



## Recyclable STEAM Crafts

### Baking Soda & Vinegar Rockets

When we think of chemistry, we often picture white lab coats, professional equipment and fancy goggles. But, that's not always the case. In fact, chemistry surrounds us. From the chemical reactions found in cooking to the rusting of iron, chemistry is everywhere, especially in this super cool science experiment.

In this rocket experiment, students fly high using recyclable materials and household ingredients to build and launch their very own plastic bottle rocket. Once all the rockets have landed, this experiment segues perfectly into the science behind the explosive magic!

#### MATERIALS:

- Rinsed plastic bottle (any size is fine)
- Cardboard
- Tape
- Cork (fits mouth of plastic bottle)
- Scissors
- One piece of toilet paper
- Vinegar
- Baking Soda
- Paint (if desired)

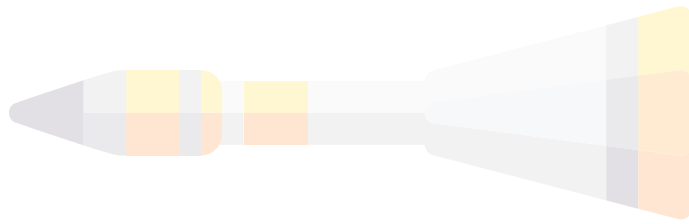


### HANDS-ON STEM EDUCATION

For over 30 years, PCS Edventures has inspired students to develop a passion for Science, Technology, Engineering and Mathematics (STEM), focusing our efforts on making learning and discovery a fun and interactive process for grades K-12.

- Classroom
- After-School
- Home Learning

# ROCKET MAKING



1. Gather all materials.



2. Cut a piece of thin cardboard into a large rectangle (9"x12").

- Thin cardboard can be achieved by tearing off a single layer of the cardboard, like so:



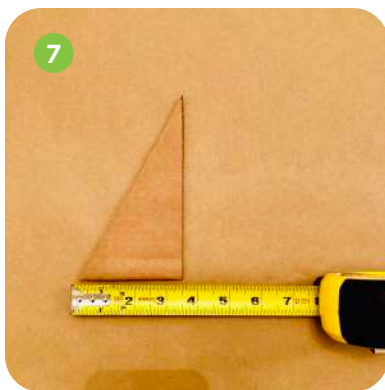
3. Roll upper left corner towards upper right corner until a cone shape forms.



4. Adjust the opening of the cone until it fits around the bottom of the bottle.



5. Tape the cone to the bottom of the bottle.



6. Insert cork into the opening of the bottle.  
 7. Cut out 3 right triangles from cardboard (base: 3.5", height: 6").



8. Flip the bottle so it is cork-side down and attach the 3 wings with tape so that the bottle can stand.  
 9. Remove the cork from the bottle to prepare for the rocket launch.

# ROCKET LAUNCHING



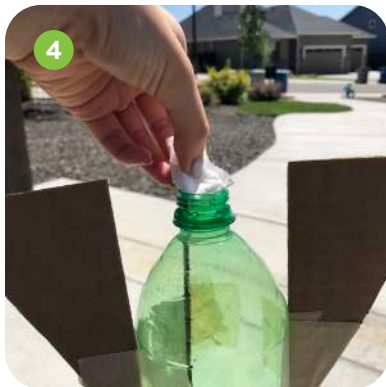
1. Move to a secure area free of pedestrians or private property (spacious backyard should be fine).

2. Fill the rocket halfway with vinegar.



3. Dump baking soda on the single piece of toilet paper and wrap it, creating a makeshift baking soda pack.

- The ratio between vinegar to baking soda should be around 12:1.



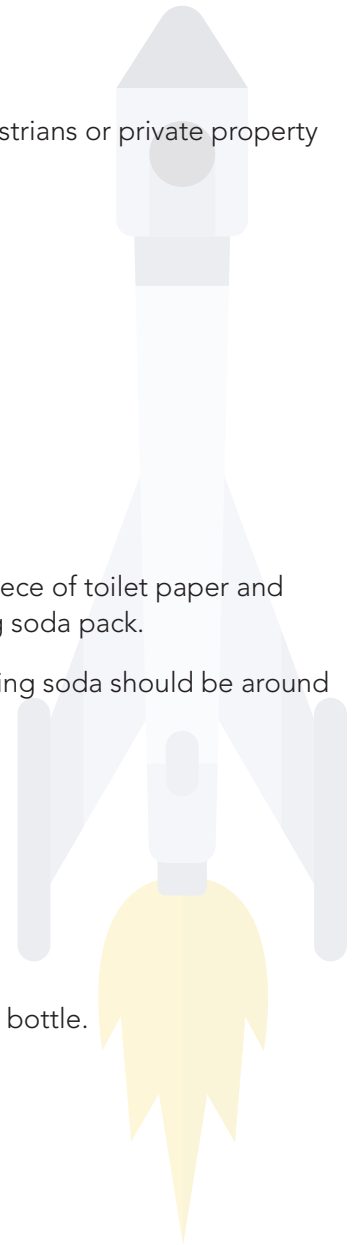
4. Push the baking soda pack into the bottle.



5. Quickly cork the bottle and stand your rocket right-side up.

6. Step at least 5 feet away and wait for around 20 seconds for the reaction to occur.

7. Watch your rocket take flight!



## A Closer Look: What Launched the Rocket?

### Acids and Bases

In science, almost all liquids can be classified as either an *acid* or a *base*. The kind of ions in a liquid determines which group it is classified in. An *ion* is a particle that is *charged*, meaning it has lost or gained an electron(s). Among these ions is the hydrogen ion ( $H^+$ ), and the hydroxide ion ( $OH^-$ ). If a liquid contains a lot of  $H^+$  ions, it is considered an acid. If it contains a lot of  $OH^-$  ions, it is considered a base. Simple, huh?

### The pH Scale

Even if all liquids are classified as acids or bases, they won't all be the same level of acidic or basic. To figure out a scale to measure just how acidic or basic a liquid is, scientists came up with the *pH scale*. pH is just a number between 0 and 14. Liquids that are 0s are the most acidic acids, whereas liquids that have a pH of 14 are the most basic bases. Some have a pH of 7, meaning they are neutral. One such example is distilled water. Some common acids include lemon juice and black coffee. Bases are substances like soapy water or bleach.

### Chemical Reaction

In this experiment, baking soda is a weak base and vinegar is an acid. When they are mixed, they create an *acid-base reaction*. When this reaction occurs, carbon dioxide ( $CO_2$ ) is formed as a result. This carbon dioxide is the kind you commonly see in carbonated drinks — they're what make sodas fizzy. Bubbles and foam begin to form inside the bottle, but the  $CO_2$  can't escape due to the stopper cork. This leads to a rapid increase in air pressure inside of the bottle, until finally — WOOHOO! The rocket bottle takes off with a tiny explosion of force!

Now that you know all about the forces at work, you can ramp up the challenge by mixing different ratios of vinegar and baking soda to see which concoction shoots your rocket the highest and longest.

Have fun, and don't forget to be safe!



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