate. Initially, the reaction makes carbonic acid which is unstable. It quickly breaks down into CO₂ and water. The gas then rapidly leaves the water creating foam and bubbles along the way.

When you close the bottle with the cork or rubber stopper, you prevent the CO₂ from immediately escaping the bottle. This causes a rapid increase of pressure inside the bottle. The pressure eventually gets to the point that the rubber stopper can no longer contain the gases and - WHOOOOOSH! - the stopper and the contents of the bottle explode through the opening. It doesn't take long to get there, either.

As the contents of the bottle shoot downward, the bottle itself shoots upward. How does that happen? This is a demonstration of Newton's Third Law of Motion: for every action, there is an equal but opposite reaction. The initial action is the rush of material and force out of the opening going one way pushing hard against the air behind the bottle. The reaction is the air pushing back with the same amount of force going the other way. The bottle is thrust forward as the rushing foam and gas shoot backward.

Other things to try with your rocket

Try different amounts of baking soda or vinegar

Test different quantities of baking soda and vinegar to lengthen the flight time and distance. Work with different sized plastic bottles, too. You're looking for the perfect combination of bottle size and fuel to achieve the best launch at the highest speed (distance divided by time). A higher flight means figuring out the best combination of vinegar to baking soda to produce the most explosive reaction.

Change your bottle

There may be modifications you can make to the bottle so it travels farther as well. Do some research on the Venturi Effect and see how that might improve things.

Try different temperature

Maybe the temperature of the vinegar you use will make a difference?

Add fins

Could you try adding fins instead of pencils? Does that change how high it can fly?

