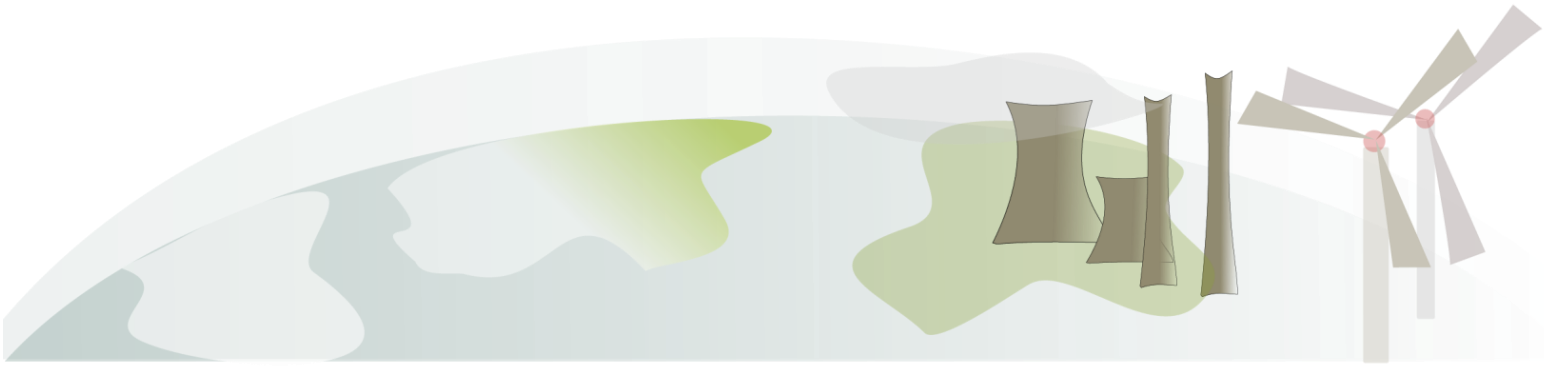

Climate Change – Resources

Thank you for downloading this Climate Change resource from *GeoBus* - https://geobus.st-andrews.ac.uk/

This resource pack was developed in partnership with Dr James Rae of the School of Earth & Environmental Sciences, University of St Andrews. Special thanks are due to Rasa Juras and Dr Rosanna Greenop for their involvement.

The development of these resources would not have been possible without the generous support of the *GeoBus* sponsors, past and present - which we gratefully acknowledge.

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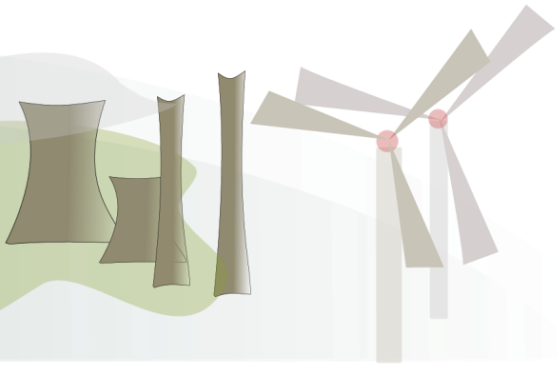
GeoBus

Climate change:
it's happening, it's us, it's serious, it's solvable

Climate Change: it's serious

Storing CO_2 in trees



Overview

Activity Description	Students take measurements of a tree, and perform a calculation to estimate the equivalent volume of CO_2 stored.
Time	1 hour
Learning Outcomes	• Understand that trees are a natural carbon sink • Calculate the carbon stored in an average tree • Consider the implications of carbon sinks and sources
Student Organisation	Individual (calculation) and small groups (discussion)
Materials Needed	How Much CO_2 Can You Store in a Tree Student Worksheet, a tape measure **or** a metre stick and some string
Related resources	Cool Earth: a charity addressing climate change by protecting rainforest; a good target for class fundraising projects http://www.coolearth.org

Background Information

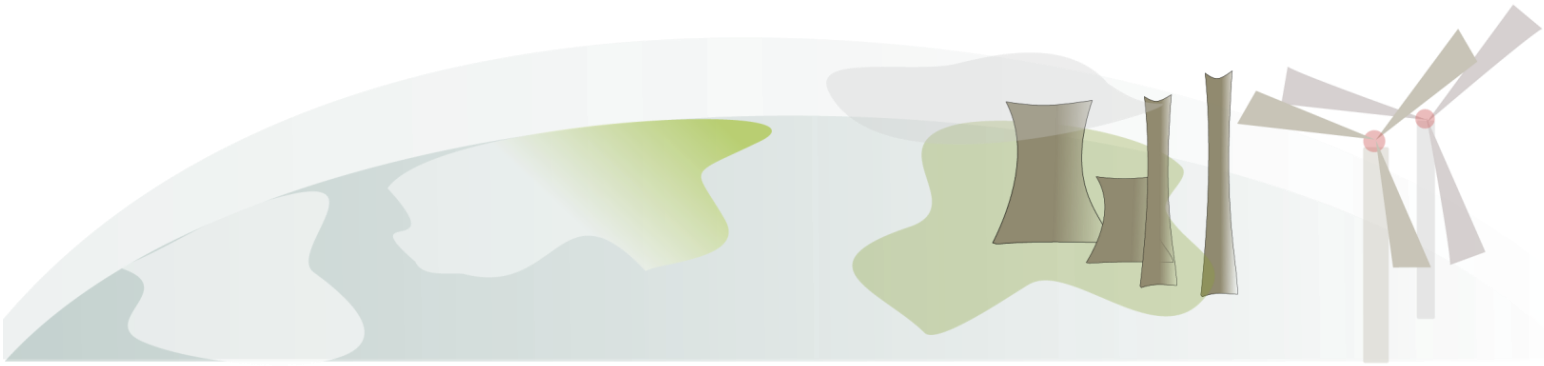
Plants, flowers and trees absorb CO_2 gas from the atmosphere. They use this CO_2 during photosynthesis to create carbohydrates, which help them grow. This process locks away carbon in the plant structure and helps regulate the levels of CO_2 in our atmosphere. The amount of carbon contained within a tree is relative to its size – older and larger trees have absorbed more CO_2 and therefore store more carbon.

Carbon is locked up within trees but when trees are burnt for firewood, that carbon is released. Furthermore, if the tree is buried and subject to heat and pressure over millions of years, the tree will become coal. Coal is a fossil fuel and burning fossil fuels releases CO_2 to the atmosphere.

Since the industrial revolution we have seen a steady increase in CO_2 in the atmosphere. Because CO_2 acts as a greenhouse gas*, this increase in the atmosphere is leading to an increase in global temperatures and is contributing to climate change.

This activity contains a fieldwork element – students measure the diameter and approximate size of a tree before using some simple calculations to estimate the equivalent amount of CO_2 gas stored as carbon by the tree.

*For a reminder of the greenhouse gas effect, take a look at the Climate Change videos on the GeoBus YouTube channel: https://goo.gl/UCZ5f7



Talking Points

Trees are a natural carbon sink. Encourage students to think about other CO_2 sources and sinks and work in groups to come up with a list.

Sources: Fossil fuels, biological sources, volcanoes

Sinks: Oceans, atmosphere, plants, land, and precipitation of carbonate minerals in rocks

Consider the relative amounts of CO_2 in each source/sink (groups could list in size order).

Compare estimates to this data: http://ete.cet.edu/gcc/?/globaltemp_carbon_cycle

Classroom/Field Activity

What you need:

- Worksheet
- A soft tape measure **or** sting and a metre stick
- Calculator
- A nearby tree!

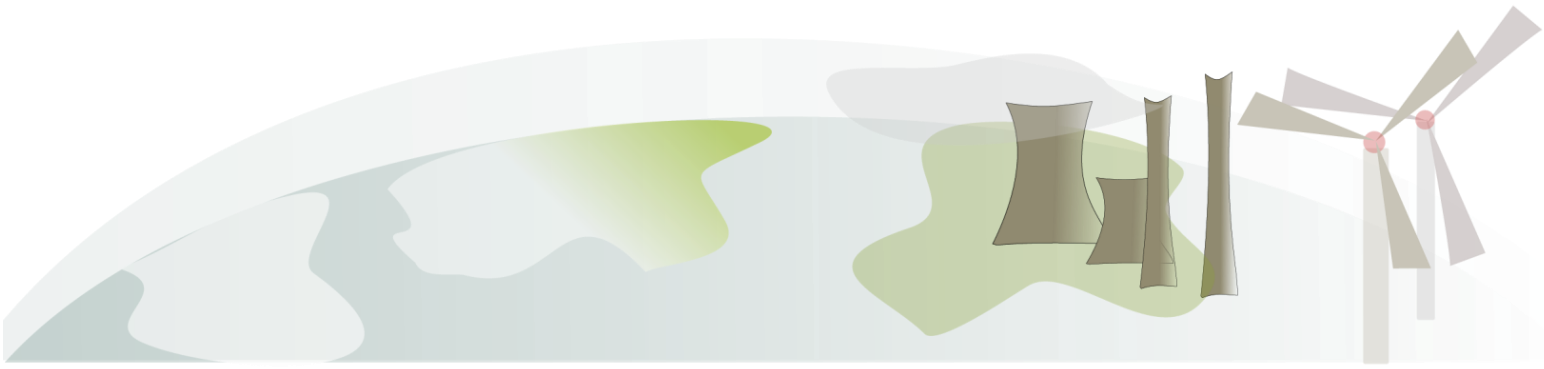
Field Instructions:

1. Working in a pair/small group, measure 1.3m from the ground up the tree trunk
2. Measure the circumference of the tree (around the trunk) at that height
3. Repeat the measurement at least twice, recording your data

Classroom Instructions:

1. Work out the average of your circumference measurements
2. Use the graph provided on the worksheet to calculate the approximate dry weight of the tree based on the circumference
3. Follow the instructions on the worksheet to use the weight to estimate the weight of carbon stored in the tree, and convert this to an equivalent amount of CO_2

Based on UK energy emissions, 1 tonne of CO_2 is roughly equivalent to the amount released to power the boiling of 25,000 kettles ... enough hot water for everyone in Aberdeen to have a brew!
[Assuming a 12000W kettle that takes 10 minutes to fully boil and holds 8 cups of water]



How much CO_2 is stored in a tree?

Measurements:

A) Calculate the average of your measured circumferences (add up all the values and divide by the number of measurements)

This removes some of the error and potential bias from the measurement.

Average Tree circumference (cm)

B) Calculate the weight of carbon stored in the tree

First, use the graph on the next page to estimate the dry weight of your tree

Dry weight of tree (kg)

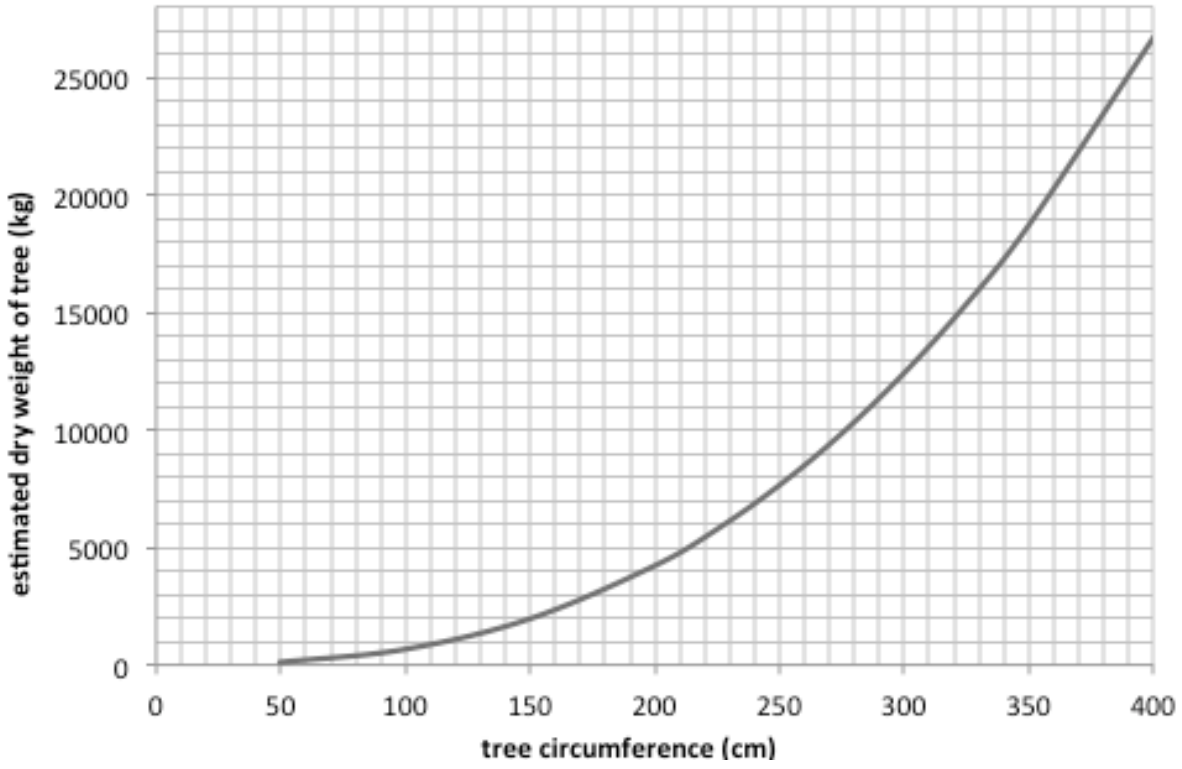
Most living things are approximately half carbon by weight. We can therefore estimate the carbon content of the tree by dividing the dry weight of the tree by 2.

Dry weight of the tree (kg)				Carbon Content (kg)
	÷	2	=	

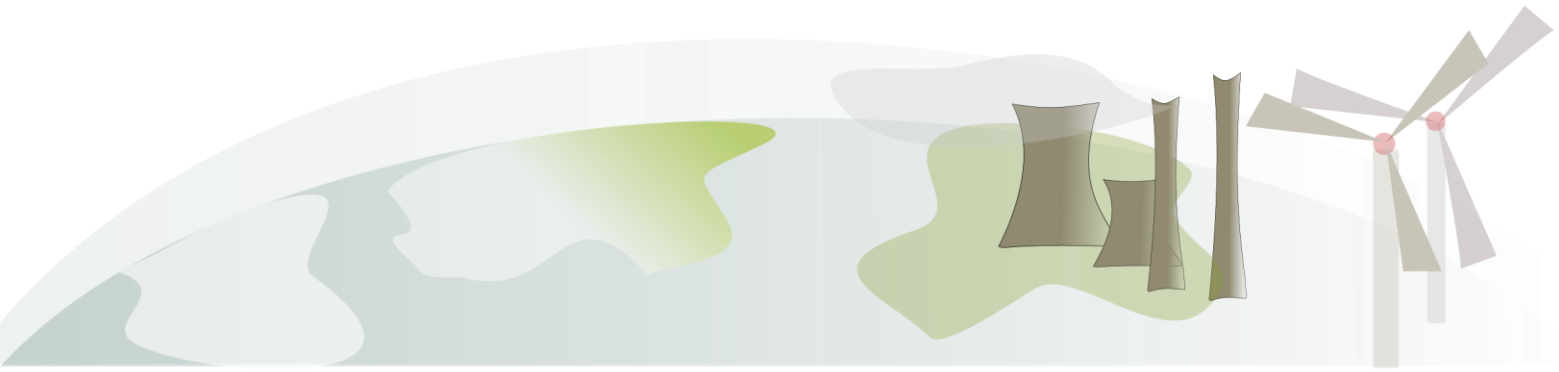
C) Calculate the equivalent weight of CO_2 stored as carbon in the tree

It is possible to calculate the equivalent weight of CO_2 stored as carbon in the tree by multiplying the carbon content by the constant 3.67 (see www.forestsforthefuture.co.uk)

Weight of Carbon in Tree (kg)				Equivalent weight of CO_2 (kg)
	x	3.67	=	



*These values, provided by **Forest Research**, are for an individual hardwood tree in Westonbirt Arboretum. They can be used as an **example** and to estimate the dry weight of the measured tree but in reality there will be a difference in growth depending on the species, soil, drainage, slope aspect and climate conditions.*



Example: How much CO_2 is stored in a tree?

Measurements:

1	2	3
132	144	138

A) Calculate the average of your measured circumferences (add up all the values and divide by the number of measurements)

This removes some of the error and potential bias from the measurement.

Average Tree circumference (cm)	138

B) Calculate the weight of carbon stored in the tree

First, use the graph on the next page to estimate the dry weight of your tree

Dry weight of tree (kg)	1,950

Most living things are approximately half carbon by weight. We can therefore estimate the carbon content of the tree by dividing the dry weight of the tree by 2.

Dry weight of the tree (kg)				**Carbon Content (kg)**
1,950	÷	2	=	975

C) Calculate the equivalent weight of CO_2 stored as carbon in the tree

It is possible to calculate the equivalent weight of CO_2 stored as carbon in the tree by multiplying the carbon content by the constant 3.67 (see **www.forestsforthefuture.co.uk**)

Weight of Carbon in Tree (kg)				Equivalent weight of CO_2 (kg)
975	x	3.67	=	3,578