

# Epic Bottle Rocket Experiment!

Making a bottle rocket is easy to do with everyday objects that can be found around the house, and it is educational at the same time.

*See how high your rocket can fly.*

## Instructions:

### 1. Prepare the rocket.

**Picture A:** Materials. (see right)



**TIP:** If you want to be scientific in your experiment then it would be best to use measuring equipment for accuracy. For example a tablespoon for the Bi Carb soda.

### 2. Place the cork in the empty bottle.

**Picture B:** Placing the cork in the bottle. (see right)

**TIP:** The cork I found to use for my experiment was too big for the bottle top so I used some sand paper to gently remove just enough of the cork for it to become the perfect fit, this means it is able to slide in easily and at the same time hold firm when the bottle is filled with liquid and turned upside down for launch.

### 3. Build a stand/ platform for the rocket.

There are a few different ideas that you can use to build a launch pad. You could use toys, craft sticks, pencils, & even Lego. For this experiment I used pencils as I had plenty at hand.

**Note:** Regardless of the materials you use the key engineering learning component of this task is that you address the experiments requirements which is to create a platform that is stable and just the right size to hold the rocket (upside down 2L bottle) without it slipping. This task works on both your math and engineering skills math for measurement and fitting a round thing in a square hole and engineering, construction a stable and strong structure for launch.

**TIP:** While some add decoration by painting the bottle or adding stickers, be aware that this will add weight to the experiment, and it will be unable to fly as high in the sky a rocket without decoration.

- Tip the bottle upside down on the table so that the cork is sitting face down on the table (this will not balance so hold onto it until the stand is secure).
- Place the pencils around the bottle. The aim is for the pencils to act as a stool to support the bottle.
- Tape the pencils in place, each pencil should be level with each other so that when you remove your hand the structure is able to stand upright on its own as seen in the picture below.

**Picture C:** Constructing bottle rocket stand.



**Picture D:** Bottle Stand complete.



## Supplies:

- An empty 2 liter soda bottle (clean and dry).
- Pencils (unsharpened is best).
- Tape- masking tape is preferred but any tape will do.
- A cork that fits the soda bottle- ask mum and dad.
- A tissue.
- Scissors.
- Bi Carb soda.
- Vinegar – the bigger the bottle the better (it may take a couple of tries to get right or in my case it is fun to do again and again).
- **OPTIONAL:** measuring equipment, cup and tablespoon.



# STEAM



- TIP: 1.** The pencils I was using were not long enough to support the rocket so 2 pencils were taped together for length.
- 2.** I found that it was important to use more masking tape than necessary to secure the pencils.
- 3.** Also once I had launched the rocket once it was too much fun so, I re launched the rocket multiple times. By the end however the tape and pencils had nearly melted of the bottle making the launch flimsy. I would suggest drying out the bottle between launches and adding more tape.

Once your rocket is prepared it is time to launch it!

**Launch instructions:**

- 1.** Separate the tissue layers as you will only need one. Lay it flat on the surface and place the tablespoon of Bi Carb soda in the center. Spread the powder around the center of the tissue. Roll the tissue up as you would a wrap fold the ends up, to secure the contents and then roll so that it is small enough to fit through the mouth of the bottle.

**Picture E:** Bi Carb Soda tissue wrap.



**Can you tell me why we wrap the Bi Carb soda in paper towel?**

By wrapping the bi carb soda in paper towel before it is placed in the bottle, we are delaying the reaction time, (the vinegar needs to soak through the paper towel to get to the bi carb soda before it can dissolve it and combine into carbonic acid) which makes it safer to tip the bottle upside down, place it on the launch pad and safely step away from the rocket before it blast off.

**TIP:** If you wish to be competitive and attempt to reach new heights you can measure and record the amounts of bi carb soda and vinegar you put into the bottle just keep in mind that any increase in bi carb soda will also require an increase in vinegar as well.

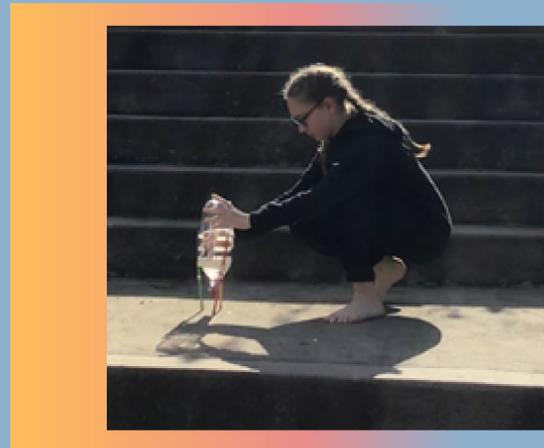
- 2.** Pour in 1-2 cup of vinegar into the rocket.

**Picture F:** Pouring vinegar into bottle.



After pouring in the vinegar, push in the bi carb soda tissue roll into the bottle and then quickly push in the cork, turn the bottle over and place on the ground. For safety step away quickly and well clear of the rocket launch, it can take a minute.

**Picture G:** Placing rocket on launch pad, quickly.



**Note:** You will want to set the rocket off in the backyard to contain the mess or in a fairly open area such as a park; make sure it's on solid ground for stability. The rocket can hit anywhere from 30-50 feet in height and if there is a high wind it can go further or be carried in another direction (sideways).

**TIP:** Be careful of pushing in the cork too tightly as it will not launch but the pressure will build up and make a mess when removed to try a second attempt.

**Video:** Rocket Launch



## Science Time:

In this bottle rocket experiment the use of bi carb soda and vinegar was used to create an acid/base reaction.

### Let's break it down.

#### Components:

Bi Carb soda= sodium bicarbonate;  $\text{NaHCO}_3$

Vinegar= acetic acid;  $\text{HCH}_3\text{OO}$

#### Reaction:

When combining bi carb soda and vinegar to create a reaction such as for a bottle rocket it is sometimes hard to see that the reaction is actually two parts as it happens so quickly.

- 1) Carbonic acid is formed when sodium bicarbonate and acetic acid mix.
- 2) The carbonic acid quickly breaks down the mixture into water and carbon dioxide gas.

#### Result:

The carbon dioxide gas that has formed begins to create pressure inside of the bottle, until it must escape the confines. When the pressure is too much it is able to push the cork out of the opening and sending the bottle in the opposite direction of the pressure release. i.e. into the sky

#### Why?

The rocket flies high into the sky because of Newton's 3rd Law of Motion. For every action, there is an equal and opposite reaction.

= The  $\text{CO}_2$  gas and liquid push out of the bottom of the rocket, which pushes the rocket upwards with great force!

#### What we learned with this Bottle Rocket project:

- Engineering, measurements (math) and some physics to create a base that is functional, strong and stable.
- Chemical reactions using bi carb soda and vinegar (a base+ an acid). We learned about how this chemical reaction has one important product: Carbon Dioxide Gas.
- Then we learned about physics and how when you trap that gas, how the chemical reaction pressure builds up and when it is finally released it has enough force to cause thrust, therefore launching our rocket "into the clouds!"

#### More on the chemical reaction

This activity explores the bi carb soda and vinegar reaction, which is a simple acid-base chemical reaction.

Vinegar or Acetic Acid has the chemical formula:



Bi carb soda or Sodium Bicarbonate and has the chemical formula:



During the reaction, the products produced are:

Sodium acetate:  $\text{C}_2\text{H}_3\text{NaO}_2$ , which is made of

- o 1 sodium ion,
- o 2 carbon atoms,
- o 3 hydrogen atoms, and
- o 2 oxygen atoms.

The other products are water ( $\text{H}_2\text{O}$ ) and carbon dioxide ( $\text{CO}_2$ ). Carbon dioxide is the gas that causes the bubbling during the reaction.

#### Clean Up

After you are done setting off your rockets, make sure you rinse everything with lots of water. As we learned in the science, vinegar is an acid. So any vinegar that is not neutralized by the reaction with the sodium bicarbonate (bi carb soda) needs to be diluted so it doesn't damage anything. Do this for everything that comes in contact with the vinegar. Including the area where you set off your reaction.

#### Safety Note:

Many teens are old enough to do this project by themselves, however it is recommended that there is adult supervision available. With younger kids I would suggest that they watch and cheer for this rocket from a safe distance while an adult, loads and launches the rockets. Also, there is a high likelihood that you will be sprayed with vinegar, so ensure all appropriate safety gear and clothing is worn to protect you from any spray. Don't ever get too close to an armed bottle rocket. Arm it, place it immediately into the launchpad and move away quickly!

