DIY Bottle Rocket

What do I need?

- An empty plastic bottle (500ml or 1 litre water bottles work well)
- White vinegar
- Bicarbonate of soda
- Straws for legs
- A cork that fits tightly into the bottle
- Sticky tape
- A piece of kitchen roll
- A spoon

Skill Level:

Medium

Time

10-20 minutes

How do I do it?

1. Turn your bottle upside down and tape four straws onto it. The top should now stand about 2cm above the ground. Make sure that it is stable and doesn't fall over. Don't forget to decorate your rocket!
2. Tear off one piece of kitchen roll.
3. If you're using a 500ml bottle cut the piece of kitchen roll in half and place one dessert spoon of bicarbonate of soda in the middle. Carefully roll the kitchen roll and twist each end so the bicarbonate of soda is wrapped like a sweet. If the paper starts to unroll dampen your finger ends and twist the paper again but be careful, don't make it too wet. If you're using a 1 litre bottle, do the same, except use a full sheet and two spoonfuls of soda.
4. Pour vinegar into the bottle until it is 1/4 full. Screw the top on until you are ready.
5. Take everything outside. Find some level ground and test that your rocket stands up steadily.
6. Your rocket will shoot up quickly so you will need to stand well back; five adult paces (5 metres) should be sufficient.
7. One adult will be the launcher. Turn the bottle so the screw top is upwards, take off the top and put to one side. You will need to do the next bit quickly. Slide the package of bicarbonate of soda you made earlier into the bottle containing the vinegar, holding the bottle as steadily as you can. Quickly push the cork firmly into the bottle. Turn the bottle over and carefully place it on the launch pad. Move back 5 paces as soon as you can and watch the launch.

Continued overleaf

DIY Bottle Rocket (continued)

Safety Advice:

IMPORTANT GENERAL SAFETY NOTE FOR SUPERVISING ADULTS. This Terrific Scientific investigation has been devised so that with adult supervision, reasonable care and by following the instructions provided, no special safety equipment or knowledge is required to enjoy the experience safely. These safety reminders are designed to assist the supervising adult when planning and carrying out the investigation. Please read the instructions fully before starting.

- Everyone should be at least 5 adult paces, about 5 metres, away when the rocket is launched.
- Wash hands thoroughly after handling the vinegar.
- Replace the vinegar bottle top as soon as you've taken the vinegar you need.
- As the rocket takes off some vinegar will spray out. If any goes onto clothes wash off immediately with water.
- Throw a bucket of water over the launchpad when you have finished to wash away any vinegar.

What's Happening? The Sciency Bit:

Vinegar is acetic acid dissolved in water. Bicarbonate of soda is a base called sodium bicarbonate. Initially the reaction makes carbonic acid but this quickly breaks down into carbon dioxide and water. The cork initially stops the carbon dioxide from escaping, but the pressure builds up until it pops the cork and the water and gas escape. As the contents of the bottle shoot downward, the bottle itself shoots upward demonstrating Newton's Third Law of Motion: "for every action, there is an equal but opposite reaction".

The force of gravity has an effect as it is pulling the rocket down; but the pressure of the gas is pushing against gravity so the rocket goes up. As the gas runs out, gravity takes over again and pulls the rocket back to Earth.

What shape will make the rocket go even higher? Why not try streamlined shapes and reduce the force of friction. Look at a real rocket taking off. Can you improve the design of your bottle shape?

My Rocket Didn't Take Off... What Can I Do?

Do not go to the rocket to investigate. If it does not take off there may be several causes. The first thing to do is wait a while, it may be slowly building up pressure. If it has not taken off after a few minutes throw an old coat or large piece of strong cloth over the rocket. Keeping it at arm's length and with the cloth completely covering the bottle, pull the cork out over a drain and let the contents run away safely.
Possible reasons;

- The cork was not a tight fit, this allowed the gas to escape so there was no pressure build up.
- The cork was pushed in too firmly.
- Your vinegar is old and is no longer acidic. Try fresh vinegar.
- The bicarbonate of soda was wrapped too tightly and the package didn't open up.
- There was either too little vinegar or too little bicarbonate of soda.
- Or a combination of the above.