WithOnePlanet

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Introduce

Lesson 1
Teacher notes
Carbon – a reactive element

Years 9 to 10

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INQuIRY

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Open education
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Carbon – a reactive element

Lesson 1: Teacher notes

This document provides the teacher with the details of the lesson.

At a glance

To capture students' interest and find out what they think they know about common chemical reactions and processes involving carbon, the different molecular forms it can take, and the different global spheres it occupies (including the biosphere, hydrosphere, lithosphere and atmosphere).

To elicit students' questions about chemical reactions and processes involving carbon.

Students:

> predict, observe and try to explain (POE) what is happening during the three carbon chemistry demonstrations
> record what they think they know about carbon as an element, a molecule and a key component of the Earth and of life
> discuss these understandings with others, including the reasons they have for these understandings
> summarise the key understandings of the class using a number of different thinking routines.

Lesson focus

The focus of the *Introduce* phase is to spark students' interest and engagement, stimulate their curiosity, and elicit their existing beliefs about the topic. Students' existing ideas and questions can then be taken into account in future lessons.

Assessment guide

Diagnostic assessment is an important aspect of the *Introduce* phase. In this lesson you will elicit what students already know and understand about the basic elemental structure of carbon and the relevant properties of carbon, including its ability to react with other elements.

Key lesson objectives

Science

Students will be able to represent their current understanding as they:

> predict the behaviour of carbon molecules in chemical reactions
> observe the behaviour of carbon molecules in chemical reactions
> attempt to explain the behaviour of carbon molecules in chemical reactions
> summarise the general properties of carbon-containing molecules.

Literacy

Students will be able to:

> contribute to discussions about the behaviour of carbon-containing molecules
> record predictions, observations, explanations and ideas using words, drawings or photographs.

Teacher background information

> See *POE demonstrations – Teacher notes* document for background details of each of the three practical demonstrations that are included in this lesson.

Equipment

For the Teacher demonstrations

> See pages 4–6 of this document for details of the equipment required.

For the Class

> See *Student observation activity: Where on earth is carbon?* for details of the equipment required.

For each Student

> *POE demonstrations - Student worksheet*.
> Approximately 10-15 sticky notes per student with more available if a student requires them.
> Coloured pencils.

Teacher preparation

> Read through pages 4–6 of this document, familiarise yourself with the safety precautions, prepare all the equipment and conduct a test of each demonstration in advance of the lesson.
> Provide each student with a copy of the *POE demonstrations - Student worksheet* that accompanies these demonstrations.
> Read the student worksheet called *Student observation activity: Where on earth is carbon?* and prepare all the equipment.

Lesson steps

Activity 1: What do all these chemical reactions have in common?

(Accompanying documents: pages 4–6 of this document and *POE demonstrations – Student worksheet*.)

1. Explain to students that they are about to observe the following three experimental Predict, Observe, Explain (POE) demonstrations:

   Blowing out candles; Burning magnesium in dry ice (Dry ice bubbles); Sugar snake.

For each of these demonstrations students are to use the *Student worksheet* to do the following:

a. *Predict* what they think will happen when the experiment is conducted.
b. *Observe* what is happening during the experiment (Explain to students that observation involves as many of the 5 senses as is appropriate, not just sight!).
c. Try to *explain* the science behind what they observed.

2. Conduct each of the experiments, pausing for students to write their responses for the relevant section of the *Student worksheet*.
3. At the conclusion of the three demonstrations, pose two questions:
   a. Were these three experiments examples of chemical reactions? If so, why? (What features identify them as chemical reactions?)
   b. In what other ways were these chemical reactions similar?

   Generate a list of student responses on the board.

   Facilitate discussion of the scientific accuracy of these responses by asking questions such as 'Do you agree?'; 'Why/why not?'
4. Students may arrive at the answer that carbon (in various forms) is involved in all three chemical reactions, either as a reactant or a product.
5. Ask students, 'What form do you think the carbon takes in each of these chemical reactions?'

   (Possible answers may include – molecule, element, mixture, carbon dioxide, pure carbon, etc.) Facilitate a discussion of student responses and whether others agree with them or not.
6. Generate two *untitled* lists on the board to summarise student responses:

   List 1 – Include all student responses about the different forms carbon can take.

   List 2 – Include all examples of different elemental and molecular forms of carbon (e.g. carbon dioxide, diamond, etc).

   Ask students what the titles to the two columns are and facilitate a discussion in order to reach a conclusion about the two titles.
7. Ask students whether they know of any other:
   a. Forms that carbon can take.

      Ask students in what **state of matter** these different forms of carbon exist in normal environmental conditions (e.g. room temperature).
   b. Chemical reactions involving carbon.

      NOTE: These reactions don't necessarily need to be conducted in a science lab; they can be everyday reactions, such as burning (i.e. combustion) or cellular respiration in living things.

Activity 2: Where on earth is the carbon? Student observation activity

(Accompanying document: *POE demonstrations – Student worksheet*, pages 10–18)

1. Distribute the equipment for this activity around the room.
2. After noting the safety guidelines on their *Student worksheet*, students are to move around and observe the different forms.
3. Students are to complete their *Student worksheet* using each of the different forms.

Carbon – a reactive element

POE demonstrations – Teacher notes

(Predict, Observe, Explain)

Activity 1: Blowing out candles

What you will need:

- tall glass jar
- large glass jug
- 100mL vinegar
- 2 tablespoons of sodium bicarbonate (baking soda/bicarb soda)
- candle
- matches

Safety:

Refer to the Material Safety Data Sheets for both vinegar and sodium bicarbonate before use. (Data sheets provided by suppliers at time of product purchase.)

Complete a practice run of this demonstration before showing it to the students.

What to do:

1. Light a candle and place it in a glass jar.
2. To make carbon dioxide gas, mix together two tablespoons of baking soda with some vinegar in a large glass jug.
3. Once you have enough gas produced, carefully pour the gas (but NOT the liquid!) over the lit candle.

You can see this experiment in action here: http://www.trueactivist.com/15-awesome-chemistry-gifs/

The science:

A candle needs three things to keep burning. The first is basic fuel, which is provided by the paraffin wax drawn up through the wick. Another is heat, which is provided first by a match, and then by the burning of the candle itself. The most effective way of putting out a candle, or any flame, is by taking away its oxygen. Carbon dioxide is a heavy molecule, heavier than the oxygen in the air. As the carbon dioxide replaces the air (including oxygen) surrounding the candle, the candle's oxygen supply will be cut off and the flame will go out.

Carbon – a reactive element

POE demonstrations – Teacher notes

(Predict, Observe, Explain)

Activity 2: Dry ice bubbles

What you will need:

- medium-sized glass mixing bowl with a rim
- small glass mixing bowl
- liquid soap or detergent
- 30 cm by 5 cm strip of absorbent cloth (cut up t-shirts work well)
- warm water
- 3–5 small pieces of dry ice, approx. 5cm^3
- thick heat-proof gloves and safety glasses

Safety:

- Refer to the Material Safety Data Sheet for dry ice before use. (Data sheets provided by suppliers at time of product purchase.)
- Wear thick gloves and safety glasses during the experiment.
- NEVER place dry ice in a completely enclosed container.

What to do:

1. Half fill each glass bowl with warm water.
2. In the small bowl, add a good squirt of liquid soap or detergent and stir it up.
3. Keep the rim of the medium bowl wet with plain water using your fingers.
4. Add the dry ice to the medium bowl.
5. Dip the cloth into the soapy water to get it wet but not dripping wet. Pull the cloth strip so that it is taut and pass it across the entire rim of the medium bowl to create a soap bubble 'skin' over the bowl. It may take several tries – don't give up!
6. Once you get it, the bubble will expand as gas is released and it will rise to create a large bubble sphere.

For step by step instructions with images see this website: http://www.sciencebob.com/blog/?p=923

The science:

Instead of the dry ice just bubbling in the water to make a cloud, the soap in the water traps the carbon dioxide and water vapour in the form of a bubble. The bubbles climb out of the container of warm, soapy water and explode with a burst of 'smoke' (carbon dioxide) as they crawl over the edge of the bowl.

Carbon – a reactive element

POE demonstrations – Teacher notes

(Predict, Observe, Explain)

Activity 3: Sugar snake

What you will need:

- 100 or 150mL measuring cylinder (tall form)
- sugar (sucrose) to fill beaker to about 1/3 full
- concentrated (18 M) sulphuric acid
- glass stirring rod
- glass pneumatic trough in which to stand the measuring cylinder
- gloves and safety goggles

Safety:

- Refer to the Material Safety Data Sheets for both sucrose and sulphuric acid before use. (Data sheets provided by suppliers at time of product purchase.)
- This experiment should ONLY be conducted in a fume cupboard, as the fumes produced are composed of sulphuric acid.
- Gloves and safety goggles should be worn throughout the experiment.

What to do:

1. Add the concentrated sulphuric acid to the beaker until it just covers the sugar and mix with the stirring rod. (You may need to add a little more sulphuric acid if the mixture doesn't start to heat up.)
2. Stop stirring when you feel the beaker heating up and close the lid of the fume hood.
3. The reaction takes about 5 to 8 minutes to start reacting fully.
4. The result should be a nice column of graphite.
   You can see this experiment in action here: http://ww.youtube.com/watch?v=AP6rTJi59NM

The science:

When sugar (sucrose) is mixed with sulphuric acid it produces pure carbon and water vapour (steam). The carbon that is produced forms a steaming tower that is a mixture of solid carbon powder and steam. The tower pushes itself out of a container, resembling a black snake. The reaction also smells like burnt sugar.