

BBC



What do trees do for me?

Investigation 4 - Trees

Teacher Resource



Welcome to...

Investigation **4** Trees

Hello! Welcome to Investigation 4 from the Terrific Scientific campaign!

At Terrific Scientific, we think it is vital to develop science learning in primary schools across the UK. By taking part in this activity, you will be developing your class's scientific thinking and investigative skills.

At Key Stage 2 (Second Level in Scotland), children need to:

- **Develop** investigative skills.
- **Understand** when it is important to control variables.
- **Predict, observe and record** results.
- **Draw conclusions** (which may generate new questions).
- **Understand** the need to repeat activities.
- **Record** what they see and not what they want to see.

We have incorporated these principles into this exciting activity. We've made it suitable for primary classrooms by using readily available equipment and suggesting opportunities for support and differentiation.

The BBC deems this activity safe if following some basic precautions. It is your responsibility as a school to carry out your own risk assessment and we recommend you consider the risks and mitigations we have described in this activity pack, as well as any risks which may be relevant to your specific class environment.





As well as these key working scientifically principles, we have made sure there are links to the science curriculum for each nation, as well as cross curricular opportunities for further learning. We think these are just as important, as they help to explain the relevance of science and how it links to the world around us.

On our website you will find a supporting 'How to' film which shows teachers and teaching assistants how to set up and carry out the experiment. You will also find additional resources including a step-by-step lesson presentation, including an introductory film, which sets the investigation into context for your students.

Related links:

Find out more about
Terrific Scientific and our
other investigations:
bbc.co.uk/terrificscientific

We have partnered with the University of Leeds for this investigation. Your class findings will help further their scientific learning and give input to professional scientific research; understanding the impact of the carbon value of trees in the UK's primary schools.

We hope this inspires you and your students to get scientific and we look forward to seeing your results!

The Terrific Scientific Team.

Supported by: University of Leeds, United Bank of Carbon, Royal Society of Biology, Woodland Trust and Primary Science Quality Mark.



Contents

Background information for teachers	<u>5</u>
Introduction. What's carbon? The science of trees.	
Teacher planning guidance	<u>9</u>
Learning intention, duration, equipment, preparation of investigation, health and safety.	
Teacher preparation	<u>12</u>
Decision tree.	
The investigation - instructions	<u>19</u>
Activity one	<u>19</u>
Measure the tree's circumference.	
Activity two	<u>21</u>
Estimate the height of the tree.	
Activity three	<u>23</u>
Identify the tree.	
Activity four	<u>24</u>
Calculate the carbon value of the trees.	
Teachers notes	<u>25</u>
Recording results, uploading data, discussion of results.	
Terrific Tropical Trees	
Information about a tree planted for your school in Africa!	
	<u>29</u>
Curriculum links	<u>30</u>
For England, Scotland, Northern Ireland and Wales.	
Glossary of scientific terms	<u>33</u>
Including conceptual knowledge and scientific skills. References.	
Starter and plenary activity	
Use this activity at the start and end of the investigation	
	<u>37</u>



Trees

Watch the film:

You might find it useful to watch the Trees introduction film before you read through the resources.

[bbc.co.uk/guides/
zgcr7p3](https://bbc.co.uk/guides/zgcr7p3)

Introduction

Trees have many roles in nature and help us in many ways too. They provide us with foods like apples and pears, are a home for a variety of creatures and their roots help hold soil together and prevent flooding. But one of the most important roles they have is removing carbon dioxide (CO₂) from the air and using it to produce the oxygen (O₂) we need to breathe. They do this through a process called **photosynthesis**.

All animals, including us, release carbon into the atmosphere as a gas in the form of CO₂ when breathing and when we decay. Plant leaves take in CO₂ from the air and with a little bit of water and sunlight, convert it to O₂ and carbohydrates they use to grow.

Plants with many leaves, such as trees, are able to remove lots of CO₂ from the air and so, are incredibly useful to us. **Carbon value** is a measure of the amount of carbon absorbed and then stored in this way whilst producing O₂.

However, since the industrial revolution, we have been releasing more CO₂ than ever before, and the rising level of carbon dioxide in the world's atmosphere is too much for trees to tackle on their own. This is contributing to **climate change**.



Notes:

To give your class some context around why the storage of carbon in trees is important for all life on Earth, or to stretch eager children, you might want to explain the Carbon Cycle using the separate resource sheet on our website.

What is carbon?

Carbon (C) is an element which is sometimes described as the building block of life, as all living things on Earth contain it. It is special in that its atoms are able to bond with other carbon atoms in different shapes, so you can find different forms including diamond, graphite and charcoal. It can also bond to other elements such as oxygen (O₂) to form carbon dioxide (CO₂).

All the forests in the world are thought to absorb around 4 billion tonnes of CO₂ each year¹. Even though this sounds like a lot, we are releasing around 3 billion tonnes by cutting down trees each year alone, and even more through burning coal, gas and petrol. It is estimated that only around one quarter of the total CO₂ emissions from burning fossil fuels is taken in by plants². On top of this, CO₂ is constantly being released from natural and long-term processes, making trees even more vital in keeping our planet balanced and healthy.

What do trees do for us?

An average tree can store several hundred kilograms of carbon, really big trees may even store one tonne (1000 kg)! Most of these trees are found in tropical forests, but we also find them in our parks and playgrounds. This means there are around 400 trees for every human on Earth.

We aren't really sure how many trees are cut down each year, but estimates are between 6 and 15 billion trees per year... that's equal to an area of forest 100 times the size of Wales each year. A lot of people around the world are concerned by this, especially as in a single year, a big leafy tree can produce enough oxygen for ten people to breathe. If we keep getting rid of trees at this rate, we will lose a very important carbon store and a major source of the world's oxygen supply, which we and other animals need to breathe and survive.



Notes:

If you are interested in planting more trees on your school site, visit the Woodland Trust "Trees for Schools" :
www.woodlandtrust.org.uk/get-involved/schools/trees-for-schools/

The science of trees

For centuries, scientists have observed and recorded what is around them. These records of observations are called data. Having accurate data about our surroundings is important in science as it means scientists can look for patterns. Scientists look for patterns they expect to see and sometimes they spot new patterns they had not anticipated.

In this scientific work, children will be recording observations (data) about the trees in their area through a survey. They will also have to think creatively about ways to make their observations more accurate and useful.

For this large scale survey, the BBC has teamed up with The University of Leeds who need your class's help in gathering information.

Scientists at the University of Leeds do research on trees and forests all around the world. There are too many trees for the scientists to measure them all individually, so they need your help! The information you collect will help the scientists work out how much the trees in schools across the UK are helping to fight climate change and will provide evidence to help protect them. At the end of this investigation, your school will also adopt a tree in Africa as part of **Terrific Tropical Trees**, helping you to contribute even more to the fight against climate change.

Even if your school has no trees, this is important information for the university to receive from you. If you have no trees on site but still want to complete the investigation, trees in a local park can be used to complete the tasks (following school guidelines for an offsite visit). You can use our 'Decision Tree' in 'Teacher Preparation' to decide the best course of action for your class.

When your class has completed the activities in this survey, please upload your data to the Terrific Scientific interactive map and to the University of



Notes:

Trees are alive, treat them with care and be careful not to damage them when doing your surveys.

Leeds, where it will be added to results from schools across the UK.

The data will be sent to scientists to look at in detail and paint a picture of the carbon value of UK schools. You can read more about their work and how your data will be useful to them here: <http://leaf.leeds.ac.uk/>

While gathering the information for the survey, there are other curriculum-linked tree activities which your children may enjoy (see 'Additional Activities'). Alongside this pack, on the website, you will find a 'Student Recording Sheet' which, as well as recording the information needed for the BBC interactive results map and for the University of Leeds, also has space for further data collection.



How do we release carbon into the atmosphere?

In this investigation, children will find out which human activities are most carbon heavy and consider their impact. To meet the learning intention children will justify why carbon storage is important, using the context of trees in their school's grounds.

Notes:

The average carbon footprint of someone in the UK is over 2000 kg (2 tonnes) of carbon⁴, which is equivalent to making 716849 cups of tea!

Learning intention

- Children will **understand and justify** why carbon storage is important, through the context of trees in their school's grounds.
- Children will **compare evidence** they collect to identify trees in the school grounds **and learn how to estimate** the size of trees on their site.
- Children will understand **how to use the data** they have gathered to estimate the carbon value of the trees on their site.

The investigation allows you to add a range of further activities (see 'Additional Activities'). These will determine further learning objectives.

This activity will:

- Enthuse children about science, underlining the principle that science is accessible to all.
- Demonstrate that science helps us to understand the world around us.
- Gather evidence through practical activities, observations and controlled investigations.
- Allow children to see that their results can directly contribute to further scientific study.
- Develop students' investigative skills, as well as building conceptual understanding.





Expected duration

Approximately 2 hours. This will depend on the number of suitable trees on your school grounds. It will take between 5 and 15 minutes for a group of 3 to investigate one tree, depending on your children's proficiency.

Equipment needed

To measure trees:

- Marker pens or chalk OR brightly coloured ribbon and a label.
- 100cm measuring tape.
- Some string (3m should be sufficient for most trees).
- 30cm clear plastic ruler.
- Pencil.
- Student Recording Sheet (provided).
- Tree ID Sheet (provided)*.
- Carbon Calculator Sheets (provided).

To collect leaves:

- Several clear plastic bags e.g. sandwich or freezer bags.
- Labels / Paper.
- Pencil / Pen.

**Tree ID sheet: We have worked with the Woodland Trust to produce a special version of its tree identification resource, designed to help children identify trees commonly found in school grounds in the UK. Alternatively, children could make their own key using leaves from the site they are investigating (see 'Additional activities'). Do make the time to go outside ahead of the lesson and practice identifying trees yourself. A little practise will pay dividends!*



Notes:



The teacher notes section will help you select trees to study and deal with any anticipated issues.

Notes:

If you have no trees and are investigating trees away from your school site, please do not submit data on these trees to the BBC or the University of Leeds, simply state that your school grounds do not have trees.

Health & safety and control measures

- Trees on site should be safe, with any potential problems identified and dealt with according to your school's H&S policy in advance.
- Avoid trees with thorns (e.g. blackthorn, acacia etc.)
- Avoid trees where stinging nettles, giant hogweed and parsnip plants grow nearby. Ivy can irritate sensitive skin. Children with sensitive skin must avoid trees covered with ivy.
- Avoid doing the data collection in windy weather.
- If working after windy/stormy weather, check the area to be surveyed prior to data collection for possible hazards (e.g. loose branches on the trees).
- Ensure children never put their hands in their mouths during the activity and never put anything they find during the activity in their mouths (e.g. berries, nuts). Children must wash their hands thoroughly after the activity.
- The data collection involves someone standing close to the tree's trunk, so check for any shrubbery/walls/thorny plants/trip hazards that may be in their way.
- Ensure children wear suitable footwear to avoid slips, trips and falls.
- Be careful of any animals and insects you might encounter, and remember you are working within their living environment so try not to disturb them. Most are harmless, but occasionally trees can be home to wasp nests, which should definitely not be disturbed.
- If working offsite, follow your school guidelines for an offsite visit.
- The oak processionary moth has part of its lifecycle that can be dangerous – cause rashes etc. – if you touch it. Please advise your children not to touch any kind of “hairy” caterpillar just in case it is related.



Teacher preparation

Notes:



The teacher notes section will help you select trees to study and deal with any anticipated issues.

Selecting suitable trees to survey

If possible, obtain a copy of your school's site map and mark the position of trees to be surveyed. Only choose trees growing on the school site.

All plants remove some CO₂ from the atmosphere, but for the purpose of this study we will be focusing on trees of 1.5 metres and taller with a clear trunk (i.e. not bushes or shrubs). Where a tree has become part of a hedge, it will not be suitable as it will be very difficult for children to measure. For example, a freestanding hawthorn tree is fine, whereas one which is part of a hedge will be unsuitable.

Your tree checklist:

- Are the trees safe to study?
- Can the staff/children get close enough to measure the circumference (girth) of the tree? ([See 'Teacher notes'](#) for guidance)
- Can the staff/children step far enough back for the height to be calculated?
- Are there any other issues such as thick ivy on the trunk, multiple stems/trunks? ([See 'Teacher notes'](#) for guidance)
- Is the tree freestanding and not forming part of a hedge?
- For a large site, are the chosen trees representative of the area in terms of species and size?



Decision Tree

How should your class investigate trees?

Once you have identified suitable trees to observe and measure, the way you organise your tree survey will differ depending on the number of trees on your site and the number of children involved with the survey.

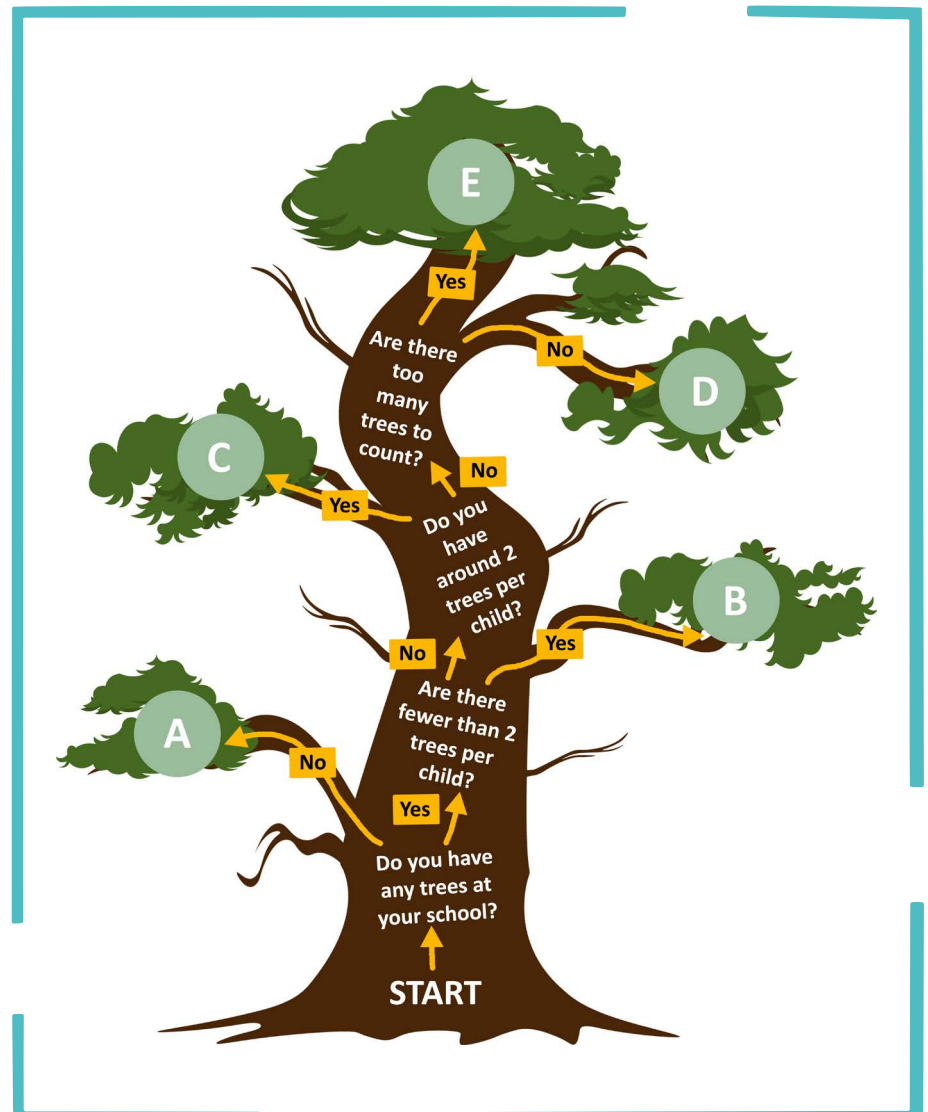
This 'Decision Tree' will help you decide on the methodology best suited to your school. You will need to consider other classes and liaise with other teachers in order to avoid problems such as double counting.

Notes:



We estimate it will take ~ 10 minutes for a group of 3 children to measure 1 tree. So, working over an hour, 3 children could hypothetically measure 6 trees.

Therefore, our "golden ratio" is 1 child to every 2 trees. A class of 30 could then, hypothetically, measure 60 trees in one hour.





Online map:



Your unique link to the map data entry page will be the same for each investigation, and a reminder email will be sent to your registered email address before each investigation is due to start. If you can't find the email please check your spam folder.

Decision Tree

Answers

Time to see which option is best for you:

Option A – You have no trees on your school grounds

Don't worry if you have no trees at your school, you can still take part!

- Record this as it is valuable data! Both the BBC Terrific Scientific map page and the University of Leeds want to know this information, so please add your data ('no trees') to both.
- You can still do some tree survey activities with your class off site (see 'Offsite tree activity').
- You could take in various leaves/branches/buds/fruits from the local area for your class to look at and identify in the classroom.

Option B – You haven't got many trees for the number of children at your school

You know exactly how many trees are on your grounds but there are relatively few compared to the number of children at your school. You have several ways of proceeding with this.

In this scenario, it is important to collectively gather information from your school's trees only once. Please liaise with other teachers taking part in this investigation.

- Before the survey begins, talk to other teachers taking part in this Terrific Scientific investigation to mark each tree suitable to be studied with a unique number using chalk.
- Each group of children can study some or all of the trees depending on how many there are, but please make sure they note down the number of each tree they are measuring on their 'Student Recording Sheet' in the "Tree ID Number" column.



- If some classes do not have a complete survey of the trees (e.g. only 10 out of 12 are surveyed by one class, but 12 out of 12 are surveyed by another class), teachers should pool results with each other to make sure every class taking part has a full data set of the trees surveyed at the school.
- Care should be taken to coordinate between classes so each class can enter a full set of data for each tree surveyed on the school grounds. This helps avoid accidentally double counting and also helps us understand how many trees are actually on the school grounds. Don't worry if each class's results are slightly different - the map will make an average of all classes.
- If each group within a class has surveyed all of the available trees, collate the data at the end of the survey to find the average measurements for each of the trees surveyed. You will then be able to enter this data onto the BBC map page.
- Alternatively, you could split children into larger groups (e.g. 3 or 4) so there is a ratio of 6 trees to every group to measure over an hour, and follow the instructions for Option C.

Option C – You have the golden ratio!

You're the Goldilocks of the tree world, your ratio of trees to children is just right!

- Before the survey begins, talk to other teachers taking part in this Terrific Scientific Investigation to mark each tree suitable to be studied with a unique number using chalk.
- Coordinate with other teachers to decide which trees each class will survey (e.g. class 1 does 1-15, class 2 does 16-30 etc.), then make sure all allocated trees are measured and identified.
- Make sure children note down the number of each tree they are measuring on their 'Student Recording Sheet' in the 'Tree ID Number' column.
- Teachers should then pool results with each other to make sure every class taking part has a full data set of the trees surveyed at the school.
- Care should be taken to coordinate between classes so each class can enter a full set of data for each tree surveyed on the school grounds. This helps avoid accidentally double counting and also helps us understand how many trees are actually on the school grounds.



Option D – You know how many trees there are, but you're not sure if you can survey them all

In this scenario, you may find the number of trees a bit daunting. Don't worry: you won't necessarily need to survey every single one...unless you really want to!

- Before the survey begins, talk to other teachers taking part in this Terrific Scientific investigation to estimate how many trees each class could hypothetically measure. Together, prepare labels on brightly coloured ribbon with a unique number, enough for one per tree. Divide these labels appropriately between the classes.
- Coordinate with other teachers to decide which areas each class will survey (e.g. class 1 does left of the school, class 2 does right etc.).
- When surveying, tie ribbons securely on the trees as you go along on the trees your class has surveyed. Make sure children note down the number of each tree they are measuring on their 'Student Recording Sheet' in the 'Tree ID Number' column.
- Keep an eye out for trees with ribbons already attached to trees by other teachers – try to avoid these to maximise the number of trees your school can count.
- Teachers should then pool results with each other to make sure every class taking part has a full data set of the trees surveyed at the school to enter on the BBC map page. You may not have surveyed every single tree on site, but as long as you make this clear when inputting data to the University of Leeds, it's not a problem.
- Care should be taken to coordinate between classes so each class can enter a full set of data for each tree surveyed on the school grounds. This helps avoid accidentally double counting and also helps us understand how many trees are actually on the school grounds. Don't worry if each class's results are slightly different - the map will make an average of all classes.
- Carefully remove all ribbons once the investigation has finished so they do not blow away and litter the local environment.



Option E – You have too many trees to count and therefore way too many to survey

In this scenario, you may find the number of trees very daunting. Don't worry: you won't need to survey every single one... unless you really want to!

- Start by finding a map of your school grounds. You could use a web-based satellite map to make this easier. Print a copy of the map and decide on the area you and other teachers will be surveying and mark this out. This will be your reference area.
- Before the survey begins, talk to other teachers taking part in this Terrific Scientific investigation to estimate how many trees each class could hypothetically measure. Together, prepare labels on brightly coloured ribbon with a unique number, enough for around 6 per group. Divide these labels appropriately between the classes and have some extra ones in case you can survey more trees than expected.
- Use your printed map to select a manageable area of trees for your children to survey. Coordinate with other teachers to decide which areas each class will survey (e.g. class 1 does left of the school, class 2 does right etc.).
- Try to choose an area which has a mix of species and sizes of tree which are representative of those across your site. You could mark these areas on the map.
- When surveying, tie ribbons securely on the trees as you go along on the trees your class has surveyed.
- Make a note of the numbers of the trees and their approximate location by writing the tree number over the reference area map. Make sure children note down the number of each tree they are measuring on their Student Recording Sheet in the 'Tree ID Number' column.
- Keep an eye out for trees with ribbons already attached to trees by other teachers – try to avoid these to maximise the number of trees your school can count.



Tip:

Why not practice each step first to help with children understanding and produce more accurate results?

Discuss:

Talk to other teachers taking part in this Terrific Scientific investigation to estimate how many trees each class could hypothetically measure.



- Teachers should then pool results with each other to make sure every class taking part has a full data set of the trees surveyed at the school. You may not have surveyed every single tree on site, but as long as you make this clear when inputting data to the University of Leeds, it's not a problem.
- Care should be taken to coordinate between classes so each class can enter a full set of data for each tree surveyed on the school grounds. This helps avoid accidentally double counting and also helps us understand how many trees are actually on the school grounds.
- Once the survey is complete, don't worry if you haven't surveyed or even counted all the trees on your grounds. You can estimate the total number and dominant species of the remaining trees from the comfort of your classroom using the guidelines as follows:
 - Look at your map again and compare the reference area you surveyed with other parts of the map which have trees. Try to estimate how many times your surveyed area fits into these parts of the map. In this way, you can roughly calculate the number of trees you have in the school.
 - By looking at the tree species in your reference area, you could make an informed prediction of the species of tree you did not survey in person.
 - Alternatively, if the trees are clear enough to make out on the map, you could count them individually in the classroom by dividing the area into smaller chunks and assigning an area to each child to count.



Notes:

Use our fun starter activity described at the end of this pack to introduce the investigation.

The investigation – instructions

The investigation for each tree is split into four activities which you could print and give to your children.

Note: the “how-to” film on our website will really help you to understand the investigation. bbc.co.uk/guides/z3nhrwx

Make sure you have introduced the investigation and explained how you have decided which trees to survey, referring to the decision tree.

1. Divide the class into small groups (3 – 5 children depending on how many are in your class).
2. Allocate a tree or collection of trees to each group to investigate.
3. Make sure each group has the equipment necessary.

Activity one:

Measure the tree’s circumference

Ensure you have safe access to take this measurement on each of your chosen trees.

You need to be able to measure the circumference of the tree 1.3 metres from the ground. Some trees may have large roots at the trunk base forming a buttress. When measuring 1.3m, choose points on the tree where there are few root buttresses to avoid confusion and measure from the bottom of the trunk.



There may be obstacles in the way of the circumference measurement e.g. shrubs, branches, climbing plants (See 'Health & Safety and Control Measures').



1. Make sure your tree has a chalk number or ribbon label on it, and note down the number in your "Tree ID Number" column of your 'Recording Sheet'.
2. On the tree trunk, measure 130cm from the ground at the base of the trunk using your 100cm tape measure and 30cm ruler (together they add up to 130cm) and make a small chalk mark on the tree bark.
3. Repeat this on the other side of the tree so that there are two chalk marks on the tree.
4. One person should hold the end of the string against the tree bark on one of the chalk marks. Another person should then wrap the string around the tree so it is tight and touching the bark. Make sure it is level with both of the chalk marks.
5. Where the string goes all the way around the tree and meets the end of the string, carefully mark the string using a marker pen or hold it carefully at this point.
6. Take the string off the tree, lay it on the ground, pull it tight and using your tape measure, measure the length of the string up to the mark you made.
7. This is the circumference of the tree. Write this information on your Recording Sheet.

Important:



Use a piece of string to measure the girth, then measure the string on the ground.

Tape measures can spring back fiercely, which is why we are recommending this method instead.



Watch the film:

Use the diagram on the next page and the 'How to' film on our website to help you with this task.

Activity two:

Estimate the height of the tree

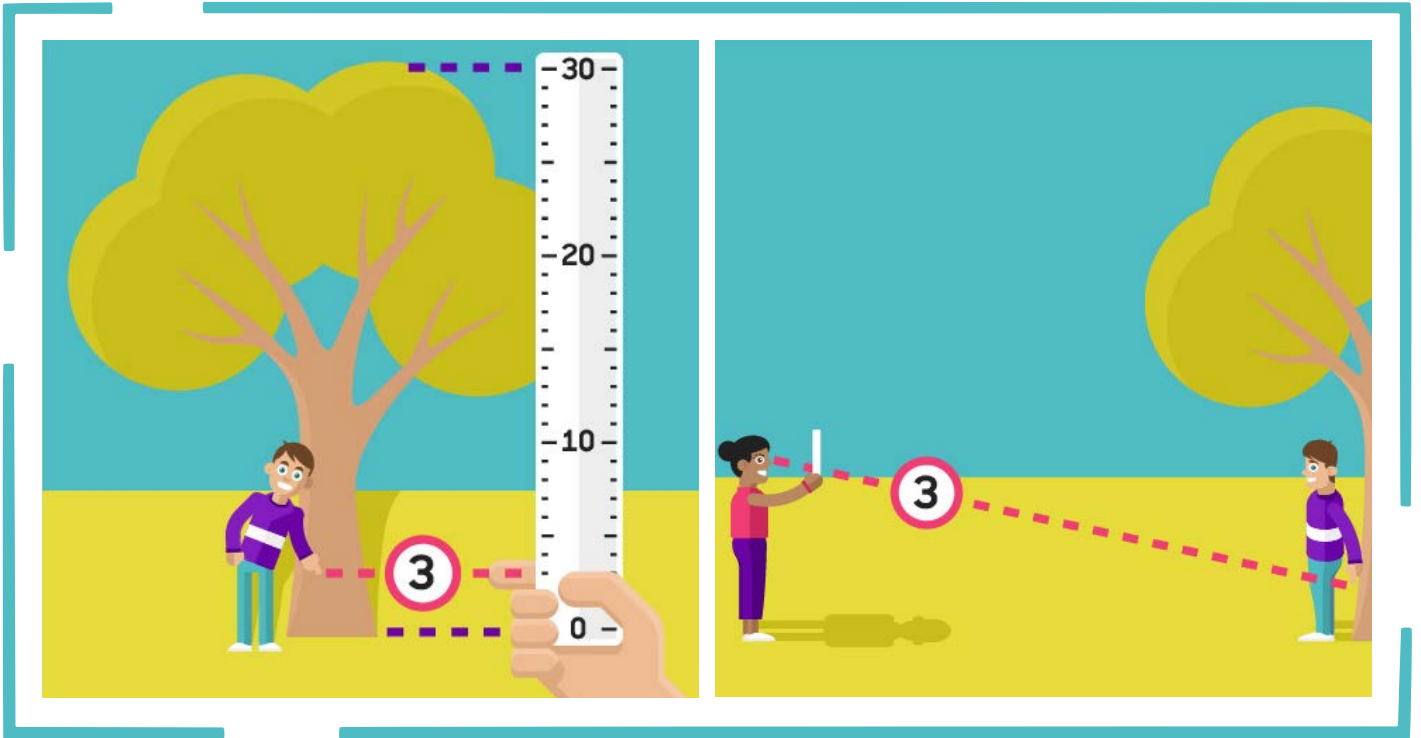
There are several methods commonly used to calculate a tree's height. For the purpose of this investigation we have outlined a simple method for all schools to follow for consistent results. You may be aware of other methods for estimating tree height; however, it is important for the integrity of the data to only submit data to the University of Leeds which has been collected using the method outlined below.

It may be useful for children to practice this procedure on a known height e.g. a second floor window ledge or netball post, so they are familiar with the methodology. You can also line up trees with something of a known height, or multiples of a known height, to check that your measurement is about right.

Please estimate the height of the tree in metres.

1. Stand facing the tree, a few metres from the trunk. Check there are no obstacles/holes near you or behind you.
2. Hold the 30cm ruler vertically at arm's length with the 30cm mark at the top. Look through the ruler at the tree.
3. Walk carefully backwards away from the tree with someone walking alongside you to guide and prevent you from tripping on anything. Whilst doing so, look through the ruler until the top of the tree lines up with the 30cm mark on the ruler and the bottom of the tree trunk is in line with the 0cm mark.
4. If you walk too far, move closer until the tree seems to be the same height as your ruler. Check the ruler is still vertical and stand still to keep the ruler in this position.
5. Someone else from your group should now stand next to the tree. Ask them to point their hand to the side of the tree trunk near the ground and ask them to slowly lift their hand up the trunk. It should start at the 0cm mark on your ruler, come up to the 1cm mark and then the 2cm mark. When their hand is in line with the 3cm mark on your ruler shout "STOP!".
6. Ask them to keep their hand that is pointing at the tree very still. Your group could mark this height on the tree with a bit of chalk to make this easier.





7. Another member of your group should then measure the distance from the bottom of the trunk to the 3cm mark on the tree.
8. Record this measurement on the 'Student Recording Sheet'.
9. Now work out the height of the tree by multiplying this measurement by 10. Remember to take care to change your measurement from centimetres to metres (1 metre = 100 centimetres).
10. Record the height you have calculated on the 'Student Recording Sheet'.



Tip:



Why not practice each step first to help produce more accurate results.

Activity three: **Identify the tree**

Children will need to gather a leaf from the tree they are collecting data from. This can be done by picking leaves from the ground or from lower branches. Make the children look up to be sure the leaves are from the tree they are recording. If there are no low branches arrange for some lower twigs to be cut off to give the children access to the leaves. If you are working early in April, some trees may not yet have their leaves, in this case try to use leaves on the ground and bark to help you to identify the tree.

To make identification easier, we have provided a 'Tree ID Sheet' produced in collaboration with the Woodland Trust. Trees can be identified whilst they are being measured or material can be collected from each tree to use in identification back in the classroom.



1. Gather evidence from the tree you are measuring. This could be leaves, fruits, seeds, flowers, or even a photograph. If you pick up a leaf or seed, look up at the branches above and check it is the same shape.
2. Sometimes other plants grow up the tree trunk, such as ivy. If there are lots of leaves on the trunk, look up at the branches to see if they are the same leaf shape as the ones on the trunk.
3. You can identify the tree now or later using the 'Tree ID Sheet' provided.
4. If you will be identifying the tree in the classroom, put your evidence in a clear plastic bag. Use one bag per tree when collecting evidence and make sure you write the tree's ID number along with your group's name on a label and stick them onto the bag/inside the bag.
5. Do not damage the tree; be careful, only take the minimum leaves/fruit/seeds.
6. Once identified, write down the name of the tree species on your 'Student Recording Sheet'. If you can't identify the tree, write "unknown" but note if it is needle-leaf or broad-leaf.



Activity four:

Calculate the carbon value of the trees

Once you have observed, measured and identified all of the trees in the survey area, you will need to work out the carbon value for each one using the chart provided and then estimate the total carbon value of all the trees surveyed.

The University of Leeds have produced two Carbon Calculator Sheets, one for broad-leaf and one for needle-leaf trees.

1. For each tree, decide if they are a broad-leaf or needle-leaf tree, you could look back at your Tree ID sheet to work this out. Use the relevant 'Carbon Calculator Sheet'.
2. You will have measured the height (in metres) and circumference (in cm) of each tree. Along the top of the chart, find the height category that your tree fits into (e.g. 7-9 m). You might need to round your measurement to the nearest whole number. Then move down the table to find the circumference category that your tree fits into. (e.g. 95-125cm).
3. The number in this box is the carbon value (in kilograms). Add this value to your 'Student Recording Sheet'.



Different species of tree store different amounts of carbon and this is mainly due to whether it is one type of tree or the other.

It is important that you still identify your trees if you can with our Tree ID Sheet as the scientists at the University of Leeds will use this information to produce more detailed estimates of the carbon stored in your trees.



Notes:



As an extension activity, each group could investigate the same trees and compare their results to check their accuracy in collecting data.

Recording results

Once your class has completed the investigation and you have filled in your recording sheets, the data should be collated and submitted to the BBC Terrific Scientific map page and the University of Leeds. See the 'Uploading Data' section below for details of how to do this.

The university would like data from as many trees on your site as you can manage. The recording box on the student sheet allows for data from 10 trees, but you can copy more recording sheets to record data from more trees should you wish.

Teacher notes

Possible issues with the trees

If there are no leaves:

- If you are investigating early in April you may find that the trees have not yet come into leaf. In this case you could use fallen leaves beneath the tree and other attributes such as branch shape and bark to help you identify.

If you find a tree you cannot identify:

- Complete the activity using the tree and collect evidence to help you identify the tree later. The carbon calculators supplied by the University of Leeds are general, one for broadleaved trees and one for needle-leaved trees. Plus, you can enter the tree as "unknown" if you can't work out its species.

If you find a trunk covered with ivy or other creepers:

- We recommend you do not measure a tree covered in ivy.

The tree has several trunks:

- Choose the main, largest trunk for the investigation. This is often seen with sycamore trees.



Notes:

Our additional activity, 'Spot the problem' may help you investigate this further.

The tree has multiple small trunks (e.g. a coppiced tree):

- This may make the tree inappropriate to study, however, if there is one main trunk use that as the basis of the circumference measurement. This is sometimes seen with hazel trees.

The tree trunk is surrounded by small shoots (suckers):

- Ignore the suckers and study the main trunk. This is sometimes seen with lime trees.

The tree has branches on the trunk down to the ground:

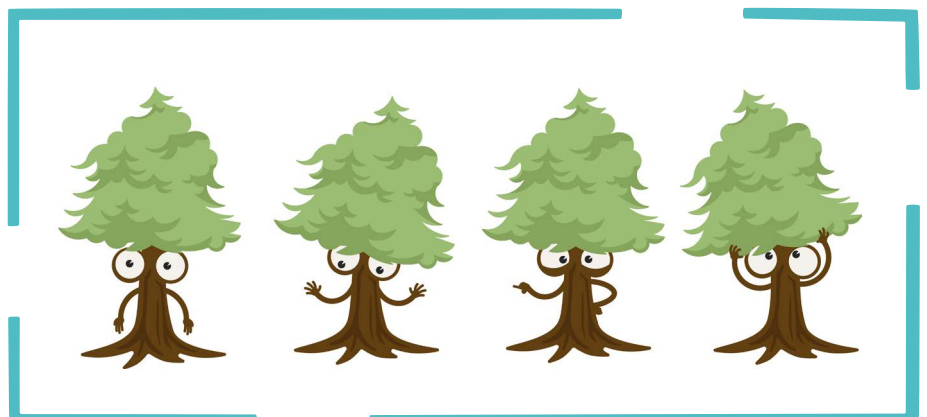
- In this case, thread the string carefully through the branches at 1.3m height, but be careful to avoid running into branches.

The tree has been pollarded so there are few large branches (many of the upper branches have been cut off):

- Carry on and complete the activity. Record this in the special information box on your recording sheet. This is sometimes seen with lime trees.

The tree has a major disease:

- Carry on and complete the activity, but be aware that some branches may be loose and may fall. Record this in the special information box on your 'Student Recording Sheet'.





Uploading data

Who are we collecting data for?

You will be collecting data for both the Terrific Scientific interactive map of the UK, and the University of Leeds study into the carbon value of trees growing on school grounds.

Meet a medallist!

Want to be in with a chance for a member of Team GB to visit your school? Simply take part in at least two of our investigations **and upload your class findings** to our map.

Remember:

Don't forget to send your detailed data to the University of Leeds to make sure you are included in the UK survey and a Terrific Tropical Tree is planted in your name!

Uploading data for the BBC

Each class involved should enter:

- The total number of trees investigated by your school.
- The total carbon value (in kg) of the trees investigated by your school.

Please note: all classes who have surveyed trees on your site should work as one team and each upload a complete set of data for all the trees surveyed. If all classes have not surveyed all the trees, please share data to ensure everyone has a full set. Don't worry if you all have slightly different total values per class (some children will have estimated slightly different heights for the same tree for example) as this will be averaged out by the map.

Once you confirm your data entry to the map you cannot change it, so make sure you type carefully!

Uploading data for University of Leeds

After you have entered the data on the map input page, a link will appear to the university data survey. Follow the link to enter the detailed data of your class' investigation. You can return to this survey later at www.tssurvey.co.uk. The scientists at the University of Leeds will use the data collected for their investigation, the results of which will be published on our website.

You need to add your data by Sunday 4th June.

The data requested by the University of Leeds will be:

- How many trees there are on your site in total (if you have too many trees this may be an estimate).
- How many trees your class(es) have surveyed (this could be the same as the total number, unless you have too many trees to survey).
- Postcode of your school.



Remember:



You can return to this survey later at www.tssurvey.co.uk.

Online map:



Your unique link to the map data entry page will be the same for each investigation, and a reminder email will be sent to your registered email address before each investigation is due to start. If you can't find the email please check your spam folder.

They will also require all the data you have collected for each tree surveyed on your site:

- Unique tree number.
- Tree circumference (in centimetres).
- Estimated tree height (in metres).
- Which species of tree you think it is (if you don't know the species you can just tell us whether it has got pointy, needle-like leaves, or broad, flat leaves).
- Estimated carbon value (in kg).

Discussion of results

As part of this discussion, please ask your children to refer to the "The things I know about trees" worksheet which they completed at the start of the investigation, and complete side 2.

- How many trees are growing on your site?
- Can you estimate their age? How does this affect their carbon value?
- What could you do to increase the carbon value of your school?
- Do any trees on your site show signs of pests or diseases? How do you think this would affect the tree?
- Discuss the other ways you could lower your carbon footprint.
- Which species of tree on your school grounds have the highest carbon value? Why do you think this is?
- Which sites close to your school would you expect to have a high carbon value?
- Where in the world would you expect trees to have the highest carbon value?



Note:



Find out more about your tree and how to reduce your school's footprint at: unitedbankofcarbon.com/terrifictropicaltrees

Watch the film:



The different layers of a deciduous forest: bbc.co.uk/education/clips/zygdrdm

Tropical rainforest: bbc.co.uk/education/clips/z2ngsg8

Terrific tropical trees

We need to plant more trees to compensate for those that have been cut down and help remove the excess CO₂ we have released into the atmosphere. As many schools don't have space to plant trees on their site, the BBC is working with the United Bank of Carbon on a project to help each school involved in this Trees investigation to plant a tree in Africa – Terrific Tropical Trees!

Trees growing in tropical parts of the world like South America, Africa and Asia not only help to fight against climate change but also provide a vital habitat for animals, and help create jobs for local people. The United Bank of Carbon (UBoC) are arranging for new forests to be planted in Africa, with at least one tree being planted and protected for every school taking part.

Schools can download a certificate to show they have adopted at least one Terrific Tropical Tree sponsored by Samuel Grant Packaging, The Bettys & Taylors Group, and UBoC, when they upload their data to the University of Leeds website.

Things to think about:

- How could your school improve its carbon storage?
- How could your school community reduce its carbon output?
- If there is no room at your school where else could you plant some trees?
- What other plants/shrubs could you plant in your school grounds?

If you are interested in planting more trees on your school site, please visit the Woodland Trust 'Trees for Schools' page:

www.woodlandtrust.org.uk/get-involved/schools/trees-for-schools/



Curriculum points – England, Scotland, Northern Ireland and Wales

England

Year 5; living things and their habitats. Describe the life process of reproduction in some plants.

Forces. Explore the effects of air resistance by observing how different objects such as sycamore seeds fall.

Year 6; living things and their habitats. Classifying plants using keys

Numeracy links: The three core tree activities of this investigation are an authentic context for mathematics. The amount and level will be determined by the extra activities (if any) added to the three core pieces of work. These headings will all offer opportunities for curriculum coverage;

Number: multiplication.

Ratio and proportion: tree height measurement.

Geometry: properties of shapes.

Statistics: C calculations.

Scotland

Sciences; principles and practice.

This activity gives opportunities for developing inquiry and investigative skills.

Planet earth; biodiversity and interdependence.

Links; E, F, S; SCN 0-01a, 1-02a, 2-02a 2-02b. Looking at living things over time.

Biological systems; body systems and cells.

Links; S; SCN 2-13a. Composting leaves.

Biological systems; inheritance.

Links; S; SCN 2-14a. Life cycles.

Topical science; topical science.

Links; E, F, S; SCN 0-20a, 1-20a, 2-20b. Using the C Calculator.

Numeracy and mathematics

Number, money and measure; E, S; MNU 0-11a, 2-11a. Measuring.

Shape, position and movement

Angle, symmetry and transformation; F; MTH 1-18a. Using grid references.

Information handling

Data and analysis; E, F, S; MNU 0-20a, 1-20b, 2-20b. Collect and sort, carry out a survey.



Northern Ireland

The world about us; interdependence.

Questions from Geography and Science & Technology can be addressed through investigating plants and local habitats, acting on a global issue, life cycles and plant growth.

The world about us; change over time.

Questions from Geography and Science & Technology can be addressed through observing seasonal changes, investigating global issues, decay of materials and shadow work.

Mathematics and numeracy; number, measures and handling data.

Using simple measuring instruments, reading and interpreting them with reasonable accuracy, multiplying by 10, calculate the perimeter, calculate and use the mean.

Wales

Science; Opportunities for Key Stage 2.

Skills; Enquiry; exploring and taking measurements.

Developing; appropriate equipment use, making careful observations and measurements, repeating data collection for accuracy.

Reflecting; children think about what they have done in order to consolidate learning and transfer skills.

Range; Interdependence of organisms; through fieldwork the plants in a local environment can be assessed, investigate how humans affect the environment.

The sustainable earth; a consideration of waste.

Mathematics; Opportunities for Key Stage 2.

Developing numerical reasoning; select and use appropriate mathematics and techniques.

Using number skills; read and write numbers, multiply by 10.

Using measuring skills; estimate and measure lengths and perimeters.

Using data skills; representing data, use the mean.



General literacy links

Children can use the Woodland Trust tree identification worksheet to find out interesting facts about the surveyed trees and be inspired to write stories about them. They could estimate the age of the tree and link to historical events that may have occurred in the tree's lifetime.

General numeracy links

The investigation involves measuring and calculating in a real life situation. You will be able to tailor the numeracy work to suit the children undertaking the investigation e.g. by calculating an average of tree data surveyed by more than one group.

Glossary

Broad-leaved	Trees whose leaves are generally large, and two sided.
Carbon calculator	Sheet used as a means of calculating the amount of carbon taken out of the air by a tree.
Carbon cycle	The series of movements by which carbon is stored and transferred through different processes in the environment.
Carbon dioxide (CO₂)	A gas made of one carbon atom and two oxygen atoms.
Carbon value	In the case of this activity, the amount of carbon stored in all living tree material, both above and below the ground.
Carbohydrates	Sugars which are produced by plants.
Circumference	The length of a circle's perimeter, in this case the measurement around a tree trunk.
Climate change	The large-scale, long-term change in the planet's weather patterns or average temperatures due to human actions such as burning fossil fuels.
Deciduous tree	A tree that sheds all its leaves annually in autumn.
Diameter	The length of a line from one side of a circle to the other, passing through the circle's centre.
Erosion	When material is worn away by something.
Evergreen tree	A tree that has leaves all year round.
Fossil Fuel	A natural fuel such as coal, oil or gas, formed in the geological past from the remains of living organisms.
Girth	See 'Circumference' .
Global warming	The process by which the world's global atmospheric and surface temperature is increasing due to human actions, such as burning fossil fuels.
Greenhouse gas	A gas that contributes to the greenhouse effect in the atmosphere by absorbing infrared radiation, such as CO ₂ . They are necessary to keep us warm enough to survive, but are damaging in the amounts we are currently releasing and contributing to global warming.
Habitat	The natural home or environment of an animal, plant, or other organism.



Horizontal	A straight line, left and right.
Identification key	A tool used to find the name of an organism through closed questions about it.
Needle-leaved	A tree that has small leaves often resembling needles.
Pollard	A tree where the branches are removed regularly at the same height to encourage growth.
Photosynthesis	The process by which green plants make food and O_2 from CO_2 , water and sunlight.
Sucker shoots	Shoots growing from the base of the plant upwards, near ground level.
Symmetrical	A shape where each side of an imaginary line is the same.
Vertical	A straight line, up and down.



References

1. Pan et al. (2011) 'A Large and Persistent Carbon Sink in the World's Forests.'
Science. 333. 988-993
2. Reich. (2011) 'Biogeochemistry: Taking stock of forest carbon.'
Nature: Climate Change. 1. 346–347
3. Crowther et al. (2015) 'Mapping tree density at a global scale.'
Nature. 525. 201–205
4. Carbon footprint per person (for 2013) from: <http://data.worldbank.org/indicator/EN.ATM.CO2E.PC>



Additional activities

There are plenty of fun learning opportunities around trees across the whole year, and we have gathered some ideas in our Additional Activities Pack which is available on the website.

We have also produced the two additional resources below:

The carbon cycle

In order to understand more about how carbon moves in the environment, we have designed this stand-alone activity. Please refer to the Carbon Cycle pdf on our website: https://guides.files.bbci.co.uk/terrific-scientific/Carbon_Cycle_Activity.pdf

WANTED: Invasive species!

Lots of our trees are at risk of disease and pests and we need your help to look for them, so we have designed this stand-alone activity. The scientists at the University of Leeds are particularly interested in any additional information you can give them about your trees. Please refer to the 'Spot the problem' PDF on our website.



Starter / Plenary activity

This activity is designed start your class thinking about trees, and the many ways in which they are beneficial to us.



You will need (per child):

- Envelopes
- Paper
- Pencil/Pen
- Copies of worksheet 'What I know about trees' (provided)
- Copies of resource 'Carbon comparisons' (provided)

1. Using the sheet provided, give your children 5 mins to list the things they know about trees on side one of the worksheet.
2. Ask them to fold up their paper and seal it in their envelope, and write their name on the front.
3. Collect the envelopes and keep them safe. At the end of the investigation, you will ask your children to repeat this exercise, this time completing side two of the worksheet, so that they can compare and reflect on their learning.
4. Discussion: Ask your class how trees are helpful to us. Collect a list of their ideas which might include:
 - a. Providing food including fruit and nuts.
 - b. Providing shade.
 - c. Home for many animals and insects, squirrels, birds etc.
 - d. Holding soil together, preventing flooding.
 - e. Fire wood – fuel for heating and cooking.
 - f. Building houses, boats etc.
 - g. Amenity value – they look beautiful.
 - h. Climbing.
 - i. Producing oxygen for us to breathe.
 - j. Removing carbon dioxide (which we breathe out) from the air and storing it.



5. Make sure you tease the last point out of your class if they don't come up with it.
6. Explain that it is this storing of carbon, which the scientists at the University of Leeds are very interested in.
7. Play your class the Trees introduction film available on our website: bbc.co.uk/guides/zgcr7p3
8. Use the classroom presentation on our website to talk your class through the investigation : bbc.co.uk/guides/zxdwpbk



Remember: At the end of the investigation you should revisit the worksheet as part of the plenary activity:

1. Give the children back their "What I know about trees" worksheet and ask them to re-read what they wrote.
2. **Class discussion: has what they know changed?**
3. Ask them to complete the questions on the second side of the worksheet, which consolidates their learning from the investigation.
4. Next, use the 'Carbon comparisons' worksheet to let the children compare the total amount of carbon stored in the trees at school with the use of everyday appliances. To complete this exercise, they will need to convert the carbon total into a CO₂ total. This is achieved by a simple multiplication, and gives a figure which can be widely compared. Instructions are on the worksheet.

Once you have a total for amount of carbon stored in the trees in your school, show your children our carbon comparison resource and let them compare how much usage of everyday items this equates to.