Chemistry in and from the forests

Concluding the series on IYF and IYC in Otherways by Jeanie Clark

Do you and your children marvel at the myriad of forms, shapes, scents and colours of trees, shrubs and other plants that abound in the forests, gardens, roadside vegetation and nurseries from late Winter? Do you also marvel at such variety in Carbon-based life forms? What about the creatures that are based on these through the food web? What about other things from forests and/or from Carbon? This article will cover such things, using mostly online education resources.

Spotting Carbon in our world

But let's start with a field visit for teaching appreciation of Carbon-based life forms. As you walk with your children around a forest, or garden, challenge them to 'spot the C-based life forms', or with younger children living versus non-living things. How many species can they find? When you find something dead, discuss where the Carbon goes, and hence is it still a Carbon-based life-form? For older children, extend from C-based life forms to spotting things that contain Carbon, researching the Carbon cycle and man-made goods.

This can also be done with photos – on computer, in coffee table books, in photo albums or from old calendars. The complexity should be appropriate for your child's level and what can be usefully seen in the image. For example, the photo below is of the River Red Gum woodland, at Lake Hindmarsh's Four Mile Beach reserve, which is also a camping ground. As it shows living, dead and man-made things, it could be used to make lists by the three levels above: living and non-living objects; Carbon-based life forms; or materials which have some Carbon in them.

What materials contain Carbon in the above scene?

- air - from the gas CO_2.
- plants – living and dead, from trees to ground cover, all store Carbon (see IYF article in Otherways 129)
- soil – Carbon from decayed plants is in the grey silt soil where the trees grow, but not in the white sand.
- People – and other creatures present, but hidden or too small to see - are Carbon-based life-forms.
- Buildings would require thought as their outside may be concrete but when you go inside … there are timber doors on the cubicles! Timber comes from… trees.
- Cars and caravans are made mainly of metals, plastics, and rubber. Where do these materials come from? Do they contain Carbon? Time for research?

Carbon in man-made products

Carbon stored in forests remains in the timber when it is used to manufacture goods. A field trip to a hardware store, into the section for building supplies can be quite mind boggling as to the many forms of timber we have available, and pleasurable for its smell. For teaching activities on the manufacture of timber products the "Forest learning" website has a comprehensive range as PDFs.

Themes at www.forestlearning.edu.au are:

- What is a forest?
- What is the role of forestry?
- Why is wood renewable and sustainable?
- How do forests and wood products store carbon?
- What is sustainable forest management?
- How do you produce wood products?
- What is the future?

nb the '.au' means it is an Australian website.

Did you know plastic comes from oil? What about where oil comes from? Does it come from Carbon? A useful teaching website for oil is The World of Oil by the Paleontological Research Institution, found at http://www.priweb.org/ed/pgws/index.html The section on 'Hydrocarbon systems' explains how oil is formed. The title reveals that plastics do have Carbon in them. Dig deeper to find if oil is from forests. The section on Daily uses of oil can be used to 'spot Carbon from oil' in our homes, as it is a coloured- coded diagram.

What about the steel used for vehicles and buildings? There are many types of steel, partly graded by how little Carbon they contain. The path of Carbon in steel-making can be found on this Iron and Steel webpage http://www.chemguide.co.uk/inorganic/extraction/iron.html It makes good use of chemical symbols and equations.

Two forms of Carbon are used in steel-making: coal and coke. For a quick summary of the process and what the Carbon is doing see Coal into Coke at http://www.newton.dep.anl.gov/askasci/eng99/eng99390.htm

Is coal from forests? Sort of. Eons ago, if a forest was in a swamp, where plants died, fell into the water and decomposed. That formed peats, which could then be

compressed into coals, its grade and colour reflecting its make-up. For a diagrammatic view of this, see the webpage Formation of coal in the publications section of http://www.australiancoal.com.au. Victoria has huge reserves of coal in open cut mines in the Latrobe Valley – perhaps worth a field trip?

Carbon and other cycles

So we have moved a long way from the chemicals in the forest. Is there a way back, i.e. a cycle? Last time we modelled Carbon as it moved from a gas in the air, through photosynthesis into a building material for plants, making complex chemical compounds from cellulose to scents and colours. Now we can see that there is a lot more to the Carbon story and the legacy of plants. When plants die and rot, the carbon moves into the soil. Eventually that can become a gas again by further decay, or by becoming a fossil fuel that has been mined and used through burning or melting.

There are many diagrammatic images of complex cycles, like the Carbon one. There is a simple line drawing of the Carbon cycle at 6.2 Carbon Tablet 1 Print 091005 at www.forestlearning.edu.au. It could be used for (science through) art work if children copied the format replacing the line drawings with their own pictures. The language is basic but may have some terms needing explanation to younger children. It could also be used to practise reading, especially breaking into syllables. At the top of the page, there is a succinct statement of carbon storage in trees that could be copied and illustrated with a forest theme.

What about for older students? This website allows you to search for materials by age as well as theme. Carbon and its storage in forest and wood products is designed for middle secondary level. It provides a clear study of the basic chemistry of carbon, the carbon cycle in text and diagram, how to calculate carbon in trees and timber, the distribution of carbon in the parts of a tree. There are exercises at the end to check understanding of the material.

The Carbon cycle is not the only one in a forest. You may also like to cover the Nitrogen cycle. A Google search on images for Nitrogen cycle shows many representations, from which you could pick what suits your level. The 'Geography for Kids' website has the simplest Nitrogen Cycle diagram and explanation at http://www.kidsgeo.com/geography-for-kids/0161-the-nitrogen-cycle.php The New Zealand Digital Library nzdl.org has a black-line diagram at p027.gif (Nutrient Cycle), linking back to a webpage which summarises the process and benefits of it. It could be also be used as the basis for a more artistic representation and, like other diagrams, could be used as a base with your own illustrations to create more 'forest' in them.

Many of the Carbon and Nitrogen diagrams are part of webpages or sites that have other cycles, like the Kidsgeo one above. Again, search for one that suits your children's abilities. The following has both clear text and diagrams, and covers, in one webpage, Carbon, Nitrogen, Phosphorus, Water, and Sulphur cycles: http://ridge.icu.ac.jp/gen-ed/ecosystems.html

Medicines

Complex compounds in plants, many of which come from forests, may be useful medicines. You could use the web to research the original source of a medicine that your child uses, or to explore medicines from other regions. The Medicines of the Rainforest website, by Dr Stephen Blythe, is intended for younger readers, with short descriptions and lots of photos of local people and their plant medicines in South America, http://www.rainforesteducation.com/about2/about.htm. This could be followed with an atlas and turned into a comprehension exercise by making a list of the medicines, their source, and what they treat.

What about our 'bush medicines'? What was in the medicine cabinet (forests and woodlands) across Australia, before they were cut down for farms and settlements? Perhaps you are aware of the soothing properties of 'eucy' oil – which we quickly adopted from our indigenous peoples. Photos and descriptions of bush medicines are found in Top 10 Aboriginal Bush Medicines by Marina Kamenev in Australian Geographic, 8 Feb 2011, which can be found on-line. With children, these ten can be grouped into source groups, e.g. plants, animals, fungi and their subgroups.

The River Red Gum was a source of healing oils and rubs for the Wotjobaluk people of the Wimmera.

Reviewing the IYF aims

The IY Forests logo encourages us to appreciate the value of forests as places of shelter for people, habitat for biodiversity, sources of food, medicine and water, and part of global climate and environmental systems, which includes long-term cycles. The IYChemistry's logo 'C' directs us to Carbon, though more is implied. This year's series of articles has focussed on River Red Gum forests and on the role of Carbon to, in and from forests, i.e. the Carbon cycle.

Finally, visit the Perth Zoo IYF Global Forest Photo Album website, with its incredible range of photos and insights of forest values from around Australia and the world. What will surprise you? For me, it was woodland trees as protection from black rhinos in Africa!