Robogals Science Challenge

Minor Challenge - Activity Sheet

STEM Field	Astronomy
Challenge Name	Launch Your Own Rocket
Challenge Level	Intermediate
Project Cost (approx)	20 - 50 USD
Materials Required	• Empty plastic bottle (2L) • A wine cork • A launchpad ◦ buy **or** see details in Instructions section below to build your own • Safety goggles • Miscellaneous craft material (scissors, tape, foil, cardboard, etc.) You can choose between a chemical launch (option 1) or a pressurized launch (option 2), or both. **Materials for Option 1: Chemical launch** • Baking soda (bicarbonate of soda) • White vinegar • Paper towel

Materials Required (continuted)	**Materials for Option 2: Pressurized launch** • Water • Bicycle pump - including an air valve • Materials to create fins and nose cones (e.g. scissors, tape, construction paper, foam, foil, cardstock, etc) • Material to drill the wine cork
Safety	• Adult supervision is required when drilling the cork and during the rocket launch. • This activity needs to be conducted outdoors away from people and buildings. • Do not stand too close to the rocket. • Wear safety goggles. • **For Option 1:** Rinse off everything with water after the launch is done. This is important to ensure that all the reactants (vinegar and baking soda) are neutralized and don't cause any damage. • **For Option 2:** Do not pressurize the rocket past 40 psi (pounds per square inch) or 275 kPa (kilopascal)
Duration (approx)	3 hours

Introduction

Rockets are awesome! In this challenge, you get to build your own rocket and launch it to see how far it can go. You can choose to make a rocket that uses a chemical reaction, one that uses air pressure, or even try both!

Option 1: Chemical Launch

This rocket uses a simple reaction between **baking soda** and **vinegar**. When these two mix, they fizz and make a gas called **carbon dioxide**. This gas builds up inside the rocket and helps push it into the air. That's why you'll see lots of bubbling!

Here is the chemical formula of this reaction:

$C_2H_4O_2 + NaHCO_3 \rightarrow NaC_2H_3O_2 + H_2O + CO_2$

Acetic acid + Sodium bicarbonate -> Sodium acetate + Water + Carbon dioxide

Option 2: Pressurized Launch

This rocket works because of Newton's third law, which basically says: when you push on something, it pushes back. If you pump air into the bottle, the air gets squished (compressed). When it rushes out, it pushes the bottle the other way—up! More air pressure means your rocket can zoom even higher.

Instructions

Safety: Make sure you're wearing your safety glasses before you start.

Step 1: Set up your launchpad!
If you bought one, just follow the directions that came with it. If you want to make your own, there are lots of fun ways to do it. Your goal is to build something that can hold your bottle rocket, stay steady, and not fall over.

You can use things like LEGO bricks, craft sticks, tinker toys, cardboard, glue, or anything else you think will work. Be creative!

Make sure you place your launchpad outside, in a big, open space on flat ground, so it's safe to launch your rocket.

Instructions

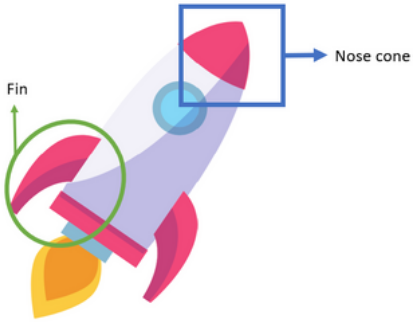
Step 2: Get your rocket ready!

Option 1: Chemical Rocket

- Pour 1–2 cups of vinegar into the bottle.
- Cut a small paper towel square (about the size of your hand).
- Put 1 tablespoon of baking soda in the middle of the paper towel.
- Fold the paper towel around the baking soda so it makes a little packet that can fit into the top of the bottle.
- Push a wine cork tightly into the bottle's opening so no air can escape.

Option 2: Pressurized Rocket

- Ask an adult to drill a hole in a wine cork so the air pump valve can fit through it.
- Pour 300–400 mL of water (about ¼ full) into the bottle.
- Put the cork into the bottle.
- Flip the bottle upside down and place it on your launchpad.



Optional: Decorate your rocket! You can draw on it with markers, add fins, make a nose cone, or even give it a "passenger" like a tennis ball or hard-boiled egg. Adding a little weight in the nose cone can help the rocket fly straighter.

Instructions

Step 3: Launch Time!

3... 2... 1... Blast off!

Option 1:

- Turn the bottle upside down and set it on your launchpad. Then step back quickly and watch it go!

Option 2:

- Stand back and start pumping air into the bottle. As the pressure builds, your rocket will suddenly shoot up into the sky!

Try using different bottle sizes or changing how much water you put inside. What differences do you see?

Optional: How do real rockets get into space?

Visit this NASA website on your computer or tablet:
https://spaceplace.nasa.gov/launching-into-space/en/

It has a kid-friendly article and a great video explaining how rockets carry satellites and spacecraft high above Earth's atmosphere!

Instructions

Extension Activities

Task 1: Make Your Rocket Go Higher!

Try different things to see what makes your rocket fly the highest. You can test different amounts of air pressure or change how much water you put in the bottle. See what works best!

Task 2: Build a Bubble-Powered Rocket

Want to make another kind of rocket? You can build a paper rocket that launches using fizzing tablets. NASA has a fun activity with step-by-step instructions:

https://spaceplace.nasa.gov/pop-rocket/en/

Once you're there, check out the explanation at the bottom of the page to learn how the pop rocket works!

Reflection Questions

- What would you change to make this challenge even better?
- How could this rocket activity be used in real life?
- What science or engineering ideas did you notice while doing this challenge?
- If you try different bottle sizes: Does a small bottle or a big bottle fly higher?
- If you change how much water is in the bottle: Does it go higher with no water at all? Why or why not?
- What could you add or change on your rocket to make it fly higher or stay in the air longer?
- Can you guess how high your rocket goes? Could you figure out how fast it shoots off the launchpad?

Submission Guidelines

Submit a photo of your rocket setup.

Include a short summary explaining how your telescope works and answering each of the reflection questions to show what you learned from the activity.

The submission form is at the bottom of the following webpage: https://sciencechallenge.org.au/index.php/minor-challenges/

> **Note:** If you want to include yourself in the pictures of your Minor Challenge, make sure you ask your parent or guardian first to see if it's okay.

Learn More! Resources

Newton's third law of motion:
https://www1.grc.nasa.gov/beginners-guide-to-aeronautics/newtons-laws-of-motion/

The chemical reaction between baking soda and vinegar:
https://sciencenotes.org/chemical-equation-for-baking-soda-and-vinegar-reaction/

Bibliography

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- Science World. 2021. Pop Bottle Rocket, Part I: Action and Reaction - Science World. [online] Available at: <https://www.scienceworld.ca/resource/pop-bottle-rocket-part-i-action-and-reaction/> [Accessed 31 December 2021].
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