

Elementary Trades and ADST Projects at Home



Project: Bottle Rockets

Time required: 30 minutes to 1 hour

Theme: ADST, STEM, Physics and chemistry.

This outdoor activity is a fun way to introduce many physics concepts including Newton's Laws of Motion <https://www.ducksters.com/science/physics/> and is a great introduction to the world of chemistry. This lesson was modified from <https://frugalfun4boys.com/epic-bottle-rocket-flew-higher-2-story-house/> and <https://www.wikihow.com/Make-a-Baking-Soda-and-Vinegar-Rocket>

Grades: K-3 as an adult demonstration, 4-7 with adult guidance

Tools and Materials:

- 2 liter beverage bottle
- 3-Pencils or substitute with sticks
- Tape (duct, masking or electrical)
- 1-Cork that fits your bottle opening
- Paper towels
- Baking soda
- Vinegar
- Scissors
- Safety glasses

Procedure:

1. Gather your materials.



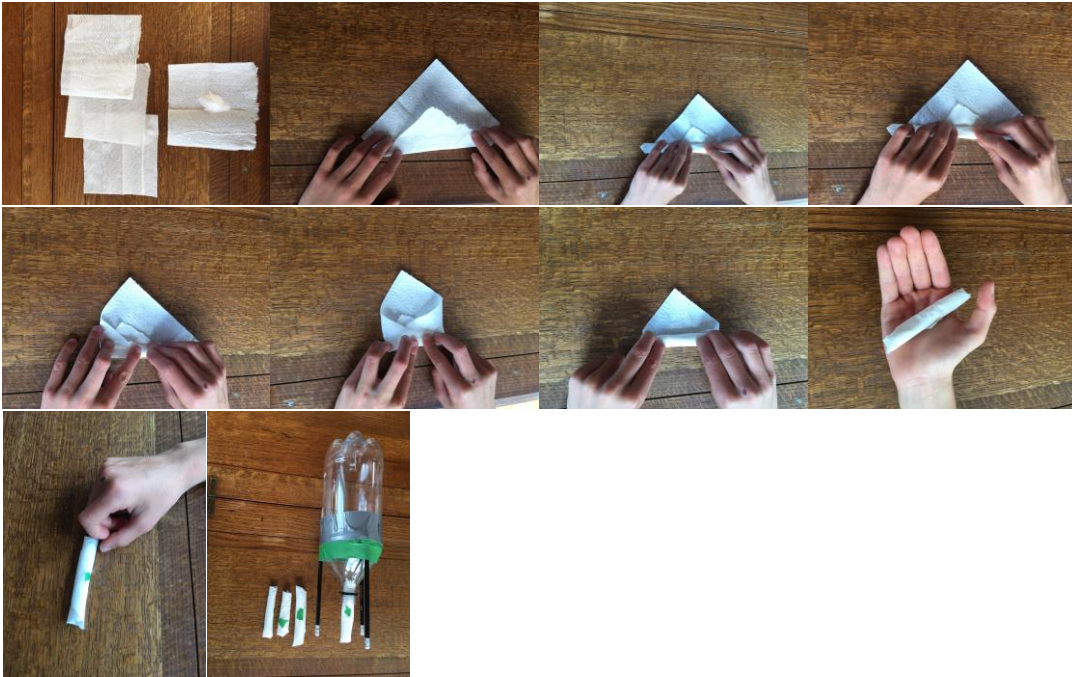
2. Create a launch pad with your pencils or sticks by taping them to your bottle. Ensure the pencils are spaced evenly around your bottle, and allow the bottle to stand perpendicular to the launch surface, with room for your cork to be pushed out, before using your tape to secure them.



Your launch pad pencils are adjustable by twisting under the tape to allow for final adjustments.

3. Prepare for launch outside by making your baking soda launch tubes. Cut small paper towel squares (roughly 6" x 6") and pour a small amount (roughly 1 teaspoon) of baking soda in the middle of one before folding like a spring roll.

<https://www.wikihow.com/Fold-a-Spring-Roll>



As you prepare for future launches you can increase the amount of baking soda in your launch packets but ensure you can fit them through your bottle opening. We added a small piece of tape to keep the launch tubes from unrolling.

4. While wearing safety glasses, in an open area outside, commence launch preparation by carefully pouring vinegar into your open rocket. Start with roughly $\frac{1}{2}$ a cup and experiment with more during the launches to come.



5. Get ready for countdown to launch, outside with safety glasses on, by adding a baking soda launch packet to the open bottle with vinegar, and quickly inserting your cork (not too far in) before flipping your rocket onto the launch pad pencils and carefully moving away from the launch area. You should have up to 30 seconds before launch so find a safe place to stand and count down!



The Science behind it:

<https://frugalfun4boys.com/epic-bottle-rocket-flew-higher-2-story-house/>

The baking soda and vinegar that we used in this bottle rocket create an acid/base reaction. Baking soda is sodium bicarbonate, and the chemical formula is NaHCO_3 . Vinegar, or acetic acid, is HCH_3COO . A baking soda and vinegar reaction is actually two parts. It happens so fast that we don't realize that it's actually two reactions. First, carbonic acid is formed. This quickly breaks down into water and carbon dioxide gas. The other product of the reaction is sodium acetate, which you can use to make [Hot Ice](#). All the CO_2 gas that is formed by the reaction creates pressure inside the bottle. The pressure builds up until it pushes the cork out of the opening of the bottle. Then WHOOOOSH! We have liftoff!

The rocket flies high because of Newton's 3rd Law of Motion, which states that for every action, there is an equal and opposite reaction. The CO_2 gas and liquid push out of the bottom of the rocket, which pushes the rocket upwards with great force!

Extensions:

- Experiment with measuring differing amounts of baking soda (measured in fractions of teaspoons) and vinegar (measured in fractions of cups), as well as varying the depth of your cork, during subsequent launches and record your results in the following chart. Height of launches can be estimated or measured with the use of a tape measure. What combination of ingredients gave you the best launch?

Baking Soda (teaspoons)	Vinegar (cups)	Launch Height (feet/meters)

- Try to concentrate the power of the jet that is created by this chemical reaction. We tried a dish soap bottle nozzle, which threaded onto the bottle nicely, but found that it became plugged quite easily. Can you think of a way to focus the jet



and allow for the free flow of the concentrated jet?

- Try building a water and air bottle rocket with a parachute by visiting <https://www.youtube.com/watch?v=p5mC0J5Yu-k> and compare the performance of the two types of rockets. Which worked better and why?
- Visit <https://www.youtube.com/watch?v=jb4CMnT2-ao> to expand your knowledge of the importance of chemical reactions to human development.

Assessment:

Visit <https://frugalfun4boys.com/epic-bottle-rocket-flew-higher-2-story-house/> and discuss the science behind it (above). Create a diagram to describe the reaction between baking soda and vinegar. Present your findings to your group.

Try to answer the following questions through group discussion.

1. Would larger or smaller bottles go higher?
2. Can we estimate how high the rockets go?
3. How could we measure and compare the heights of the different rockets?
4. How can we estimate or measure the speed of the rocket as it leaves the launcher?
5. How could we increase the pressure in the bottles before they took off?
6. How could we modify the bottles to get longer or higher flights?
7. What other chemical reactions do you know of that create this kind of power?

Resources and Links:

<https://frugalfun4boys.com/epic-bottle-rocket-flew-higher-2-story-house/> (vinegar and baking soda bottle rocket lesson)

<https://www.wikihow.com/Make-a-Baking-Soda-and-Vinegar-Rocket> (vinegar and baking soda bottle rocket lesson)

<https://www.science-sparks.com/making-a-bottle-rocket/> (water and air bottle rockets)

<https://www.scienceworld.ca/resource/pop-bottle-rocket-part-i-action-and-reaction/> (water and air bottle rockets)

<https://www.youtube.com/watch?v=jb4CMnT2-ao> (6 chemical reactions that changed human history)