

# The Carbon Cycle and Canada's Forests

## Activity Info

**Level:** junior to senior

**Subject:** science, chemistry, biology and ecology

**Duration:** one or two classes

**Group:** class and individual

**Setting:** classroom; optional trip to woodland or forest

**Preparation:** copy **The Carbon Cycle** (see page 35) for each student; research local forest ecology

## Summary

Students will explore the nature of the carbon cycle and its relationship to different processes within the forest. They will come to understand the dynamic nature of forests in storing and releasing carbon. They will look at their local forest, and come to understand its role in natural processes, particularly the carbon cycle.

## Learning Outcomes

Students will:

- discuss carbon and the carbon cycle
- gain an understanding of why carbon is a concern in global warming and look at the evidence that proves this natural cycle is out of balance
- look at the life cycle of the forest and forest succession, and at the different processes in the forest to learn which store and which release carbon
- discuss the role of Canada's forests in acting as carbon sinks

## Background

If we look at how nature operates without the influence of humans, we see what appears to be a series of perfect systems. These systems or cycles provide the basic needs of all life. When they are in balance, what is **waste** at one stage becomes a **resource** at another.

### Carbon Cycle

Carbon atoms form the basis of all plant, animal and human life. The atmosphere contains only .03% carbon dioxide. At first glance, it might appear that we will run out of carbon. But if we look at the fact that life has existed on Earth for over three billion years we realize that something else is going on. Carbon is constantly being recycled through the environment.

The carbon atoms that we find in plants and animals come from the air, water and from rocks such as limestone. During photosynthesis, plants convert this carbon into a form usable by animals, including humans. Animals also release carbon atoms back into the atmosphere through the process of respiration.

### Carbon Dioxide

One of the biggest concerns around global warming is the increase of carbon in the atmosphere. Levels of carbon dioxide, a greenhouse gas, have increased by over 30 per cent since 1700. This suggests that the carbon cycle is seriously out of balance. A big source of this carbon is the burning of fossil fuels (gas, coal, oil and wood). Fossil fuels are derived from living organisms that release carbon when they decay or are burned.

### Forest Cycle

Forests grow, age and change their makeup over time in a process known as **succession**. In its early stage a forest is made up of many small plants that establish themselves quickly and grow rapidly. These plants create soil and, if the conditions are right, are in turn replaced by shrubs and other woody plants. Tree species eventually move in but even these may be replaced by other kinds of trees as the forest evolves and matures.

The forest grows rapidly when it is young, and eventually develops to full maturity when it becomes a **climax forest**, a stage where little growth or change occurs. While some types of forests may remain in this mature state for very long periods of time, forests eventually succumb to insects, decay, fire, wind damage, and other natural forces. To keep the forest cycle alive, mature trees fall to the ground, rot, and form the soil and nutrients needed to sustain the next generation.

### Formula for Photosynthesis:





**1. Using the illustration on page 35, discuss the carbon cycle with your class.** Compare it to other cycles, for example the natural water, oxygen and nitrogen cycles, or industrial recycling processes (paper or metal). Your students may be aware of some of these cycles, but you may need to introduce them to others.

**2. Using the formula for photosynthesis, ask your students to define how a forest absorbs carbon.**

- What are the three substances created when carbon dioxide and hydrogen react with each other during photosynthesis? (*answer: sugars, oxygen and water*)
- Using this equation, what other cycles are also involved? (*answer: water cycle, oxygen cycle*)

**3. Ask your students to research what it means when a cycle or system is in balance.**

- Are there signs that the Earth's carbon cycle may be out of balance?
- Where does this extra carbon come from?

There are several examples in this booklet that they can study.

**4. Discuss forest succession with the students** using your local forest and forest species as an example. If you need help you may want to contact a local Model Forest, your provincial forestry association, or a provincial department or ministry of natural resources or forestry.

**5. Ask the students to describe forest succession** using their local forest as an example.

If at all possible, visit a local woodland or nearby forest.

Ask your students to study the forest closely in relation to the carbon cycle, and to record their findings. For example:

- Identify trees of different ages.
- Are there many seedlings?
- How thick is the understorey of plants and shrubs growing under the taller trees?
- What is the forest floor composed of? Is there a lot of litter such as dead leaves, twigs, branches?
- Are there signs of the buildup of organic, carbon-storing matter?
- Does this forest appear to store a small or large quantity of carbon? Many forests will vary as you move through them. Some tree species will have very little undergrowth, while other parts of the forest will be very dense.

## Mystery of the Missing Carbon #1

Each year the burning of fossil fuels releases about seven billion metric tonnes of carbon into the atmosphere. Scientists have been able to determine that three billion tonnes remain in the atmosphere and another two billion are absorbed by oceans. But what about the remaining two billion tonnes? If this carbon were not being absorbed somewhere, the levels of CO<sub>2</sub> would be rising even more dramatically than they are already. Scientists assume that plants absorb this missing carbon but they are not sure where this is happening and how much is being taken in.

BOREAS (see pages 6 and 10) is only one of many initiatives attempting to solve this scientific quandary. It studies the Earth's carbon cycle to gain a better understanding of global warming.

## Mystery of the Missing Carbon #2

In 1999 Canada's 36 recycling mills used 1.6 million tonnes (about 13.5 times the weight of the CN Tower) of old newspapers to produce newsprint and packaging materials. More newspapers are recycled each year at Canadian mills than Canadians read. How can this be?

- Canadians don't read their papers, they only use them to line bird cages and kitty litter boxes.
- Canadians have been hoarding newspapers for decades and are only now putting them into their recycling bins.
- Canadian mills recycle not only Canadian newspapers but American newspapers.

*See answer on page 39.*



# The Carbon Cycle

The carbon cycle is a natural process involving the transfer of carbon atoms to and from the atmosphere. The numbers in this illustration represent billions of metric tonnes. Scientists believe that the natural balance in this cycle has been altered by human activities such as the burning of fossil fuels and deforestation. Carbon is building up in the atmosphere as a greenhouse gas (CO<sub>2</sub>), which is contributing to global climate change.

Forests play an important role in the carbon cycle, storing carbon in vegetation and soils, and in taking CO<sub>2</sub> out of the atmosphere through photosynthesis. It is important to note here that deforestation in this illustration means converting forested lands to other uses such as agriculture. This does not include managing forests through sustainable harvest and regeneration. Canada is a world leader in sustainable forest management.

