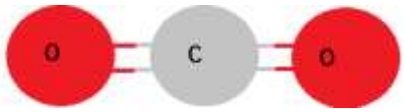
What is Carbon Dioxide? TEACHER'S NOTES

Curriculum links
Science – Compounds and their properties

Three experiments for demonstration and experimentation to explain what carbon dioxide is.



Carbon dioxide

Carbon dioxide (chemical formula **CO_2**) is a colourless, odourless gas vital to life on Earth. This naturally occurring chemical compound is composed of a carbon atom covalently double bonded to two oxygen atoms.
The carbon cycle is a complex system where CO_2 is exchanged between 4 main regions of the planet. CO_2 is recycled through the biosphere, geosphere, oceans and the atmosphere.

The biosphere is made up of plants and animals. Plants take in CO_2 and give off oxygen as a waste product. Animals do the opposite. Deforestation, reforestation, and increases and decreases in populations of animals – including humans – all affect the carbon cycle on land.

The geosphere includes the Earth's interior, rocks and minerals, landforms and the processes that shape the Earth's surface, such as weathering and erosion. Carbon that was locked away in rocks and fossils long ago is released as a result of natural weathering.

The oceans at the North and South Pole trap huge amounts of CO_2 in the water where it is dissolved at low temperatures. CO_2 is also stored in the shells of sea organisms. This so called carbon 'sink' can hold CO_2 for millions of years: if the shells are turned into limestone for example.

The burning of fossil fuels for transportation and electricity production is producing an imbalance to this natural cycle. The oceans cannot absorb the gas quickly enough so the amount of CO_2 in the atmosphere is steadily increasing. The gas is collecting in the upper atmosphere and trapping the sun's rays, preventing them from re-radiating back into outer space. Just like a greenhouse in the height of summer the earth is gradually warming up.

Aim

- Students find out about CO_2 gas - how it is made and what it can do.

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A Word of Caution

- The materials used for these simple experiments are generally low risk but care should be taken so that none of them, or the foam produced, get onto clothes or into student's eyes.
- Wear kitchen gloves.
- If a food dye is used, make sure it is non-toxic and take care that it does not stain clothing.
- A bowl will help to prevent any foam getting onto surfaces.
- To dispose of the materials, place the bowl and contents into a sink.
- Wait for the reaction to complete.
- Rinse the equipment thoroughly and flush the foam down the sink with copious amounts of water.

Resources

Carbonated drink in bottle, Alka-Seltzer or other 'fizzy' antacid tablet, baking soda, a beaker or glass, washing up bowl, empty plastic drinks bottle (or similar), washing up liquid, beaker and vinegar, 2 balloons and a small empty drinks bottle, teaspoon and tablespoon

Timing

45 minutes – 1hour

Outcomes

Gifted and talented students will be able to explain how CO_2 is released from an alkali by the addition of an acid. Other students will be able to describe the experiments and say that CO_2 is a colourless, odourless gas.

Tasks

1. Making CO_2 from a fizzy drink.
2. Making CO_2 with an Alka-Seltzer.
3. Make a baking soda volcano.
4. Does CO_2 have mass?

1. CO_2 from a fizzy drink (Demonstrate)

Demonstrate the CO_2 gas that is dissolved in a fizzy drink by simply shaking and opening a new bottle of fizzy drink. To prevent sticky splashes this experiment could be done with carbonated water. As the CO_2 'escapes' out of the liquid it causes the bubbles and froth and makes a hissing sound. It can be demonstrated that the bubbles contain a light gas by adding a handful of raisins to a bottle of fizzy drink. The bubbles attach to the rough surface of the fruits and carry them up to the surface. When the bubbles burst, the gas is released and the raisins fall back to the bottom to collect more bubbles and rise again. Students can observe that CO_2 is colourless and odourless.

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2. CO_2 with an Alka-Seltzer

Break Alka-Seltzers in half and ask the students to drop the antacid tablet into a glass or beaker of water. The antacid tablet contains sodium bicarbonate and this releases CO_2 as it dissolves. Students can see the fizzing and the bubbles produced which are full of CO_2. Antacid tablets are generally low-risk but, as with any medication, care should be taken to ensure that students do not take any tablets or drink the solution.

3. Baking soda volcano

Baking soda, is bicarbonate of soda (an alkali). It will react with vinegar (acetic acid) to produce CO_2. If a small amount of washing up liquid is added to the mixture it forms a long lasting foaming froth.

I) Place two teaspoons of baking soda into a clear, plastic drinks bottle.
II) Place the bottle into a bowl to collect the foam that spills out.
III) Mix ¼ of a cup of vinegar with a few drops of washing up liquid. Food colouring can also be added for greater effect.
IV) Add the vinegar mixture to the bottle and watch the foaming 'lava' that erupts.

The sodium bicarbonate is reacting with the acidic vinegar to produce CO_2 gas. The washing up liquid then froths up. The bubbles contain CO_2. The plastic drinks bottle can be made to look like a volcano by either using card made into a cone shape or by using wet sand.

4. Does Carbon dioxide gas have mass? YES or NO?

Half fill a cup with fizzy lemonade and weigh it. Carefully stir the lemonade until it goes flat and weigh it again. Will the cup of flat lemonade be heavier or lighter than the fizzy lemonade?

The fizzy lemonade has carbon dioxide dissolved in it. Flat lemonade is lighter than fizzy lemonade and the difference in the weight is the mass of CO_2 that has been lost to the atmosphere.

Another way to see the mass of carbon dioxide is to fill a balloon with CO_2. Put half a teaspoon of bicarbonate of soda into a small bottle and add 2 tablespoons of vinegar. Put the mouth of the balloon over the top of the bottle and shake. Collect the CO_2 that is produced. Using a balance scale hang the filled balloon up at one end and blow up a second balloon using a balloon pump which can be hung from the other end. CO2 is heavier than air.

Worksheet

There is no worksheet for this activity. However, teachers may want to ask their students to write up these experiments, noting method, observations and results.

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