THE GLOBE PROGRAM

GLOBE TY: Trees

Introduction

This module will focus on Trees. The students are encouraged to explore their local environment to better understand the role trees play in the Carbon Cycle and Climate Change.

Description: Exploring our local environment - Trees

Age: Designed for Transition Year

Introduction: Learn about the role trees play in our environment followed by hands-on outdoor activities

Activity: Seek out trees near your school (in a local park or green area) to take measurements

1. Estimate tree height using a clinometer or the GLOBE Observer app
2. Measure tree circumference and identify your tree species using a field guide or app
3. Estimate biomass and carbon content of a tree(s)
4. Share your results with GLOBE!

Time Required: Variable, depending on how many measurements you take – 1 to 3 hours

Purpose: Increase awareness and knowledge about trees and the role they play in the carbon cycle

Curriculum: Integrate maths (estimation, measuring and recording) and science (carbon cycle) into your outdoor learning.

Tools required: Device to measure angles: a) make your own clinometer to measure tree height, please find instructions here, b) use the GLOBE Observer app Trees tool to estimate height or c) use a clinometer, if you don't have a clinometer in your school you can purchase one here. Measuring tape (20 m preferable). Recording sheet and pencil.

Optional extras: Tree Identification Guide – if you do not have one, there are cheap easy to use guides for purchase from the Field Studies Council here

GLOBE Teacher Training/Guide: https://observer.globe.gov/do-globe-observer/trees

https://www.globe.gov/get-trained/protocol-etraining/etraining-modules/16867717/3099387

Why are trees important?

Trees play an important role by **storing water**, **cooling our air**, **protecting soil from erosion**, providing important **habitats for wildlife**, **filtering** pollutants, and by **removing carbon dioxide** from the atmosphere and emitting oxygen.

On a global scale, forests have a huge influence on carbon dioxide in the atmosphere. Forests, as part of the biosphere, absorb carbon dioxide in large quanitites during the growing season.

The carbon dioxide, along with nutrients and water, form new biomass within the **trunk**, **roots and leaves of growing trees**, acting as a carbon store.

During the growing season, trees will absorb more carbon dioxide through photosynthesis than they emit via repsiration. At night, trees release carbon dixoide through respiration.

When a tree reaches a mature stage, the amount of CO_2 that it absorbes is approximately equal to the amount of CO_2 it emits.

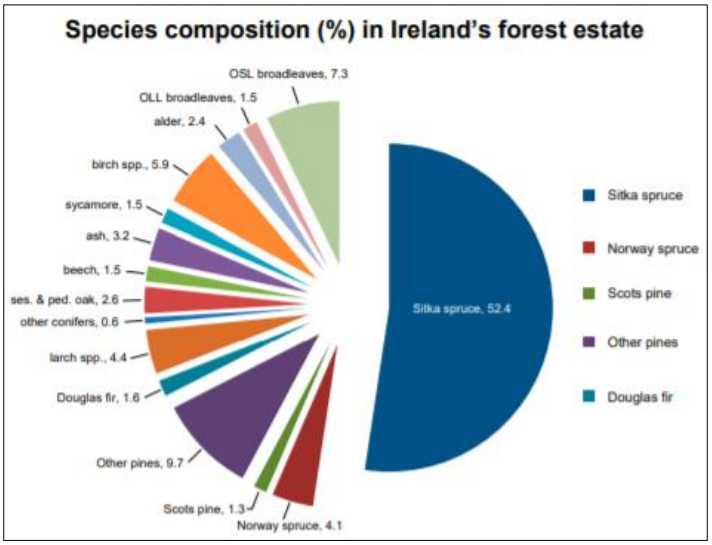
The removal of carbon dioxide from the atmosphere by Ireland's forests exceeds **6 million tonnes** per annum.

Trees release oxygen to the atmosphere as a byproduct of this photosynthesis process. Check out this NASA video on the role of the biosphere in balancing carbon dioxide in the atmosphere,

"A year in the Life of Earth's CO2"

In addition, to trees acting as carbon sinks, they also play a role in human health and wellbeing, trees can capture harmful particluate matter from air pollution and exposure to woodlands and forested area is shown to increase feelings of wellbeing and relaxation.

In Ireland, approximately 11% of our land area is covered by trees, this is a relatively low percent coverage compared to other European countries, which are closer to 30% coverage.



The majority of our forested areas are made up of just one species, **Sitka Spruce**.

According to the Forestry Policy Review *'Non-native species represent 76.2% of the forest area, native species 23.8%. The total growing stock is estimated as 70 million cubic metres, with 74% being in publicly owned forests'*

Ask Students

- Is your local area forested? If yes, what species of tree do you observe?
- Why is just one species of tree, Sitka Spruce, so common in Ireland?
- What are Ireland's native trees?

Why collect tree data?

It is important to observe and collect data around our local trees. We are custoidians of our local environment and need to take an active role in the management of our local land where possible.

The **Trees Around the GLOBE campaign** is asking the same questions!

The Trees around the GLOBE campaign is in it's 3rd and final year. We recommend that you participate in this campaign and share your tree data with GLOBE.

There are some excellent student activities here:

https://observer.globe.gov/toolkit/trees-toolkit/activities

There are some interesting resources from the campaign here:

https://observer.globe.gov/toolkit/trees-toolkit/books-videos-and-presentations

Why share your tree data with GLOBE?

NASA satellites, such as ICESAT-2 which is currently in orbit, are measuring the distance to the Earth's surface using lasers. This tool can build an incredibly detailed elevation dataset of the Earth's surface at such a high resolution that it can detect small changes in height with repeated measurements through time. This satellite, in addition to other applications, is measuring the height of forest canopies. Observing tree height allows NASA scientists to understand the gain or loss of biomass which can inform calculations of the carbon that forests either take in from or release into the atmosphere. Tracking how trees are changing over time can help us estimate the number of trees that make up an area – read more here.

Your ground-based tree height measurements help NASA verify measurements from satellites!

Time for an outdoor activity!

Tree height and Trunk measurement activity

The purpose of this activity is to measure tree height and tree circumference. Students will then use the biometry measurements to estimate the biomass and carbon content in their chosen tree.

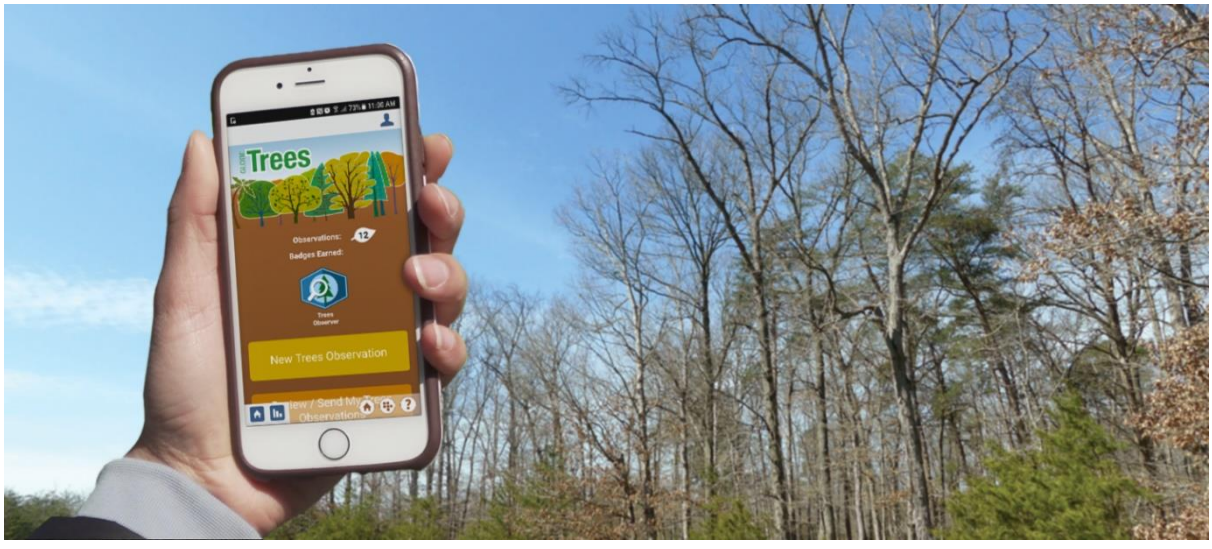
Instructions:

1. If you are using a clinometer, students can use the tree height and circumference recording sheet in the appendix or ask students to create a data recording sheet. Discuss the kind of information that will be gathered.
2. Go outside to a local green area with trees
3. Find a tree, preferably taller than 5 metres high, make sure you can find a spot, approximately 7-15 metres away where you can clearly see the top and bottom of the tree
4. If possible, identify the tree species using an identification guide

Before students begin, ask them to guess the height of the tree and record their answer. This can be compared to their measurement later.

How to start making measurements

Activity 1: Estimating Tree Height



There are 2 different methods you can use depending on what tool you choose – a) using **GLOBE Observer app** method b) **clinometer** (home-made or purchased) method

A. GLOBE Observer app – Tree height method

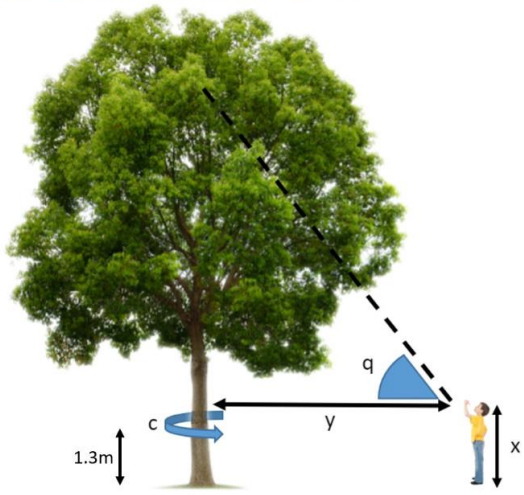
1. Find a spot 7-15 m away from the tree, where you can see the top and the bottom of the tree
2. Aim the app's viewfinder at the tree base and the treetop (remember to hold your phone at eye-level and tilt to adjust view) this isn't completely clear to me – should they have both in view at the same time or tilt from top to bottom?
3. Walk to the base of the tree counting your steps and enter the value into the app
4. Measure your location at the tree (the app will use your GPS in your phone for this)
5. The app will then estimate the height of your tree in metres
6. Remember to upload your data to GLOBE using the app

B. Clinometer – Tree height method

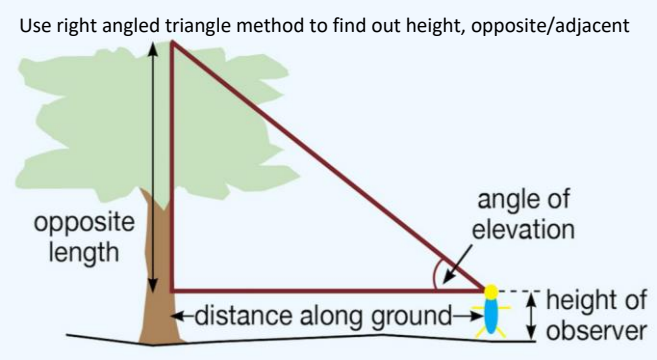
1. Find a spot 7-15 m away from the tree, where you can see the top and the bottom of the tree
2. Try to choose level ground between your viewing point and the base of the tree
3. Aim the viewfinder of the clinometer at the top of the tree and record the angle (q)
4. Measure the distance (y) between the observers viewing point and the tree
5. Record the distance (x) from the ground to the observer's eye level in meters
6. Use the formula to estimate tree **height: h = y (tan q) + x**

Tree height = distance to tree (tan clinometer angle q) + observer's height to eye level

Figure 10 – Measuring tree height and circumference.



Source: Field Studies Council



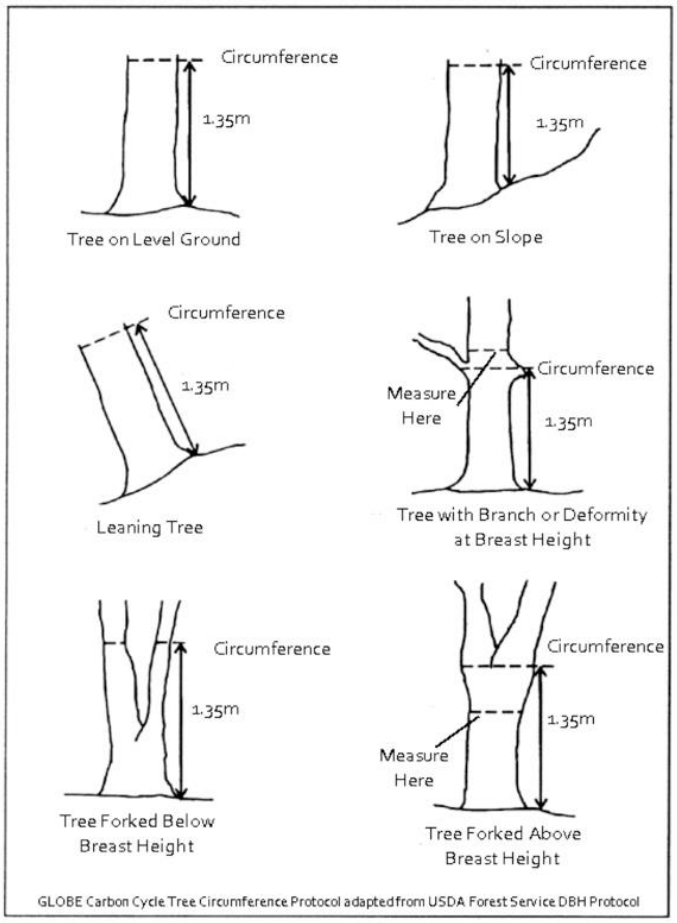
Activity 2: Measuring Tree Circumference

1. Measure the circumference of the tree trunk at approximate 'breast height', 1.35m up from the base of the tree, in centimetres using a measuring tape and make note of it on your data recording sheet

2. If you are using the GLOBE Observer app, you can enter the tree circumference in the app

3. Use your circumference measurement to calculate the diameter at breast height (DBH) cm using the formula below

$$\textbf{DBH} = \frac{c}{\pi}$$ **where dbh = diameter (at breast height), c = circumference**



Have a look at this picture guide on how to measure tree circumference when there is a slope, branch deformity or other potential issues.

Activity 3: Estimating Biomass and Carbon Content

(using the DBH of tree trunk)

Estimating Biomass and Carbon Content of a tree is an excellent activity to tie everything together. Students use the tree measurements they took and follow the guidelines to estimate biomass and carbon content for their chosen tree. It is a nice class project where you can aggregate measurements for multiple trees and assess how much carbon is being stored in your local forested area.

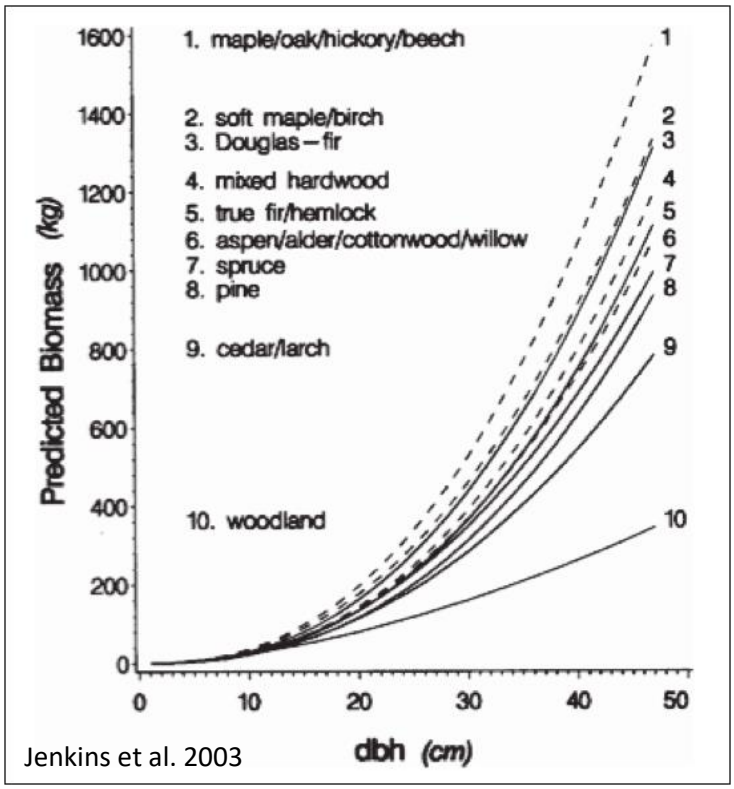
Steps:

1. Use your diameter at breast height (dbh) measurement in cm for your tree to estimate biomass. You will need to identify the species to use the correct species line (1 through 10) on the graph below. If you cannot find your tree species, try to choose a similar species

2. Once you have determined your biomass (kg) from the graph below, you can divide by 2 to get your approximate amount of carbon in kg

   $$\text{Tree Carbon Storage} = \frac{\text{Total Tree Biomass}}{2}$$

3. For example, for a spruce tree with a dbh (cm) of 30 has an approximate biomass of 360 kg or 0.36 tonnes and a carbon content of 0.18 tonnes



Jenkins et al. 2003

Compare your tree diameter measurement (x axis) using the tree species line (1 through 10) to the predicted biomass (y axis).

If you cannot find your species on the graph, try to pick a species that is similar.

Activity 4: If you have not used the GLOBE Observer app, you can still share your results with GLOBE via their data entry website page

1. After students have returned from the field with their paper data sheets, data can be shared with the GLOBE and scientific community by entering it into the GLOBE online science database (https://data.globe.gov)
2. You will need to register your site to submit data this way
3. When you submit your data through GLOBE, the calculations to convert your raw data to biomass and carbon storage values will be completed for you

What can you do with this carbon data?

Forestry contributes much to the health and diversity of Ireland's natural environment. Irish forest management practices have impacts on water quality, habitats, and ecosystems. The removal of carbon dioxide from the atmosphere by Ireland's forests exceeds 6 million tonnes per annum!

Calculate your school carbon footprint to see how many trees you need to offset your carbon footprint per annum! Is it possible to plant more trees near your school?

What else can we do?

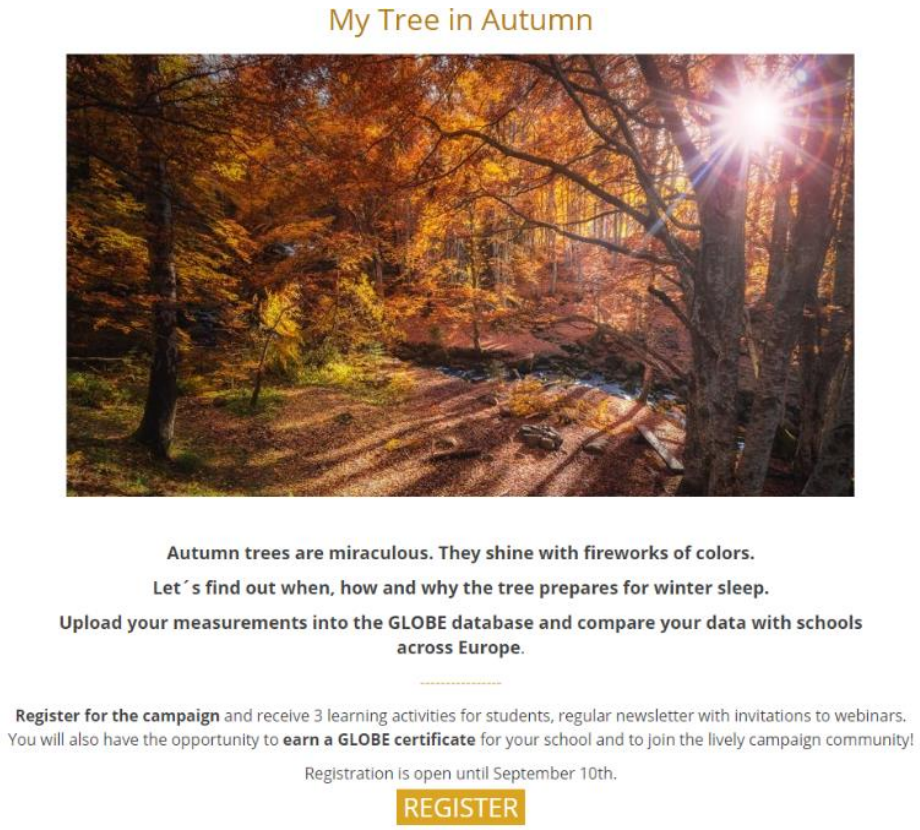
The autumn GLOBE European Phenology campaign has been launched! The phenology campaign focuses on seasonal changes in 7 species of trees. Tree observations and measurements are made in spring (observing bud burst and leaf growth) and autumn when tree leaves change colour and begin to fall to the ground.

Recording seasonal tree activity from year to year provides insightful data around climate change and the conditions affecting tree growth. This campaign is suitable for all age groups and can be a meaningful way to contribute to citizen science right outside your school.

To participate, you need to select one of the 7 tree species – Hazel, Fig, Lime, Oak, Cherry. Birch and Beech.

If you choose one of the 7 species above, you could combine tree height measurements with observed seasonal changes in spring or autumn.

Tree Phenology Campaign Species



The Leaf Programme

The Environmental Education Unit of An Taisce coordinates the LEAF (Learning about Forests) programme nationally. The programme was initiated in 1999 by the Forest in Schools programmes in Norway, Sweden, and Finland in cooperation with the Foundation for Environmental Education (FEE) and rolled out in the spring of 2000. Today, the Learning about Forests programme is coordinated by FEE at an international level. The Learning about Forests programme is well-recognised internationally, with over twenty countries from around the world participating. The programme aligns itself with Education for Sustainable Development (ESD), the Global Action Programme (GAP) and the new Sustainable Development Goals (SDGs).

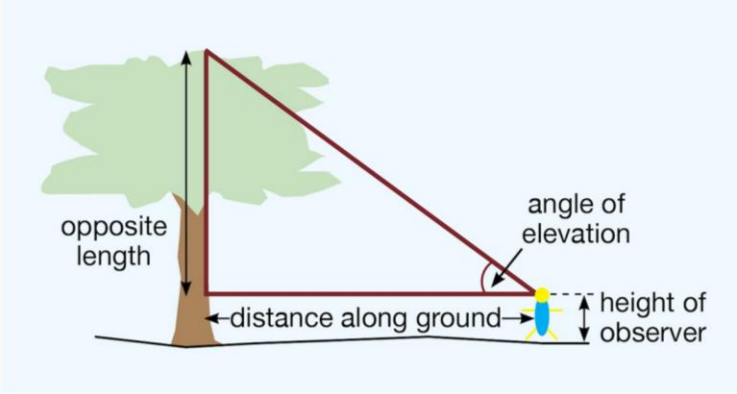
There are some highly recommended resources available through the LEAF website that encourage outdoor education and learning.

Tree Height and Circumference Recording Sheet

Name:

Date:

Habitat:



Record distance along the ground and angle of elevation in the field.

Equipment: clinometer, measuring tape, and tree identification guide

Location	Tree Species	Dist. from base, y (metres)	Clinometer Angle, q (degrees)	Eye Level height, x (m)	Circumference (cm)