Westonbirt
The National
Arboretum

Growing Green

Activity Pack

Forestry Commission England

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Learning in your arboretum

Westonbirt
The National
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Contents

Roots and soil – general facts and information

Roots

Roots have two roles:

- To anchor the tree in the ground
- To take up water, minerals and nutrients from the soil to help the tree grow.

Roots grow from their tips, but not throughout the year. In temperate parts of the world such as Britain, the roots of deciduous trees are the first part of the tree to start growing in springtime. As the ground warms, the roots grow millions of tiny hairs that absorb water and nutrients from the soil. This is then channelled into rootlets, passed into the main roots and then into the trunk.

Most of the nutrients taken into the tree are absorbed by young roots.

Old roots are tough and woody, anchoring the tree.

A tap root is the root that grows down deep into the soil, anchoring the tree with extra strength. Many of our British trees do not have or need tap roots.

Lateral roots spread out sideways, mostly within the first 1m of soil from the surface.

Many species of tree need fungi to survive. The thin threads of the fungi, known as hyphae, intertwine with the root hairs of a tree. The fungi provides the tree with more water and minerals, whilst the tree provides the fungi with some of the food that it has made. Different species of fungi are associated with certain species of tree. For example, if you wish to spot a fly agaric mushroom (red cap with white spots, and poisonous) look for birch trees.

Soil

It is the soil that provides the trees with the water and nutrients it needs to grow healthily.

The bedrock weathers down to create particles of soil and provides minerals. Different bedrocks produce soils with different pH. There are two main types of soil at Westonbirt - Cotswold limestone produces an alkaline soil whilst forest marble produces a sandy acidic soil. Different species of tree will grow in each type of soil – alkaline = horse chestnut, acidic = magnolia

Dead material, such as leaves, animal droppings, rotting wood, and fallen fruits, decompose and return nutrients back to the soil. The decomposed matter is called humus.

A more detailed look at soil:

Soil is a mixture of broken down rock, decomposed organic material, air and water. There are different layers of soil called horizons differing in the composition of weathered rock, minerals and organic matter.

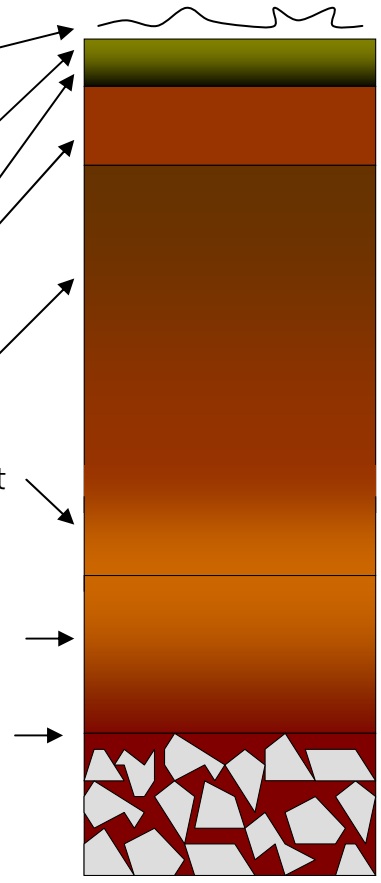
The topsoil is made up of four horizons, containing lots of decomposing and living plant and animal matter:

L Leaf litter – dead organic material
F Fermentation layer – partly decomposed organic material
H Humus – decomposed organic material
A This is where most of the plants roots can be found

Subsoil is made from two horizons, :

E Eluviation – particles are washed downwards from the E horizon to the B horizon
B There will be a change in colour in this layer as minerals that have leached through the soil are deposited where the B horizon joins C horizon

C Weathered bedrock – a layer where the bedrock has been broken down
D Bedrock or Regolith – the parent rock



Sandy soil allows water to drain away quickly making it harder for the tree to take up enough water.

Clay soil retains too much water becoming waterlogged. This makes it harder for the tree to survive as the tree roots need oxygen. The soil also becomes unstable, and it is more difficult for the tree to anchor itself.

Earthworms are important because as they burrow they create channels for the air to spread throughout the soil to reach the roots.

1. Root explorers

1. A tree where you can see the roots going down into the ground ☐

2. Nibble marks on a tree root – who do you think has been munching? ☐

3. Animal burrows that use a tree's roots as a roof to the home

Mouse or vole ☐

Rabbit ☐

Fox ☐

Badger ☐

(Hint: an animal will dig a tunnel about the same width as its body)

4. Roots uncovered where a badger has been digging for worms ☐

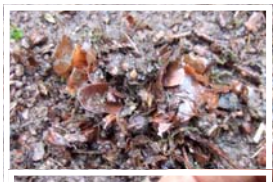
5. Two trees whose roots will be intertwined ☐

6. A tree with enough space for the roots to spread out ☐

2. Soil explorers

1. Charming earthworms - can you make a worm come to the surface? ☐

Worms are sensitive to vibrations – if you drum of the ground with your hands or feet you may find an earthworm popping out of the ground! It is thought that the drumming sounds like rain and the earthworm comes out of the ground to avoid drowning underground.



This is a little pile of leaves and stalks. They plug up the worm tunnel to stop water and predators from getting inside. The leaves and stalks will be pointing inwards. ☐

When you find a worm plug, gently lift it up to see the tunnel beneath but be sure to put it back to safeguard the worm. ☐

Little piles of mud that look like mud toothpaste! This is worm poo, and is fantastic plant food. ☐

5. Orange-brown sandy soil ☐

6. Darker brown crumbly soil ☐

7. Things that provide soil with nutrients

Dead leaves ☐ 

Twigs ☐

Fallen seeds and fruits ☐

Animal poo ☐

Feather ☐

Snail shells  ☐

8. Rich almost black layer of humus – decomposed matter ☐

3. Root networks

The roots of a tree spread 1½ to 4 times as far as its branches. The actual distance will depend on the species of tree, the depth of soil and how nutrient-rich the soil is.

Here are two ideas that help to show the extent of this amazing network.

Activity A – A quick, but great visual way of exploring root networks

1. Select a tree with branches above the children's head. Ask a few children from your group to stand where they think the roots reach to under the ground.
2. Now gather the whole group at the trunk, facing outwards. Ask each child to look forwards and upwards whilst walking in a straight line away from the trunk until they are standing at the tip of the branch.
3. Explain that the roots of the tree reach at least as far as they are standing, in fact the roots are underneath their feet, reaching out even further, as much as 1½ to 4 times as far as they are standing.

Extension

4. Pair up the children, and ask them again to stand at the ends of the branches. One child stays at the spot whilst the other measures the distance from the tree trunk (any method will work – e.g. tape measure, strides, toe-to-heel steps).
5. Ask the pair to calculate the distance / no of strides / number of steps for 1½ times the branch length. From the trunk measure / pace out this distance and stand at this new position. This is the minimum distance the root network will spread out to.
6. If the location is suitable, ask the pair to calculate the distance / no of strides / number of steps for 4 times the branch length. From the trunk measure / pace out this distance and stand at this new position. This is the furthest distance the root network may spread out to.

Q1 Will the roots spread out further in deep or shallow soil? Why?

Q2 Will the roots spread out further in poor quality soil or rich soil? Why?

Hint: Think about what the roots take up from the soil and which option will provide this most easily.

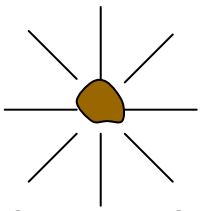
Activity B – Creating a root network map

This activity is an extension to 'Canopy Maps' – the full method is included below. It creates a bird's eye view of the tree, including the extent of both the canopy and root network.

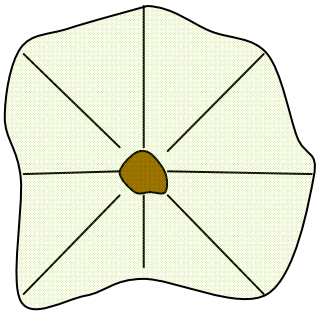
Additional resources

8 x 2m lengths of string or rope

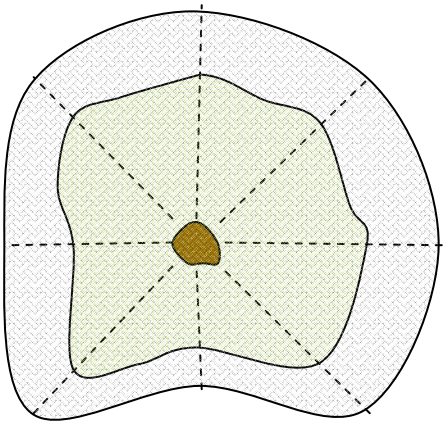
1. Select a tree with branches above the children's heads. Lay out the 8 pieces of string or rope, radiating straight out from the trunk like 8 points of a compass (the orientation of N is not important).



2. In pairs ask the children to follow one of the pieces of string, continuing in a straight line until they reach the end of the furthest branch, or edge of the canopy. Measure this distance and record.
3. Repeat for all 8 directions, travelling around in a clockwise direction.
4. Transfer and plot the 8 recorded distances on a scale drawing at 1:10 where 1m = 1cm, and 10cm = 1mm. Join the 8 dots to form a roughly circular canopy.

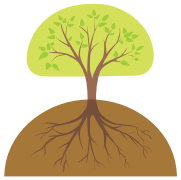


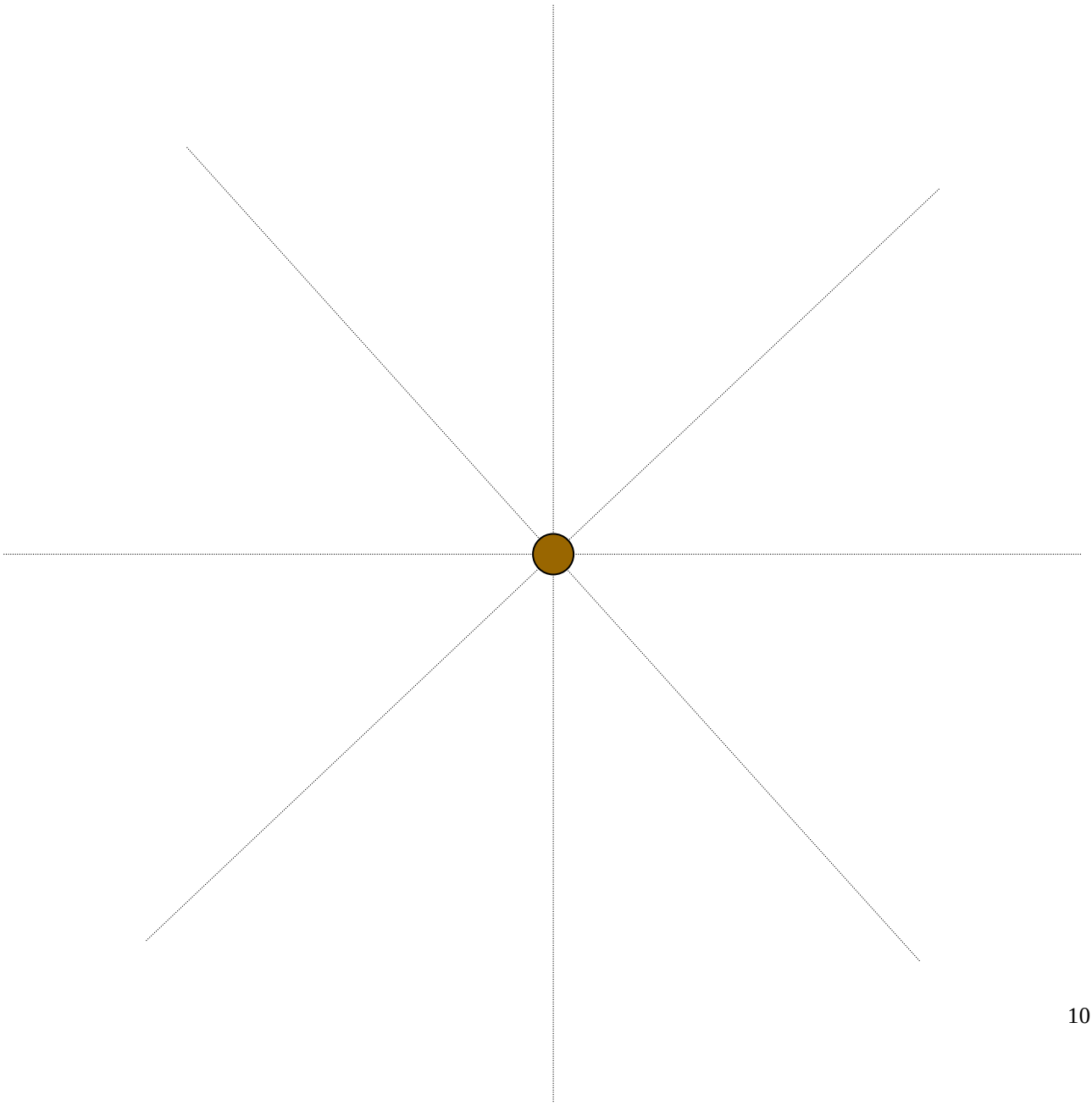
5. Now add in the root network for 1½ times the distance of the canopy to complete the map.



4. Root network and canopy map

- Set out the 8 pieces of string or rope in straight lines that look like the 8 points of a compass with the trunk in the centre.
- Follow along a piece of string, continuing in a straight line until you reach the end of the furthest branch and measure this distance.
- Repeat for all 8 directions.
- Plot these on the scale map below – where 1m = 1cm, and 10cm = 1mm
- Join the dots in a rough circle to represent the tree canopy.
- Plot the root network by calculating 1½ times the distance for each of the 8 directions. Join these dots to represent the root network.





5. The mucky hand test

Soil is a mixture of broken down rock, decomposed organic material, air and water.

Farmers use a simple soil test like the one below to discover what kind of soil they have in their fields. There are lots of other tests a farmer or forester can do to find out exactly what kind of soil they have.

At Westonbirt we want to know as much as we can about soils so that we plant the most suitable plants in them.

You will need

- Small bottle of water
- Sample of soil

1. Add enough water to the soil sample so that you can knead it for a few moments in your hand.
2. Try and make the following shapes. The shape you get most easily will tell you what type of soil you have.

	Shape	Type of soil
	Cone	Sand
	Ball	Loamy sand
	Worm	Loam
	Bent cracked worm	Clay loam
	Bent smooth worm	Clay

The final shape you get is the soil texture, for example, if a worm shape can be made but it breaks if bent, it is a loam.

6. Fun with fungi: making spore prints

The spores of a mushroom are enormously important in the process of identification. Microscopic details - like the size of the spores, their shape, whether they are smooth or ornamented (and so on) – are frequently used by mycologists (people who study fungi) to help them decide what species a mushroom is. Although amateurs don't usually have high-powered microscopes at their disposal, a mushroom's spore colour is still useful in the identification process. While a single spore can't be seen by the naked eye, a pile of many spores can be seen, and the colour can be determined easily. Making a "spore print" is the best way to view spore colours.

How to make a spore print.

Umbrella-type fungi are the most suitable for prints. Unless you are an expert, use a mushroom brought from your local super-market, as there are lots of poisonous fungi varieties. If you do pick a mushroom from the wild, always wear gloves and wash your hands after handling. Remember that bracket fungi, puffballs and stink-horns are unsuitable.

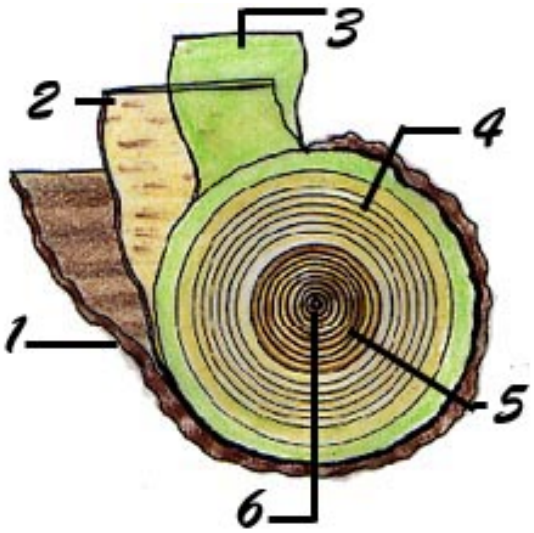
1. Pick and handle the mushrooms very gently.
2. Cut away the stem flush with the rim and place the fungus, gills down, on a sheet of paper. Fungi with white gills print well on dark paper, while those with black ones show up better on light paper.

   [Note: for purposes of identification, many mycologists recommend white paper for more precise identification of light-coloured spores.]
3. Cover it with an inverted bowl or jar to prevent drafts affecting your print.
4. Leave the fungi overnight to allow the spores to be released onto the paper. A mushroom of the same type, similarly cut and placed on a sheet of paper but left uncovered can be lifted at intervals to check the release rate. Don't leave your 'printing' cap too long as the definition of the lines is lost and the ridges of the spores fall and smudge.
5. Make the print permanent by spraying with fixative spray (hair lacquer can be used for black prints).

For variations try slightly elevating one side of your cover dish to allow drafts in. This will create wispy effects. You can overlap caps or make one print on top of another. Experiment! See what pattern variations you like best and make some unique stationery.

Tree trunks – general facts and information

The structure of a tree trunk



1. The outer bark protects the tree from extreme temperatures, bad weather, insects and fungi.
2. The phloem (bast) is also called the inner bark. It conveys the food-bearing sap developed in the leaves down to the various parts of the tree.
3. The cambium is a thin layer of cells, which produce phloem on one side and xylem (sapwood) on the other.
4. Sapwood is the living wood in the tree through which the raw sap rises from the roots to the leaves.
5. The heartwood consists of old cells. This is the dead part of the tree that nevertheless provides structural strength.
6. The pith is the central core of the tree (missing in many species).

In areas where there are pronounced seasons, tree form new cells, arranged in concentric circles called annual rings or annual growth rings. These annual rings show the amount of wood produced during one growing season. Rings are made up of a light and a dark band. At first, the cambium produces numerous large cells with thin walls that form the springwood (earlywood). If you look at a cross section of a tree, this is the light-coloured band. The function of springwood is to help the transport of water to the buds. Then, towards the end of the summer, growth slows down. The cells manufactured at this time of year are small, with thick walls. They form the summerwood (latewood) which appears as a darker band on the tree cross section. This wood is primarily for support and strength.

The darker wood is not formed in winter, as some people believe, because the cambium is completely inactive in the winter.

The following year, a new two-part ring is added. The older rings are closest to the centre of the tree. The tree grows in diameter because it manufactures new cells around its circumference, not because the old cells get larger.

The old annual rings form the heartwood of inactive cells: this is the dead part of the tree. The live portion includes only the most recent rings. Depending on the tree's age and species, this portion is 1.5 to 7.5 cm wide. The dead wood is the largest part of the tree. Often, it takes on a darker colour.

Rings are narrower in years of low rainfall.

The three main things we can tell from tree rings are

- age of the tree
- clues to the growth of the tree and factors affecting it e.g. reaction wood, fungal attack, where branches grew (knots), site conditions
- past weather patterns, particularly rainfall.

Bark facts

- The bark is essential for protecting the tree against animals, fungi, disease, and from drying out.
- For most trees, when the bark is damaged, it allows a way for fungi and disease to get into the tree, affecting the health of the tree. Tree sap will ooze out of the cut and harden in an attempt to seal the damaged area. However, if the bark is stripped off all around the tree, most species of tree will die.
- Cork oak trees can survive the outer bark being stripped halfway around the trunk as it will regenerate.
- The Wellingtonia, or giant redwood, has spongy, fibrous bark that can be up to 30cm thick. It's fireproof - protecting the tree from forests fires
- The bark of many young trees is fairly smooth – it develops cracks as it grows older
- The horizontal dashes seen in birch bark are called lenticels. They are pores that allow gases from the air to reach the wood beneath. All plants take in gases through their stems /trunks as well as their leaves. You may notice that birch bark peels off naturally. When the lenticels become blocked with algae or pollution, fresh bark is grown beneath, allowing the old bark to peel away, cleaning the trunk.

Trunk facts

- The centre of the trunk is called heartwood. It is very strong and enables the tree to grow tall, supporting the weight and spread of branches. This gives the tree an advantage as it gains good access to sunlight, shading out the ground plants below.
- Each year the girth of a tree increases, a new ring grows just under the bark, and this is necessary to support the extra height and spread of longer / new branches.
- The trunk also houses the transport network of the tree. There are two different types of tubes running up the length of the trunk – phloem that carry food-bearing sap, and xylem that carry the water and minerals from the roots up to the leaves.
- A mature oak tree can absorb 50 gallons of water in a day – that's the equivalent of 227 litres, or 689 cans of lemonade! On a hot day it can be more than this.
- The tallest tree in the world (an therefore the longest trunk) is called 'Hyperion' - a coastal redwood 115.5m high.
- The type of tree with the largest trunk (the greatest volume of wood) is called 'General Sherman' – a giant redwood or wellingtonia

7. Trunk explorer

1. Bark that feels

Texture	*Name of tree*	
Smooth		
Rough		
Silky		
Prickly		

2. Bark patterns

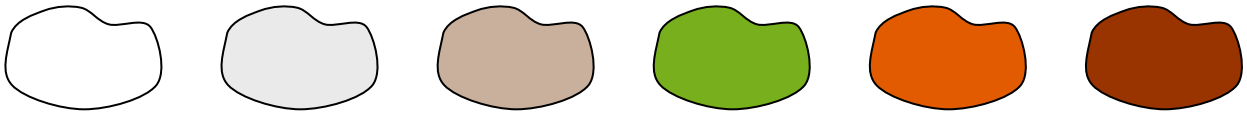
dashes

spotty

diagonal stripes

jigsaw

3. Find bark that matches these colours



4. Damaged bark low down on the trunk – circle which animals may have caused the damage

5. Damaged bark high up on the trunk – circle which animals may have caused the damage

6. Sticky oozing sap
(the tree is trying to protect itself because it has been damaged)

7. Peeling bark
(the tree is cleaning itself where the bark's pores have been blocked by algae or pollution)

8. Things growing on the bark

green furry moss

feathery lichens

fungi

9. Signs of things living in the trunk

round woodpecker hole

larger hollow for an owl

loose bark where bats can roost

10. A trunk you can reach your arms around

11. A trunk that needs more than 3 people to reach around it

12. A trunk that smells good!

8. Bark casts and bark books

recording diversity through clay and plasticine imprints and rubbings

These activities will give your students the opportunity to make careful observations of the bark as well as learn to use bark to classify and identify trees. Winter is an excellent time of year to do this activity as the barks of many trees are very prominent at this time of year

Bark casts

Materials

- modelling clay
- plaster-of-Paris
- base board
- 42cm card strip stapled into a ring about 2 inches high
- tree ID guides with bark patterns shown for different species

Method

1. Prepare by flattening out a stick of modelling clay or plasticine so that it forms a rectangle about half an inch thick.
2. Press the flattened clay hard into the bark of a tree. (Make sure that students push on the back of the clay as hard as they can.)
3. Carefully pea
4. el the clay off the bark.
5. Place the card collar over the clay and push down – this will stop the plaster of Paris from oozing out.
6. Mix plaster-of-Paris and pour into the bowl. Let it set. When hard remove clay or plasticine.

Questions

- Have students group the casts according to similarities and explain why they grouped them the way they did. See if the students can identify individual species from their bark cast patterns.
- Discuss with students the importance of making careful observations. You may want to have the students paint the casts to make them look like the bark. Be sure that they try to paint their casts match the bark of the tree - not just paint it brown.

……...

Bark books

Provide the group with a selection of papers and crayons. Demonstrate how to take a rubbing and give them time to experiment and discover how to achieve a good print. Invite them to collect rubbings of a variety of trees to make into a bark book back at school. Remind them to record the name of each tree.

9. Story of a tree's life

examining tree rings to tell the story of how a tree grows

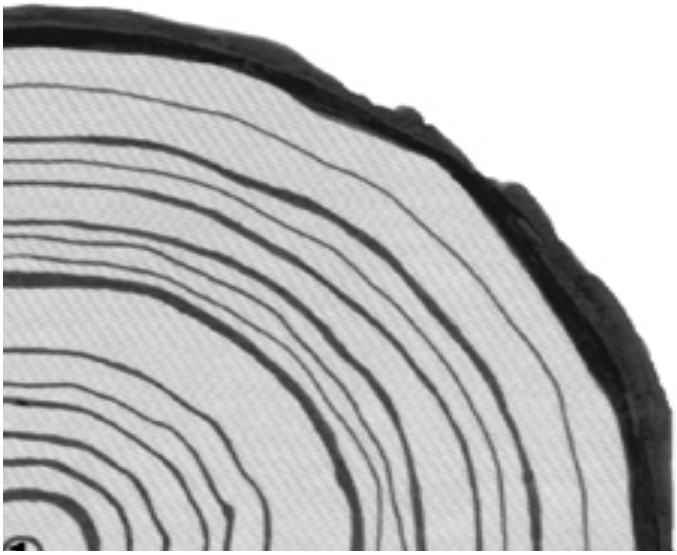
Dendrochronology is the dating of past events (such as climatic changes) through the study of tree ring growth. A tree's growth can be affected by rainfall, sunlight levels, wind, temperature, soil properties, snow accumulation and competition from other trees.

Look for a tree stump or fallen trunk and examine the rings. What can you find out about the tree's life?

Each year a tree grows a new ring just beneath the bark.

Each ring is made up of two bands:

- a light band (the quick growth of spring)
- a darker band (the slower growth of late summer)



Not every annual ring is the same:

- In warmer, wetter years, trees grow well so the ring will be thicker
- In colder, drier years, trees do not grow so well so the ring will be thinner.

- If the rings are narrow on one side of a tree with wide rings on the other, the tree was either crowded on the side of the tree where the rings are narrow or exposed to the wind.
- The side with wider rings shows the tree had more space to grow or was sheltered from strong winds.

10. Ancients of the wood

using tree girth to calculate the age of trees

Foresters measure a tree's girth, or circumference in order to calculate its approximate age, the volume of timber in the tree and even how much carbon is stored in the wood.

Find an oak, Scots pine, yew or horse chestnut tree to measure




Method 1

1. How many of your hand spans does it take to go around the trunk?

Hand spans

2. Using a ruler, measure how wide your hand span is.

cms

3. Using your hand span measurements, estimate how big the girth of the tree is.

	X		=	

In Europe, Britain, Canada and Australia tree trunk girth is measured at a fixed height of 1.3m above the ground - a point called **Breast Height**.

Method 2

4. Using a tape measure, measure the girth of the tree at breast height.

5. Does this measurement differ from your hand span estimate?

6. Can you think of any reasons why?

You can use the girth of a tree to work out its approximate age. Different types of tree grow at different rates. The table below shows the average growth rate of a selection of trees, how much the girth increases each year.

You can find out the age of the tree by dividing the girth by the growth rate.

Type of tree	Average trunk growth rate (girth) per year (cms)
Sycamore	2.5
English Oak	1.5
Cedar of Lebanon, London Plane, Douglas Fir	7
Scots Pine, Horse Chestnut, Common Lime	1
Yew	0.7

7. Using the table work out the girth of a 100-year old Cedar of Lebanon tree.

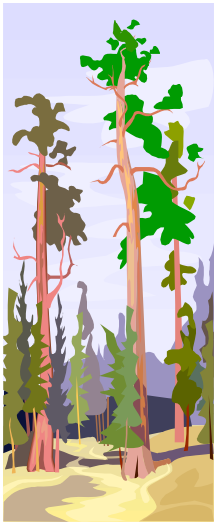
8. Using the table work out how old a Common Lime with a girth of 135cm would be. Is it older or younger than a Sycamore with a girth of 315cm?

9. Now use the table to work out the age of your tree.

11. Sun seekers

measuring tree height in a variety of ways

Foresters use tree height for many things. Tree height can give a clue as to how old a tree is. It can also reflect the quality or fertility of the soil. The height of a tree can indicate a trees' dominance within the forest canopy, and is used to calculate the amount of timber per tree.



There are several different ways to measure the approximate height of a tree.

Try each of the methods for the same tree and see if you arrive at similar answers.

Look for a tree that stands separate from the rest as you will need the space around it to help you measure.

Resources

- Calculator
- Tape measure
- Ruler or fairly straight stick
- Clinometer

Method 1

Working as a group, estimate the height of your tree as follows.

(a) First measure the height of one person.

	cms

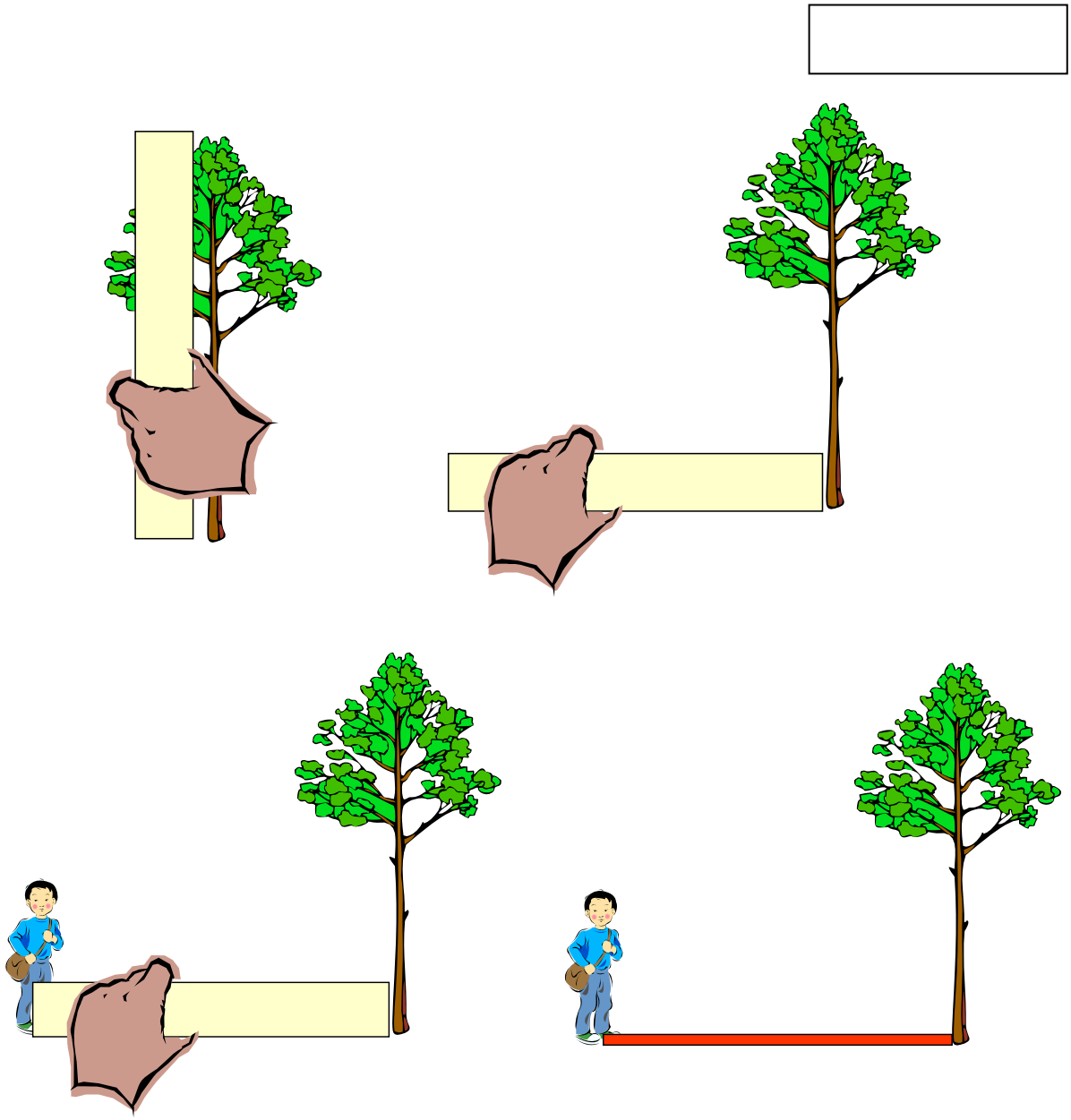
(b) Get that person to stand straight against the tree while the rest of the group stands at a distance and estimates how many "heights" of that person make up the tree height.

(c) To calculate the height of the tree, multiply the height of the person (a) by the number of person heights it takes to make the height of the tree (b).

	(a)	x	(b)	=

Method 2

1. Working in pairs, have your partner stand at the base of the tree while you back away from the tree, holding a ruler or stick in front of you in a vertical position. Keep your arm straight.
2. Stop when the tree and the ruler or stick appear to be the same size. (Close one eye to help you line it up.)
3. Turn your wrist so that the ruler looks level to the ground and is in a horizontal position, keeping your arm straight.
4. Now get your partner walk to the spot that you see as the top of the ruler. Be sure the base of the ruler is kept at the base of the tree.
5. Finally measure the distance between your partner and the tree – this is the tree's height.

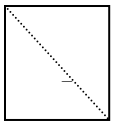


Method 3: Using a clinometer

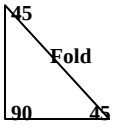
Making a simple clinometer

You will need:

- A square piece of card
- A drinking straw
- A length of string
- Sellotape
- A weight (such as a washer or nut)

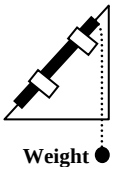


1. Fold the card to form a triangle.



Since the paper was square, an isosceles triangle will be formed – 2 sides of equal length, a 90 degree angle and two 45 degree angles.

2. Tape the drinking straw along the long edge of the triangle. The straw will be used as a sight.



3. At the upper end of the long fold attach the string. Tie the weight to the other end of the string, making it long enough so that the weight dangles a few inches below the corner of the triangle (see diagram). Held as shown in the diagram, the student will look up through the straw.

Using your clinometer (in pairs)

1. One student looks up the straw to sight the top of the tree, while the other student guides and tells them when the string is hanging straight down (i.e. when the string is vertical or parallel to the edge of the card).
2. When the student sighting through the clinometer can see the top of the tree with the string hanging straight down they are as far away from the tree as the tree is high. They can now simply measure the distance from where they are to the base of the tree (Remember to add on the height from the student's eyes to the ground!)

Using your three answers work out the average height of the tree.

12. Carbon calculator

using girth to calculate how much carbon a tree stores

Activity: Use a calculator, a tape measure and a nearby tree to measure how much carbon is stored inside.

Trees take in carbon dioxide from the atmosphere and store it as carbon in their trunk, roots and leaves. They can help us to reduce climate change.

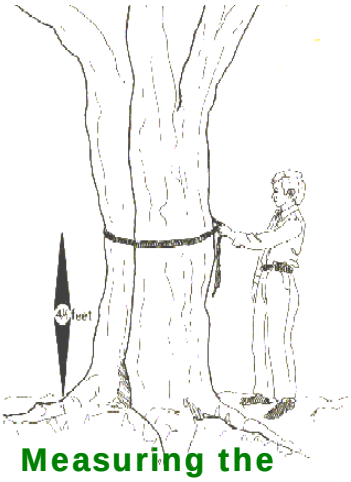
Follow the steps below to calculate the amount of carbon stored in a tree.

Approximately half of the dry weight of a tree is carbon. Therefore to work out how much carbon your tree is storing, we must first work out its dry weight.

You can also work out how much carbon dioxide was absorbed from the atmosphere to create that carbon store.

1. To calculate dry weight first of all you must use the tape measure to measure the circumference of the tree. Give the tree a big hug! The circumference is the distance all the way around the trunk at about chest height.
2. When you've measured the circumference look at the table below to convert this to dry weight. Use the nearest value in the table to the one you have calculated.

Circumference (cm)	Dry weight (kg)
50	106
100	668
150	1,964
200	4,221
225	5,771
250	7,641
275	9,842
300	12,410
325	15,350
350	18,700
400	26,674



Measuring the circumference

3. Because half of the dry weight of the tree is carbon, you then need to divide your answer for the dry weight by 2. This tells you how much carbon is stored in the tree.

One step further…

4. You can calculate how much carbon dioxide was absorbed to create this carbon store by multiplying your figure for carbon by 3.67.

Example

The circumference of a tree is 150cm. Looking at the table this means its dry weight is about 1964kg. Dividing this by 2 tells us that the tree is storing 982kg of carbon. Multiplying this figure by 3.67 tells us that the tree has absorbed 3604kg of carbon dioxide throughout its lifetime.

Up in the canopy – general facts and information

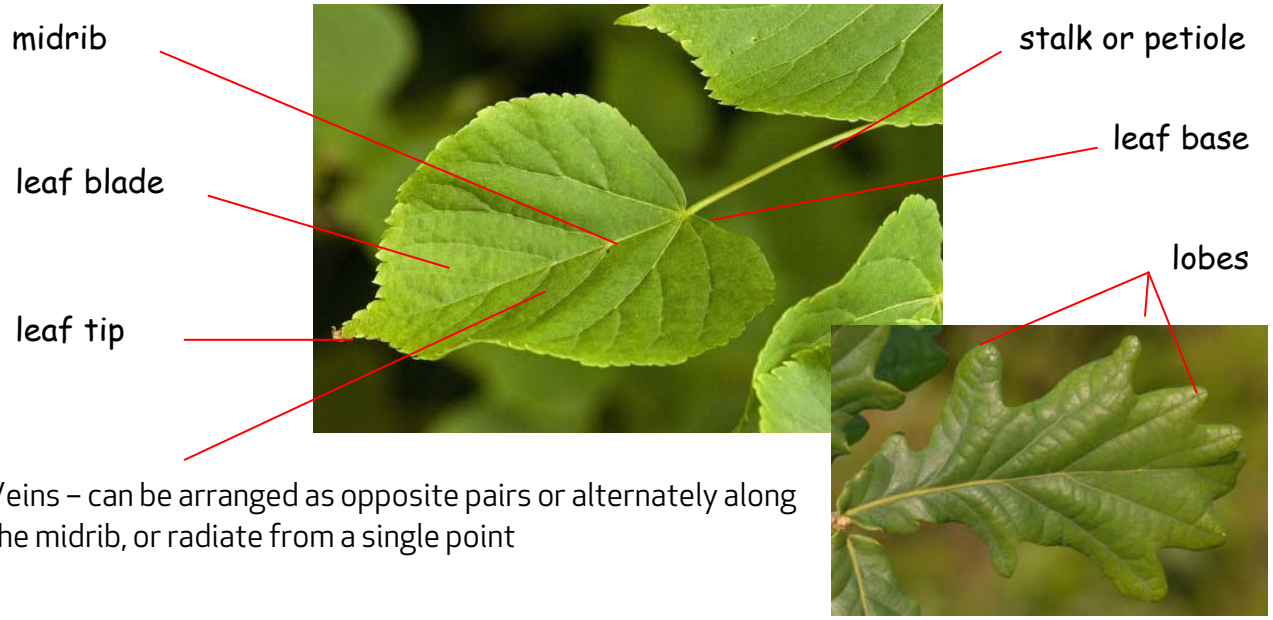
Leaves

- Leaves are the food factories of the plant. They contain a green pigment called chlorophyll which is able capture sunlight energy and use it to turn carbon dioxide and water into sugars and oxygen. This process is called photosynthesis.
- The veins in a leaf are the vessels that carry water into the leaf and transport the sugars out of the leaf to feed the rest of the plant.
- Leaves have tiny holes called stomata, through which carbon dioxide is taken in from the air, and oxygen is released in the air. Water is also lost through these holes.

Leaves can be divided into the following groups:

- Simple leaves – a single leaf
- Compound leaves – a group of leaflets arranged along the leaf stalk
- Needles – individual, clusters, whorls, pairs, threes, fives etc.
- Scales – a series of overlapping flattened leathery leaf scales

Parts of a leaf – useful when identifying or classifying / sorting leaves



Veins – can be arranged as opposite pairs or alternately along the midrib, or radiate from a single point

Edges – leaf edges can be toothed, jagged, wavy or smooth

Flowers

- Tree flowers come in a huge range of shapes and sizes.
- All broadleaved trees produce flowers, whilst conifers grow male and female cones, simpler structures than flowers.
- The flowers most easily spotted are those that are insect pollinated. These will use colour and scent to attract the insects, often producing nectar for the insect to drink. Examples include magnolias, cherry, hawthorn, and horse chestnut.
- Many tree flowers are wind pollinated. These flowers tend to be inconspicuous, greens, browns, pale yellow, and have no scent as they do not need to attract insects. Some are in the form of catkins. Examples include hazel, birch, alder, sweet chestnut and oak

Flowers and pollinators

Different colours, scents and shapes of flowers will attract different insects

(a) bees – prefer yellow, blue or purple. They are often marked with spots, lines or other patterns and will be scented at specific times of the day

(b) butterflies – prefer strong, bright colours such as red, purple and white

(c) moths – many moths fly at night and will therefore visit night scented white or pale yellow flowers

(d) open and flat flowers are often pollinated by butterflies as they are easy for them to land on. The nectar is often found at the end of a long petal tube

(e) bell-shaped flowers can be pollinated by wasps, flies and bees

(f) tube-shaped flowers such as the foxglove are pollinated by bees

(g) daisies and dandelion can be pollinated by many different insects, including butterflies as there is a good landing platform for them to stand on

(h) large cup-shaped flowers such as magnolia can be pollinated by beetles – they need the large cup shape to aim for as they are heavier than many insects and clumsy fliers

Seeds - Different types of tree seed

Winged – maples, sycamore, birches, alder, conifers


Fleshy fruit – berries, arils (yew) and fruits such as apples, pears


Nut – acorns, horse chestnuts (conkers), sweet chestnuts, beech nuts, hazelnuts


Nutlet - hornbeam

Drupe – a fruit with one seed

Follicle –magnolia – seeds held by a hair


Pods - robinia

13. Leaf I-spy – spring, summer and autumn

Leaves come in all shapes and sizes and yet they all have the same job – to absorb sunlight to make food for the plant. As you walk around, which of these types of leaf can you spot?

			
A leaf with a smooth edge	A leaf with a jagged or toothed edge	A leaf with a wavy or lobed edge	A prickly leaf
			
A leaf with a point only at the tip	A leaf with points at both ends	Needle-like leaves	Long and thin leaves
			
A triangular shaped leaf	A star-shaped leaf	A leaf with 5 fingers	A round or oval leaf

Four for you to draw

A soft and furry leaf	A shiny waterproof leaf	A leaf that tickles	A leaf that feels rough like sand

14. Leaf activity walk - autumn

Leaves come in all sorts of colours, shapes, and sizes. Some have hidden scents, some make wonderful sounds and there are many different textures to explore.

- Look for these leaf shapes.





- Find leaves that feel tickly or prickly, waxy or hairy, rough or smooth.

- Make a leaf pile, put you feet into it and rustle or stomp to create leaf music.

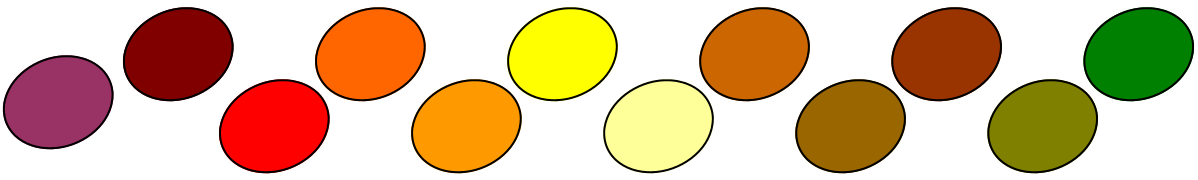
- Lay some leaves in a line on the floor to create a leaf snake winding through the trees.

- Watch the leaves dance as they fall to the floor.

- Stop still and listen to the wind in the tree tops.

- Find a Douglas Fir where Loop Walk meets Holford Ride. Rub the leaves and smell the hidden citrus scent.

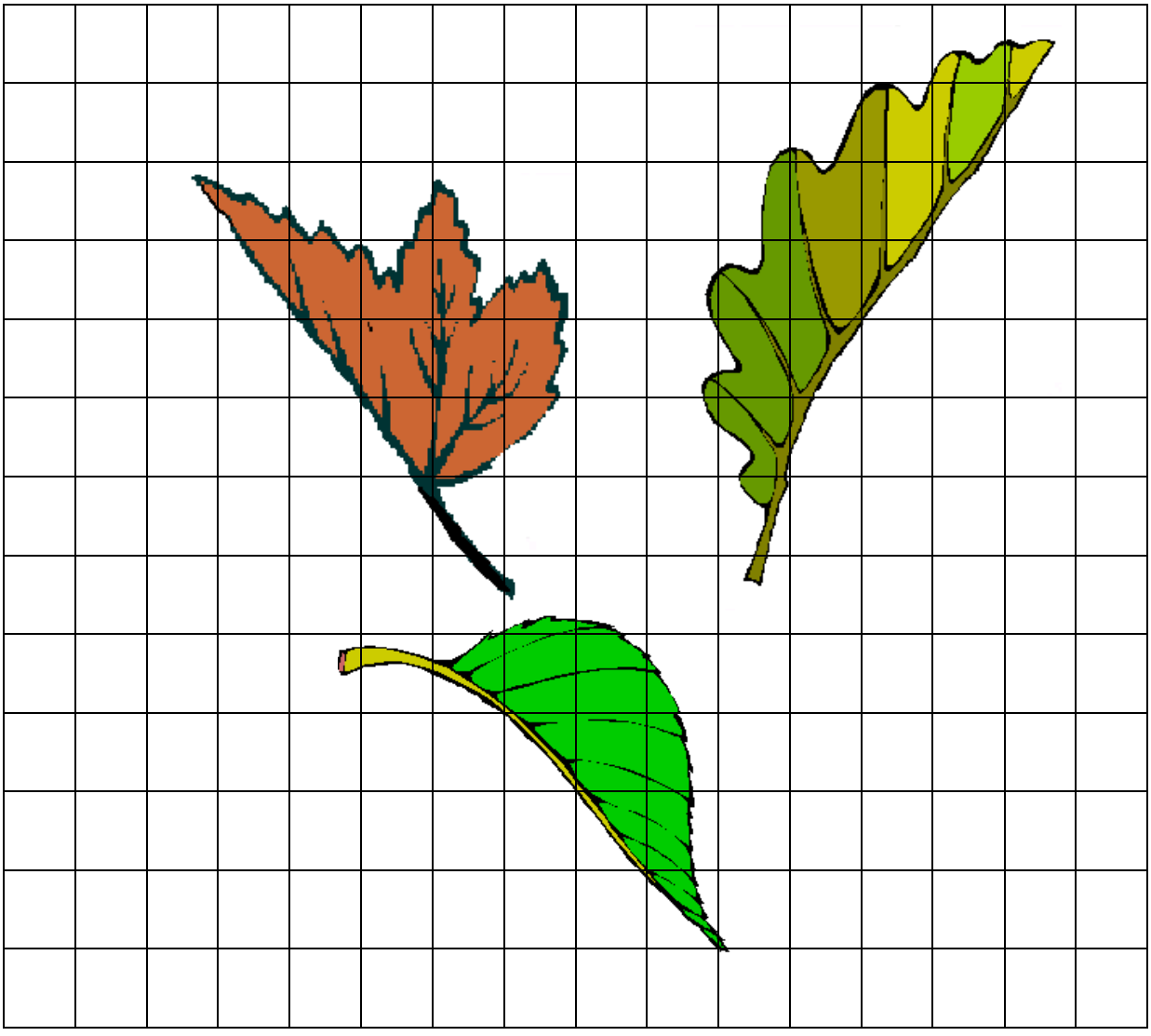
- Match as many of these autumn leaf colours as you can.



15. Leaf activities – symmetry and area

You will need to bring cm squared paper with you to do Q5

1. Using the templates below and your knowledge of reflective symmetry draw the other half of the outline of the leaf onto the squared paper.



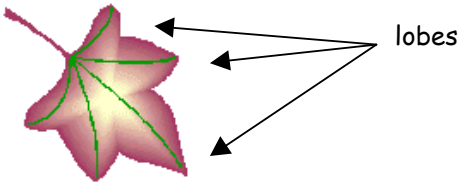
2. Work out the area of each leaf in cm"

3. Which leaf has the largest area?

Plants lose water through tiny holes in their leaves called stomata. The larger the area of the leaf, the more stomata it is likely to have.

Different leaves have different ways of limiting water loss:

- If a leaf has lobes, it is similar to parts of the leaf being removed and this reduces the area of the leaf,



- It may have a thick or waxy coating,
- The leaf may be small, or even needle-like, with a much smaller surface area and fewer stomata to lose water through.

4. Using the table decide which leaf may lose the most water, and which may be best at limiting water loss.

Leaf	*Size*	*Thick or waxy coating?*	*Lobes?*
Oak	Medium	No	Yes
Maple	Medium	No	Yes
Scots Pine	Needle-like	Thick and waxy	No
Magnolia	Large	Thick	No
Birch	Small	No	No

5. Collect 3 leaves and draw round them onto centimetre squared paper.

- Work out the area of each of the 3 leaves.
- What is the average area of these 3 leaves?
- Which of your leaves would lose the most water? Why?

16. Quick leaf activities

Guess the feature

1. Ask every child to collect 5 different leaves from the woodland floor, of their own choice.
2. Give the children time to look closely at their leaves and place them in an order – e.g. from dark to light, small to large, wide to thin, smoothest edge to most jagged edge, smoothest to roughest etc.
3. Pair the children, ask one to display their leaf order and ask the other child to guess before swapping.

Extension

4. Ask each pair to choose one of the ways of sorting that has just been shared.
5. Give the pair time to combine all 10 leaves and place them in the chosen order.
6. Now group two pairs together, each pair taking it in turns for the others to guess before swapping over.

Guess the leaf

1. Collect 2 each of 6 – 12 different types of leaf, depending on the age of your group.
2. Sit or stand the children in a circle with one set of the leaves displayed on the floor in the middle.
3. In secret, pop one of the leaves from the second set into a bag.
4. Pick a child to put their hand in the bag and describe what they feel. Encourage them to describe size, shape, edge, texture etc.
5. Can the rest of the group guess which leaf is being described and find it from the set in the middle of the circle. If possible name the leaf.
6. Repeat with some of the remaining leaves.

What am I?

1. Collect a variety of different leaves, show and name them with the group and then put into a bag.
2. Choose one child to ask questions. With their back turned, pick one leaf out of the bag and show it to the rest of the group.
3. The chosen child now asks the group yes/no questions for the group to answer, until they guess which leaf was picked out of the bag.

   If you know which leaves you are likely to pick beforehand, make a picture card that the child guessing can look at to help.

17. Leaf ID team challenge

This activity challenges students to collect a variety of different leaves, create a simple key, and then use identification features to play a team challenge game.

Materials to bring

- Piece of fabric (optional but helps students to see collected leaves clearly on a potentially leafy woodland floor)
- Paper and pens / pencils

Activity

Part 1

1. Divide your group into small teams or 5 or 6 children. Write each team name on the score sheet.
2. Give each team a photo list of 10 - 12 leaves they have to find and ask them to collect one of each type. Stress to the group that they must collect a fallen leaf whenever possible. NB. All teams need to find and collect the same species.
3. Ask each team to sort the leaves through a series of yes / no questions to create a key. (Each team will probably create a different key, but the important part of this task is that the team has looked closely at the distinguishing features of each leaf and named them.)

Part 2 – teams can choose to use their keys for this part although it will slow them down!

4. All collected leaves need to be placed on the fabric, or in one clearly marked location.
5. Line the teams up a short distance away from the gathered leaves. Give each child in the team a number.
6. Call out a number and a leaf name. The child of that number from each team needs to run to the gathered leaves, select the one they think it is and then come to you. Ask the children to replace the leaf before the next round.
7. Score as follows: 2 points for the first team to bring the correct leaf, and 1 point for every other team who also selects the correct leaf.
8. Repeat for all leaves – ideally each child would have two goes.

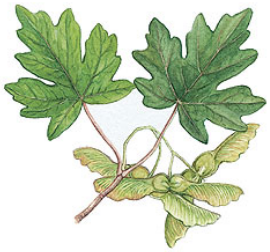
(See suggested picture lists and score card below)

Leaf ID team challenge - suggested picture list

(All of these trees can be found at the Native Tree Collection, along the Native Tree Trail)

ash

Scots pine

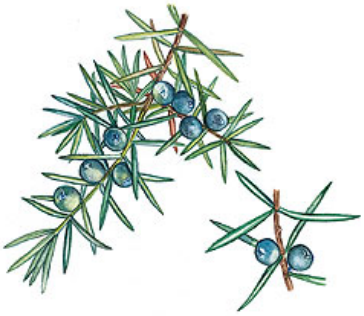


field maple

oak

hawthorn

willow



juniper

whitebeam

lime

hazel

birch

beech

Leaf ID team challenge - score sheet

	Team 1	Team 2	Team 3	Team 4	Team 5	Team 6	Team 7
Number 2 - oak							
Number 6 - birch							
Number 3 - beech							
Number 1 - whitebeam							
Number 5 – hazel							
Number 4 - juniper							
Number 6 – willow							
Number 1 – Scots pine							
Number 3 – ash							
Number 4 – lime							
Number 2 - hawthorn							
Number 5 – field maple							
Total scores							

18. Buds and twigs Explorer Challenge

Dec – Mar

Suggested location - Native Tree Collection

terminal bud – the bud at the tip of the twig

lateral bud – the side buds along the length of the twig

leaf scar – this shows where a leaf was growing before it fell off in autumn

girdle scar – a ring around the twig that shows how much the twig has grown each year – count the girdle scars and you can tell how old the twig is

1. Choose a twig on a nearby tree and see if you can discover the following:
   - The twig's age – count the girdle scars
   - How many lateral buds does it have?
   - Find the terminal bud
   - What shape are the leaf scars?
   - Can you see small dots in the leaf scar?
     These are the holes where the xylem tubes once carried water into the leaf and where the phloem tubes carried sugary sap away from the leaf to feed the tree.

2. Exploring the trees in this area look for and name a tree that has:

A twig with pairs of bud opposite each other 		A twig with buds alternating from one side to the other 	
A hairy twig			
A twig with thorns			
Buds lying flat along the twig			
Buds sticking out from the twig			
A twig with a cluster of buds at the tip			
Black buds		Green buds	
Purple buds		Dark brown buds	
Reddish buds		Grayish buds	

19. Flower search – April – July

- Some flowers are bright, colourful and scented in order to attract insects.
- Flowers are different shapes – each shape will suit a different type of insect.
- Insects benefit by drinking the sweet, sugary nectar.
- Plants benefit as pollen will stick to the insect's body, hopefully to be carried away to pollinate another flower.
- Not all flowers are colourful or scented. These are usually pollinated by the wind.

As you walk around the arboretum, which of these can you spot?

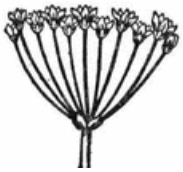
1. Look for these different shaped flowers. Which could a butterfly land on?

flat open flower

bell-shaped flowers

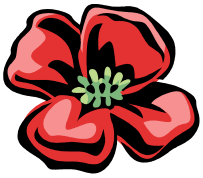
tube-shaped flowers

cluster of many tiny flowers in one flower head



tiny flowers on stalks like an umbrella

2. Which of these types of petals can you spot?



four petals

five petals

many petals

pointed petals

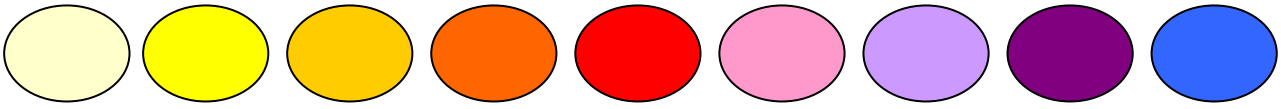
notched petals

3. Can you find and name 5 different tree flowers? Some will be wind pollinated and difficult to spot as many will be green. Some tree flowers are tiny. Look closely!

4. If you spot a bee visiting a flower, wait and watch where it goes. What shape of flower is it visiting?

5. Which colour of flower smells the strongest? Which scent do you like best?

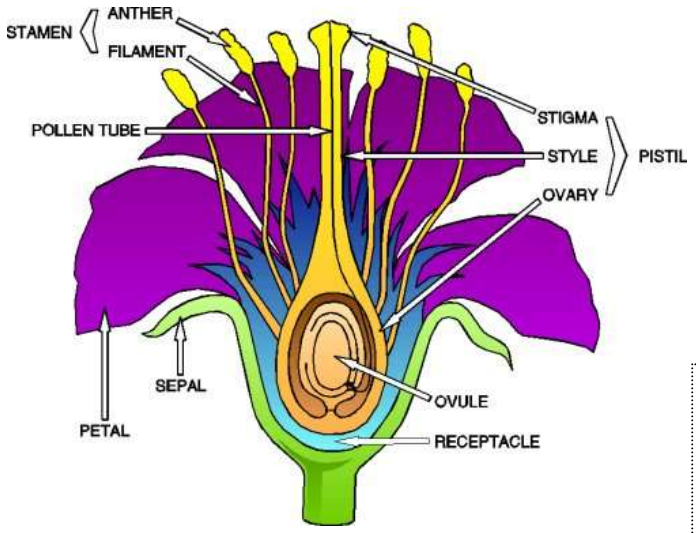
6. How many of these flower colours can you match?



20. Flower detectives – April - July

Suitable for Y5+

1. Find a tree or shrub in flower. Look at the diagram below. Find and name each flower part for the flower you have found.



2. Do the petals show symmetry? Draw the shape here.

3. Are the petals separate and flat or do they form a tube?
   Which is most likely to pollinate your flower – a bee or a butterfly? Why?

4. How many stamen does your flower have? Can you see any pollen grains?

> *Pollination task:* If there is another tree or shrub of the same species in flower nearby, why not try being a pollinator! Gently touch the anther of one flower to get some pollen on one of your fingers, walk to the other tree and touch the stigma with your finger to transfer the pollen. Hopefully a seed will now start to develop!

5. Can you find a flower that has already been pollinated and fertilized? Look for a flower that has dropped its petals, leaving the stigma and ovary behind.

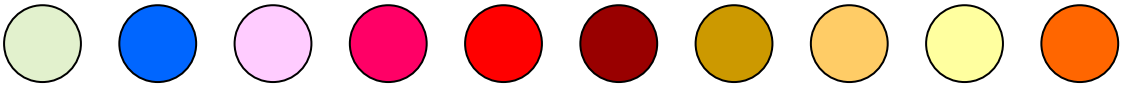
If you find a horse chestnut tree in flower (conker tree) look at the colour in the centre of the flower. Yellow centres show the flower has yet to be pollinated. Red centres show the flower has already been pollinated. The insect pollinator is only attracted to the yellow centres!

If the receptacle / ovary is swollen, the seeds are beginning to develop.

21. Seed explorer

1. Collect and bury 3 nuts like a squirrel, then go off for a walk. Can you find them again when you get back?

2. Look for a rainbow of seed colours as you walk.



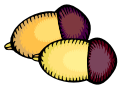
3. Find a nibbled cone and discover what has eaten it:

Squirrel – scales are gnawed off, eaten cone looks untidy and are found in open spaces

Mouse – scales are neatly gnawed off, not found in the open but at hidden feeding sites

Woodpecker – scales broken and ruffled

4. Look for and touch
   - smooth acorns,
   - pricky seed cases,
   - the furry inside of a sweet chestnut case,
   - spongy conker cases,
   - nobbly knopper galls



5. Find an open cone and see if you can shake out any tiny winged seeds. Wellingtonia cones are good for this!

6. Leave a trail of seeds for a vole to follow – where will you lead them? To a waiting store of nuts, to a new burrow or somewhere else?

7. Find an elf's home and leave them an autumn surprise - decorate the house or garden with seeds and seed cases.

22. Seed Sorter

1. Gather 8 – 12 different seeds, from the forest floor where possible.

Remember to include the seeds from conifers - cones will have small seeds inside. Look for a cone with open scales and sharply tap the cone in the palm of your hand. You may find a seed falls out. Wellingtonia cones are good to try.

Many berries are poisonous to people, so see if you can spot these rather than collect them and remember what you find.

2. Which of the seeds can you name?

……..

Seeds need to travel to a new place to grow. This is called seed dispersal.
If a seed lands, or ends up in a good space with little competition from other plants, and on soil, it has a chance of germinating.
In Britain, seeds are dispersed in one of five ways:

(a) By the wind – these seeds will have 'wings' or hairs
(b) By animals collecting them, storing them, and forgetting about some of them.
(c) By animals eating them, the seed travelling through their digestive system and coming out in the animal's droppings
(d) By hooking onto animal fur and dropping off later
(e) By water – you are unlikely to find many of these today but trees that thrive along riverbanks, such as alder, have seeds that float down river until they are washed ashore

3. Which of your seeds are dispersed by the wind?
4. Try throwing some of the winged seeds into the air – what happens as they fall to the ground?
5. Which of your seeds are stored by animals and hopefully forgotten about?
6. Name 2 animals that like to store these seeds?
7. Which seeds did you find that are dispersed through animal droppings?
8. Do any of your seeds have hooks? How will these seeds be dispersed?

23. Trees and Wildlife

Look at the diagram below. Find an oak tree and observe closely.

- Which of the signs of wildlife can you discover?
- Which animals are using the tree as a home
- Which animals are feeding on different parts of the tree?

Up in the canopy

oak galls – lumps and bumps of leaves and twigs where a tiny wasp has laid an egg

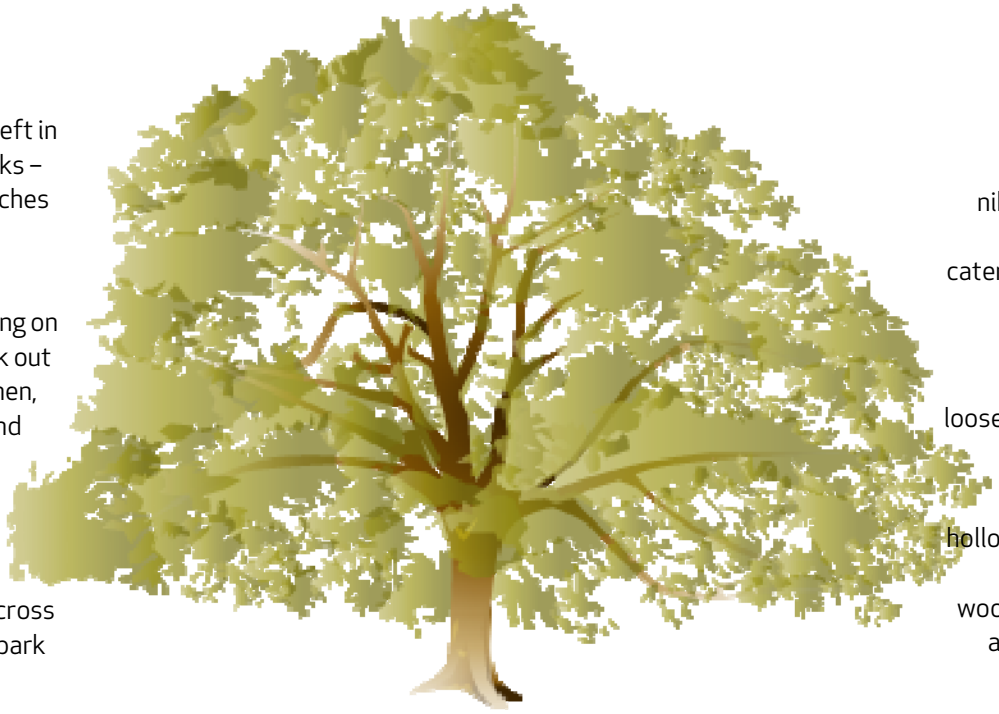
butterflies and caterpillars

birdsong – can you identify the bird?

nests – most likely to be birds close to the edge of the branches, whereas squirrels build their dreys near to the trunk

The trunk

tiny nutshells left in the bark cracks – left by nuthatches



nibbled leaves – evidence of caterpillars and other minibeasts

minibeasts living on the bark – look out for harvestmen, woodlice and earwigs

loose bark where bats can roost

hollows in the trunk – home to woodpeckers, owls, and a range of minibeasts

spider webs across cracks in the bark

The ground

droppings – birds, rabbit, deer, badger and others

nibbled acorns

one or two feathers from a bird preening up in the canopy

Mushrooms on the ground and on the trunk – look for nibble marks

rotting wood and bark on the ground – look for small holes of wood boring beetles and other minibeasts

underground homes – burrows amongst the roots. Mouse, vole, rabbit, badger and fox. Match the size of tunnel to size of animal's body

nibbled roots or nibbled bark – voles, mice, rabbits, deer and squirrel

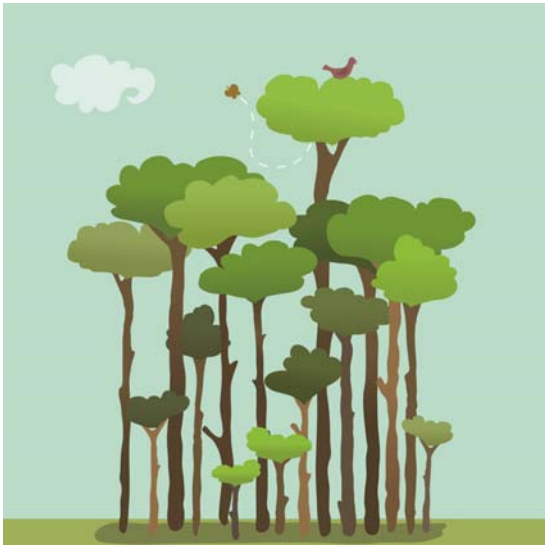
24. Down in the woods – a sensory poem

1. Ask each child to choose a tree that they think is special and sit down underneath it quietly for 5 minutes. Suggest they focus on the following:

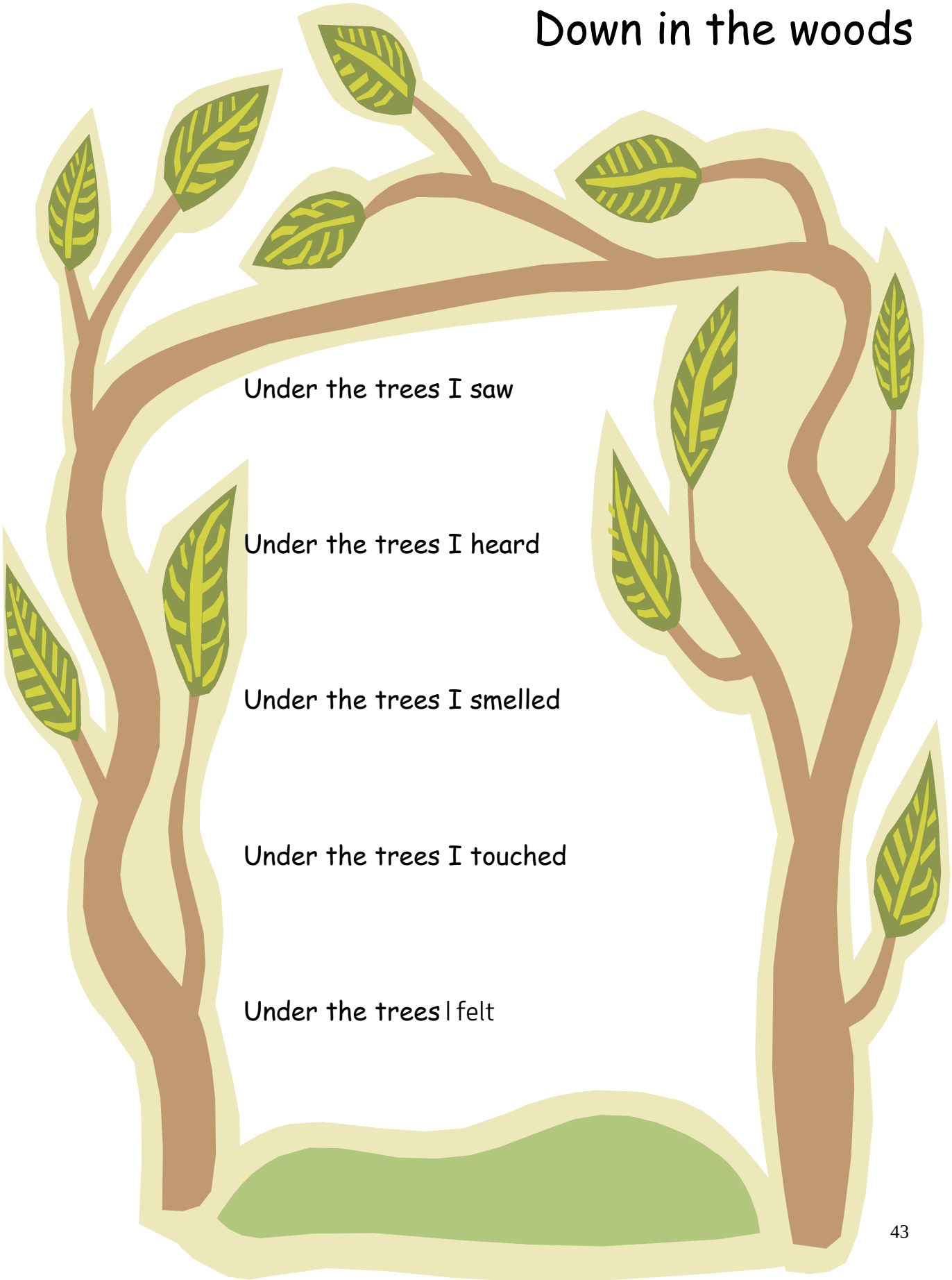
- Take time to listen to the sounds of the trees and wildlife around you.
- Feel the ground beneath the tree and the parts of the tree you can reach – the roots, trunk and bark, low branches and leaves.
- What woodland smells do you notice? Does your tree smell at all?
- Look closely at different parts of the tree. What colour is the bark, leaves, flowers or seeds? Are their any patterns in the bark or flowers? Are there any holes or signs that animals have visited this tree?

2. Using their observations and discoveries invite them to write a tree poem. You may like to consider a range of poem styles, including acrostic, haiku, rhyming couplets, rhyming or non-rhyming verse.

An example of a structured poem for younger groups is included on the next page.



Down in the woods



Under the trees I saw

Under the trees I heard

Under the trees I smelled

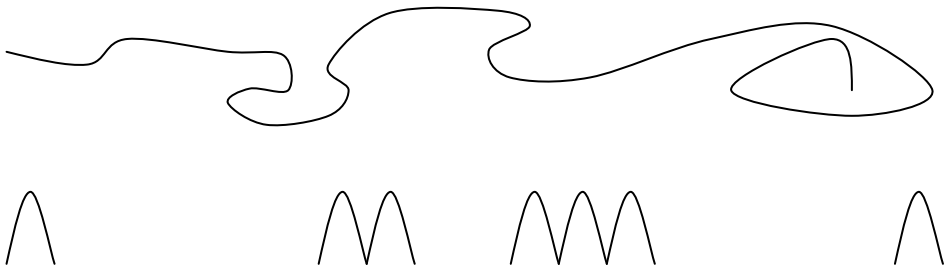
Under the trees I touched

Under the trees I felt

25. Woodland sounds and tree music

1. Ask each child to choose a tree that they think is special and sit down underneath it quietly for 5 minutes.
2. Listen carefully to the sounds of the woodland.
   Can you hear your tree making a sound?
   Are there any animals in your tree making a sound?
   What other sounds of nature can you hear nearby?

3. Gather the group back together. Ask them to share some of the sounds they heard.
4. Describing one of the sounds, show how the sound can be drawn. This is a creative process and there is no right or wrong way of representing the sounds.



   These drawings represent (a) the wind blowing through the treetops and (b) the hops of a blackbird in the crunchy autumn leaves

5. Invite the children to go back to their tree and draw different pictures or symbols for each sound they hear.

Extension

6. Give each child a square piece of paper and ask them to mark a dot in the middle. This is their tree and where they are sitting.
7. Over the next few minutes ask them to listen to the sounds around them and mark on the card the location the sound is coming from to create a woodland sound map. They could use a sound drawing or symbol to represent each sound.
8. With a partner, each child tells the story of their woodland sound experience using their sound map.