

Questacon at HOME

Activity Sheet – Invisible Fire Extinguisher

Invisible Fire Extinguisher

Background

Chemical reactions occur when two or more substances combine to create brand new products! You can create a chemical reaction in your own kitchen by combining bicarb/baking soda with vinegar. The bubbles you see during this reaction are full of newly formed carbon dioxide gas. Carbon dioxide gas has lots of interesting properties! In this experiment, we will explore its ability to extinguish a flame.

Materials

- A jug
- Bicarb soda
- Vinegar
- Teaspoon
- Small flame, such as:
 - Tealight candles
 - Matches

Safety

Take care with naked flames – avoid touching hot objects, remove flammable materials from the area and don't leave burning flames unattended. Operate in an open space.

Supervision is recommended at all times

Procedure

1. Combine one teaspoon of bicarb soda and half a cup of vinegar in the jug.
 - What do you observe?
2. Leave the jug undisturbed while most of the bubbles pop
 - Can you see anything in the jug?
3. Light your small flame
4. Carefully 'pour' the jug over the flame, making sure not to pour any of the liquid out
5. Observe what happens to your flame!

Tips and Tricks

- Placing the jug over the sink or a plate can help catch any overflow of bubbles
- Mix the bicarb soda and vinegar carefully. If you stir the mixture too vigorously or leave the mixture for too long, the carbon dioxide will escape the jug.
- Putting tealight candles inside a bowl or a glass can help to direct the carbon dioxide gas onto the flame before it disperses.
- Cooking or baby oil is helpful for removing any spilt wax, particularly from glass. This can be followed by hot water and detergent.



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What's the Science?

The chemical reaction between vinegar (acetic acid) and bicarb soda (sodium bicarbonate) produces carbon dioxide gas, water and a salt called sodium acetate. On its own, carbon dioxide is 1.5 times denser than the air around us, so it will stay inside the jug for a short amount of time.

But why does carbon dioxide extinguish a fire?

For a fire to burn, it must have:

1. A fuel (e.g. wood, petrol)
2. An oxidising agent - usually oxygen from the air around us
3. Heat

If any of these components are removed, the fire will extinguish. In this experiment, the dense carbon dioxide displaces the oxygen-rich air surrounding the flame, effectively suffocating it.

What questions should I be asking?

Before the experiment

Establish what you already know

- What does a fire need to burn?
- What is the fuel from a candle? (It's actually not the wick!)
- Where is the oxygen?
- What is a chemical reaction? What other types of chemical reactions can you think of?

If anything unexpected occurs, ask yourself why did that happen? How would you further test your ideas? All ideas are good ideas.

During the experiment

Make predictions and form hypotheses

- What do you see when the bicarb and vinegar are mixed? What's happening?
- What do you think will happen when the carbon dioxide is poured onto the flame?
- Why did the flame go out?

Co-design extension experiments

- Phone a friend! What is a different way to put out a candle? What of the three essential things for fire has been taken away?

What's Next?

- If you have a container with a narrow opening, such as a soft drink bottle, you can use the carbon dioxide gas created by this reaction to fill up a balloon. Try comparing this to a balloon filled with regular air. Do they feel the same? Do they fall to the ground at the same rate?
- How many candles can you extinguish with one jug of CO_2 ?
- What if you place them all in a bowl first?
- If you use matches instead of candles, try 'dipping' the flame into the jug. Try this with an empty jug as well - is there any difference?

