



national science week 2023

DIY Science – Thoughtful Fun with Fire

Impress your friends by re-lighting a candle and putting out a flame using invisible gas.

Safety

An adult must supervise and assist with any activities that use fire. Activities should be carried out in a safe indoor area (e.g. kitchen) or in a sheltered outdoor area away from flammable materials. Do not do fire activities outdoors if there is a total fire ban in your area. Blow out the candle flame after each activity and never leave the lit candle unattended.

What you need

Bucket of water, small candle (e.g. tea light candle), heat-proof surface, matches or lighter, small jug, white vinegar, teaspoon, sodium bicarbonate, ruler, aluminium foil

What to do

Have a bucket of water close by in case you need to put out a fire. Record your results on the next page.

Part A: Observing a candle flame

Place the candle on the heat-proof surface and light the candle using the matches or lighter. Observe the candle for several seconds. What can you see? The solid candle wax close to the flame melts and turns into a liquid. Some of the liquid moves up the candle wick and gets even hotter, turning into wax vapour, which is a gas.

Part B: Re-lighting a candle

NOTE: This activity will not work if there is any wind.

1. Light the candle and let it burn for 10 seconds.
2. Light a match/lighter, quickly blow out the candle, and place the match/lighter flame above the wick to ignite the gas coming off the wick. The flame should jump down to the candle wick, re-lighting the candle. It can take a bit of practice to get it to work.



How high can you hold the match/lighter flame above the wick to re-light the flame?

Part C: Pouring carbon dioxide gas

1. To the small jug, add about 50 mL white vinegar.
2. Leaving the jug sitting on the workbench, add 1 teaspoon sodium bicarbonate to the white vinegar in the jug and watch as a chemical reaction produces bubbles of carbon dioxide gas.
3. Leave the jug sitting on the bench until it stops bubbling.
4. Light the candle and slowly pick up the jug and pour the invisible carbon dioxide gas from the jug over the candle flame to put out the flame. Do not pour out any of the liquid.
5. Repeat the activity, but this time, make a ramp out of aluminium foil and pour the carbon dioxide gas down the ramp to extinguish the flame. How long can you make the aluminium foil ramp and still put out the flame?





What's happening?

Fire is a 'combustion' reaction and it requires three things: fuel, oxygen, and heat. The combination of these three things is known as the 'fire triangle'. In the burning candle, the fuel is wax vapour, the oxygen comes from the surrounding air, and heat came from the match or lighter when it was lit. Blowing out a candle destroys the fire triangle by removing the fuel and heat as it pushes the hot wax vapour away from the wick.

The chemical reaction between sodium bicarbonate and the acetic acid in vinegar is an acid-base reaction. One of the products of the reaction is carbon dioxide gas. The jug in the Part C activity fills with carbon dioxide gas, which is heavier than the mixture of gases in air, so the carbon dioxide gas will remain inside the jug if it is left to sit for a short time. When the carbon dioxide gas is poured out of the jug, the gas falls down towards the candle flame and extinguishes the flame. The carbon dioxide gas pushes the air out of the way. This destroys the fire triangle because there is not enough oxygen gas to keep the fire burning.

Results

| Activity | Question | Answer |
|---------------------------------------|---|--|
| Part A: Observing a candle flame | List the solid, liquid and gas parts of the burning candle | Solid: _____ Liquid: _____ Gas: _____ |
| Part B: Re-lighting a candle | How high can you hold the match/lighter flame above the wick to re-light the flame? | Test 1: Distance above wick _____ Test 2: Distance above wick _____ Test 3: Distance above wick _____ Highest distance above candle wick: _____ |
| Part C: Pouring carbon dioxide gas | How long can you make the aluminium foil ramp and still put out the flame? | Test 1: Length of foil ramp _____ Test 2: Length of foil ramp _____ Test 3: Length of foil ramp _____ Longest ramp: _____ |

Did you know?

Eucalyptus trees contain a lot of oil and the oil is flammable. The oil vaporises as it burns, and the hot gases that result from the fire can rise up through the air and carry burning embers for kilometres, starting spot fires in front of the main fire. Some plants, like the *Banksia*, need fire to release their seeds, and the chemicals in bushfire smoke act as a signal to the seeds that conditions are good for the seeds to start growing.

Find out more

- Discover how scientists at Murdoch University in Western Australia are researching the effect of fire and smoke on *Banksia* woodlands: <https://bit.ly/41ah3CW>
- See how fire is used for traditional land management in Arnhem land to prevent large bushfires: <https://ab.co/43DDx0A>
- Learn how fire extinguishers work: <https://bit.ly/3 ofjg1b>