WithOnePlanet

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Investigate

Lesson 4
Teacher notes
The carbon detectives

Years 5 to 6

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INQuIRY

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The carbon detectives

Lesson 4: Teacher notes

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

At a glance

To provide students with hands-on, shared experiences of:

> the different forms that carbon can take in the different spheres of the carbon cycle and the transfer of energy between these spheres

> the way that humans can manipulate the energy transfers of the carbon cycle to generate electricity and heat.

To support students to represent and explain their understanding of the energy transfers within the carbon cycle, and the generation of electricity and heat from these energy transfers.

Activities:

1. Carbon in the sea, carbon on the land

Students:

Investigate a range of different forms that carbon can take in different spheres of the carbon cycle.

2. Up in flames!

Students:

Investigate how trees are made of carbon and how this carbon can be released back into the atmosphere through burning.

3. Carbon is electric!

Students:

Investigate how carbon can be released from plant material and used to generate energy and electricity.

INQuIRY focus: **Investigate**

The *Investigate* phase is designed to provide students with hands-on experiences of the science phenomenon. Students explore ideas, collect evidence, discuss their observations and keep records, such as science journal entries. The *Investigate* phase ensures all students have a shared experience that can be discussed and explained.

In the *Investigate* phase, students develop a literacy product to represent their developing understanding. They discuss and identify patterns and relationships within their observations. Students consider the current views of scientists and deepen their own understanding.

Assessment guide

This assessment guide supports teachers in identifying the types of assessment that are appropriate for this lesson.

Formative assessment is an important aspect of the *Investigate* phase. It involves monitoring students' developing understanding and giving feedback that extends their learning. It involves monitoring students' developing understanding of:

> the forms that carbon takes within the carbon cycle and the energy transfers that occur in the carbon cycle and that can be manipulated to produce electricity.

You will also monitor their developing science inquiry skills.

Summative assessment of the science inquiry skills is another important focus of the *Investigate* phase. Rubrics can be used to gauge the level of student achievement on performance tasks.

Key lesson objectives

Science

Students will be able to:

> observe and measure the amount of carbon in a variety of different naturally-occurring compounds

> construct an electrical circuit from a carbon-based life form and view an experiment showing an energy transfer between two different spheres of the carbon cycle

> understand that carbon exists in many different forms on the Earth and that humans can manipulate transfers between these spheres to produce electricity.

Literacy

Students will be able to:

> contribute to discussions about carbon's role in the carbon cycle and electricity production

> record ideas, descriptions and explanations in diagrams and words in a variety of written modes including experimental report templates.

This lesson also provides opportunities to monitor the development of students' general capabilities.

Teacher background information

The carbon cycle is one of the essential elemental cycles to sustain life on Earth. Most of the chemicals that make up living tissue contain carbon. When living things die, the carbon is recycled and can then be used in other processes in other parts of the cycle.

Carbon moves between four main spheres, or components, of the Earth - the living sphere, or biosphere, the atmosphere (the air), the hydrosphere (the water) and the lithosphere (the soil).

In each of these spheres carbon exists in different types of compounds. Carbon is able to move between these spheres as a result of specific processes that occur on the Earth.

Carbon enters the atmosphere as carbon dioxide from cellular respiration, which occurs in all living things, and combustion (or burning). It can also be removed from the atmosphere via the process of photosynthesis, which occurs in plants and a small number of other living things. The carbon in carbon dioxide is used by these living things to make carbohydrates (or sugars).

When animals feed on plants, most of the carbon they consume is used in the process of cellular respiration to produce energy for daily activities. The carbon itself is then exhaled as carbon dioxide.

These animals and plants eventually die and the dead organisms are eaten by decomposers, such as fungi and bacteria. The decomposers are able to return the carbon from the dead bodies to the atmosphere as carbon dioxide. In some conditions, decomposition is blocked and the plant and animal material may then, over millions of years, form fossils, ultimately to be made available as fossil fuel for future combustion by humans.

In the sea, marine animals may convert some of the carbon in their diet to calcium carbonate which is used to make their shells. Over time, the shells of dead organisms collect on the seabed and form limestone. Owing to Earth's movements, this limestone may eventually become exposed to the air where it's weathered, allowing the carbon to be released back into the atmosphere as carbon dioxide. Volcanic action may release carbon dioxide from the lithosphere back into the atmosphere.

Session 1: Carbon in the sea, carbon on the land, carbon and fire

(Includes aspects of the *Carbon futures* program)

Equipment

For the Class

- a collection of shells
- tap water
- universal indicator solution
- a soda siphon and carbon dioxide cartridge
- a group of trees (approximately 20 or more) of the same species in a small geographical area
- a tape measure
- numbered flags (from 1 – 20 or more) on stakes (for identifying the trees that will be measured)
- access to the North Sydney Carbon Calculator website: <http://www.northsydney.nsw.gov.au/carbon/carbon.html>

(This part of the task can be completed at any time after the tree measurements are taken.)

- an area of forest that shows signs of recently being burnt and an area of forest without any recent signs of fire (alternatively, you can use photographs of two such areas as available in Appendix A at the end of this document).

For each Student

- Refer to *Carbon fieldwork Student worksheet* for all required equipment.

Preparation

- Carbon fieldwork student worksheet:
  - Read through the student worksheet.
  - Prepare all of the equipment.
  - Check that the carbon calculator website is working.

Lesson steps

1. Take students to planned location.
2. Students to complete all of the tasks outlined in the *Carbon fieldwork Student worksheet*.

Session 2: Carbon is electric! (An experiment)

Equipment

For the Class

> Access to the *Burning a peanut* video demonstration

For each Student

For the *Carbon is electric!* experiment:

> a 2 cm piece of thick copper wire or a 2 cm x 3 cm flat sheet of copper*
> a galvanised iron nail
> a sheet of coarse sand paper
> one lemon
> a voltmeter or multimeter (set to measure voltage)*
> an LED*
> 2 alligator clips*

*If your school does not already have the specialised equipment required, it can be purchased relatively cheaply and easily from science educational supply companies (such as Wiltronics or Jaycar), many of which have online purchasing available.

> Each student will require a copy of the *Carbon is electric!* Student worksheet.

Preparation

> For the *Making a fruit battery* activity:
  – Read through each Student worksheet
  – Familiarise yourself with the safety precautions
  – Prepare all the equipment
  – Conduct a test of each demonstration in advance of the lesson

Lesson steps

1. Explain to students that, as well as the movement of carbon between different parts of the carbon cycle, energy can also be transformed from one form into another. Sometimes when carbon moves this can cause energy to change forms (for example, from chemical energy in sugar to heat energy).
2. Ask students for an example of this from the previous session (*Carbon in the sea, Carbon on land, Carbon and fire*). Combustion (i.e. setting something on fire) is a good way to release the chemical energy stored in a material. It is transformed from chemical energy into the heat energy, light energy and sound energy of a fire. Show students the *Sankey* diagram of the energy transformations involved in a fire in the introduction section of the *Carbon is electric! Student worksheet.*
3. Explain to students that they are going to complete an activity that transforms the chemical energy in a fruit into electrical energy. They are also going to watch a video of an experiment that converts the chemical energy in a peanut into heat energy.
4. Students to complete all of the tasks outlined in the *Carbon is electric! Student worksheet*.

Source:

North Sydney Council 2013, *North Sydney Council Carbon Calculator*, viewed 18 December 2013, <http://www.northsydney.nsw.gov.au/carbon/carbon.html>.