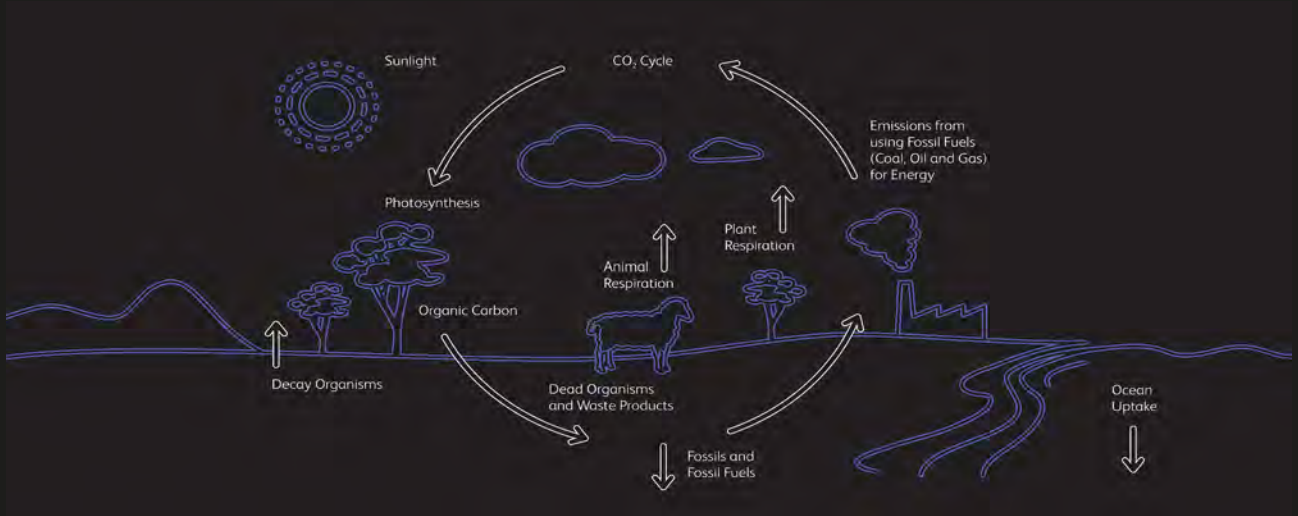
Forest Education Foundation
National Forest Learning Centre
The stories behind our trees

Carbon and Forests

The carbon cycle - stores and transfers

Carbon is an element that combines with others to create complex molecules. Some of these are organic i.e. they form a part of living or once living organisms, whilst some molecules exist in an inorganic state: within solid rock, dissolved in fresh water and the oceans, or as a gas in the atmosphere.

These living and non-living sections of the environment are often referred to as ''spheres" (the atmosphere, for example), and contain quantities of carbon that move in and out of the sphere by natural processes: plants absorb carbon dioxide and incorporate the carbon their leaves via photosynthesis, and animals eat the plants, transferring the carbon compound to their own bodies. The animals eventually die and are decomposed by respiring bacteria, which release the carbon back into the atmosphere.



The carbon in these spheres, or stores, moves relatively quickly, but often carbon becomes held in a store that has limited reactivity – the rock store (lithosphere) for example. Fossil fuels are an example of this; originally biological material that has been partially decomposed, compressed and heated over millions of years, the carbon within it remains geologically isolated underground and not part of the carbon exchanges on the earths' surface.

Changes in the cycle

Carbon dioxide is actually a vital component of our atmosphere. During he earths evolution over millions of years, the trapped heat in the atmosphere kept the planet warm rather than it becoming a freezing ball in space. This allowed the evolution of life on earth, with the cycling of carbon between the atmosphere and biosphere reaching a balance. Any sudden peak in atmospheric carbon dioxide, due to a wildfire for example, being easily reversed by natural processes such as photosynthesis, returning carbon to the biosphere.

However, during the last two hundred years, this balance has been disrupted. Humans have removed large quantities of fossil fuels from the rock store, and released the previously trapped carbon back into the atmosphere, causing global temperatures to rise. Whilst trees can remove some of this carbon and store it in wood, they cannot absorb all the carbon from burning fossil fuels. To do so would require us to produce enough wood to form a 30-cubic-kilomtere block of wood almost four times the height of Mount Everest from the forests each year*. This is clearly impossible, and valuable as it might be, storing carbon in forests doesn't change our use of fossil fuels: carbon is still being "added" to the atmosphere and this process can't be reversed on our timescales.

The Warra Supersite in the Southern Forests of Tasmania has a new carbon flux tower and is collecting data to help our understanding of carbon in the environment – for more information go to:

http://www.warra.com/index.php/component/content/article/138

Carbon capture in forests

So if we can't remove the carbon from the atmosphere, we need to find a way to reduce the amount that is finding its way in from the fossil fuel store. This is where forests can play an important role. By using wood in place of other structural materials such steel, aluminium and concrete, the manufacturing energy needed to create that product is greatly reduced; wood is actually a carbon positive resource. More lithospheric carbon stays where it is rather be removed for energy use.

The other advantage is that timber products store a very high proportion of carbon – it comprised 50% of the dry mass. Using a wood product keeps the carbon tout of the atmosphere for the lifetime of that product, plus the area from which the wood was harvested will be regenerated with young, vigorously growing forests that rapidly absorb carbon dioxide.

So from a carbon perspective, it makes sense to sustainably manage our forests to produce timber products that we can use in place of emission–intensive alternatives. By re-growing the forests, we replace our resource, and reduce our fossil fuel use – a sustainable strategy for the future.

**.Dr Martin Moroni, Senior Research Scientist, Forestry Tasmania*
http://www.theage.com.au/business/oldgrowth-forests-wont-save-planet-20110904-1js5i.html

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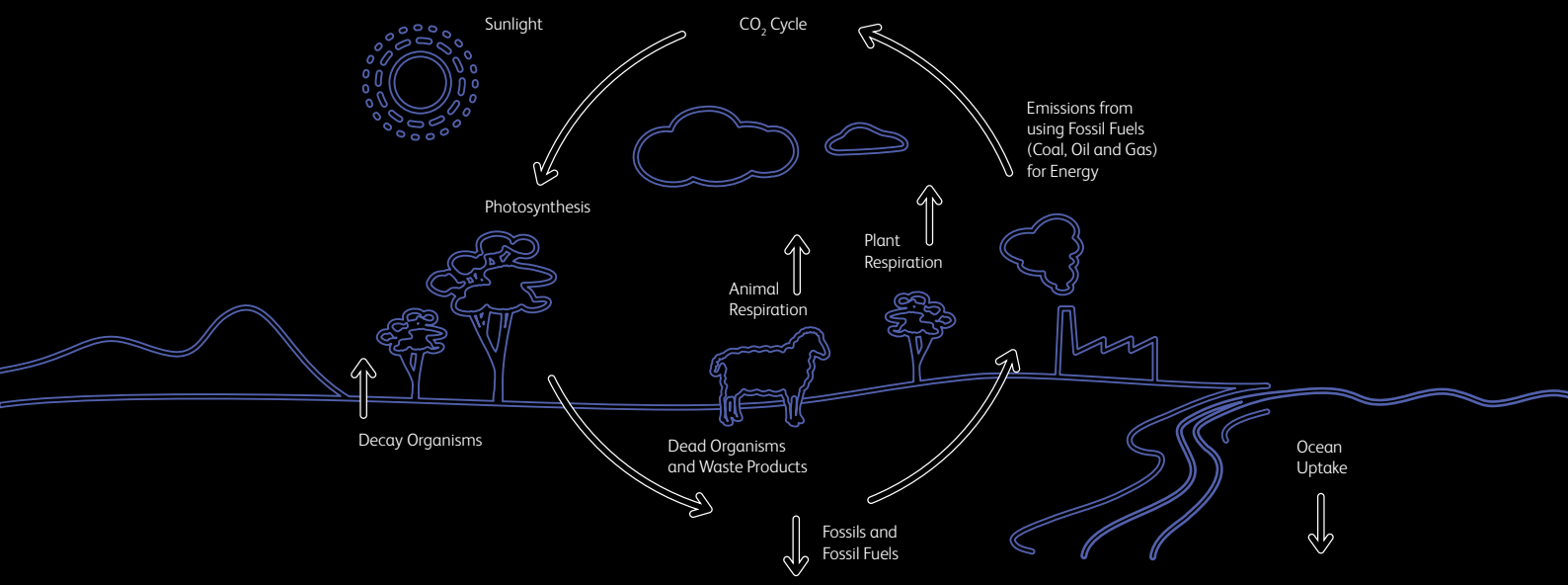
Contact:

79 Mellville Street
Hobart, Tasmania
Australia 7000

Phone: 03 6235 8240
Email: info@forest-education.com
Web: www.forest-education.com

Carbon

A tree is a column of carbon – as it grows, it captures carbon from the atmosphere and locks it away in its trunk, branches, roots and leaves.



The Carbon Cycle

The Earth is a planet of carbon-based lifeforms – the element carbon is the basis of all life on this planet, because carbon atoms can bind with each other and with other atoms, forming the complex molecules that are the building blocks of all living things.

Carbon moves through the global environment in a never-ending process of recycling.

All green plants take carbon from the atmosphere, processing it with water and sunlight to create molecules that store energy and molecules that become the building blocks of wood, bark, roots and leaves as the plant grows.

As they grow, plants release oxygen and store carbon. Huge amounts of carbon are stored in the world's 'carbon sinks' – forests, oceans and soil; and in reserves of coal, oil and gas.

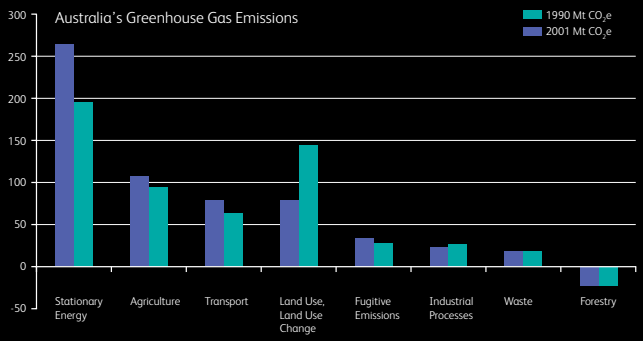
Plant-eating animals take in carbon as food (flesh-eaters get it from the plant-eating animals they consume). As animals breathe, and when their bodies decay, carbon dioxide returns to the atmosphere.

Carbon is also released when fossil fuels (oil, gas and goal) are burned; and through volcanic activity.

The burning of these fuels to power industry and generate electricity is the main factor in the phenomenon of global warming, which is the result of increasing concentrations of greenhouse gases, including carbon dioxide, in the Earth's atmosphere. Increasing levels of greenhouse gases are widely believed to be a factor in global warming and climate change.

That's why the role of forests is so important in the fight against global warming – the carbon they capture in the trees and in the soil stays out of the atmosphere.

When trees are harvested and processed into timber products or paper, carbon continues to be stored – often, long after the forest stops growing.



Source: Australian Greenhouse Office, 2001

Carbon Capture In Forests

Australia's forest industries store more carbon than they emit. That's partly because wood products such as timber framing, building cladding and furniture lock away carbon for a long time; and also because the young forests that flourish when they are regenerated after harvesting absorb large amounts of carbon. It's true that harvesting operations and timber processing are activities that release carbon – but this is more than balanced by the carbon that is stored by well-planned, sustainable forestry practices.

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Ideas for student questions

Which part of a tree absorbs the carbon (carbon dioxide) from the atmosphere?

Which part of the tree does the absorbed carbon get stored in?

Will the carbon remain stored forever? Why/why not?

Which processes in the carbon cycle result in rapid transfer between stores? Which are the slowest?

How have humans affected the natural carbon cycle?

Explain how using wood products can help reduce the quantity of carbon dioxide released into the atmosphere.

Ideas for classroom activities

Draw up a carbon cycle and describe the processes by which carbon transfers from one store to another. Discuss the impact of human use of resources on some of the transfer processes.

Make a list of products from forests. Try to think of alternatives to these products. How does the energy required in the manufacturing/transport process of these alternative products compare to the timber product? What is the implication for the future use of timber products?

Explore the role of managing forests into the future in relation to carbon storage/release and the ongoing use of timber products.

Links to Australian Curriculum - Science

Forest Education opportunities through science - years 9/10

Links to further information

What is the future of forests? - further information

Links to further supporting websites

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