How can we identify native trees in autumn?

Geometry teaching pack

The Harmony Project

GEOMETRY ACTIVITIES

ENQUIRY OF LEARNING How can we identify native trees in autumn?

Leaves come in all sorts of amazing shapes and sizes – but why? Trees live in a range of different locations around the world and face very different challenges to their survival. Over time, trees have adapted to these challenges by developing their own distinctive leaf shapes. For example, trees that live in hot, dry places often have small, narrow leaves that don't lose too much moisture through their surface. However, trees that grow in tropical climates often have very large, broad leaves, which scientists think could help the tree regulate heat. Due to the huge variety that exists in leaf shape, size, texture and colour, it's possible to identify trees by the appearance of their leaves.

The six activities in this pack have been developed to explore with students the beautiful geometry of the leaves of six trees that are native to the UK. They can be used to support learning about shape in maths, to enrich an exploration of leaf shapes in art or to teach geometry as a standalone activity. They could also be used to introduce students to the principle of Geometry. You can find out more about Nature's principles of Harmony on The Harmony Project website. For each activity, step-by-step text instructions are provided as a guide for teachers, with accompanying diagrams and lists of the resources students will need to complete each activity. There are photocopiable templates as well as a factsheet introducing different leaf shapes.

CONTENTS

COMPASSES

The activities in this pack can be adapted so that there is no need to use a compass to complete them by using the templates provided at the end of each activity. However, if you would like your students to engage in more of the geometric construction, Jakar compasses will help ensure accuracy and are easy to use. The can be purchased at a discount through The Harmony Project website.

WHY GEOMETRY?

Learning the geometry of Nature provides students with a new way of looking at the world. The observational skills and careful drawings that are required to recreate this geometry can have a powerful impact on students' understanding of Nature and their place in it. If we are to create a sustainable future, we need to see the world through a different lens, to understand that the patterns of life that exist around us also exist in us. This way of seeing the world means we view everything from a place of connection, rather than separation. This sense of connection is an essential part of learning to live sustainably. After all, the word 'Harmony' means joined or connected.

Leaf types and autumn colours

This page shows four of the main types of leaf shape as well as some autumn leaf colours. During spring and summer, leaves are mostly green because they contain **chlorophyll**, which helps them to **photosynthesise**. But when days get shorter and colder, trees stop making so much chlorophyll. Then other colours that were there all along, such as red and orange, become more visible.

Simple

Simple leaves have a basic, one-piece shape rather than having several parts. They can be oval or round in shape, or even triangular.

Triangular

Triangular leaves have three sides and 'corners'. They're a type of simple leaf and their shape makes them easy to spot.

Lobed

Distinct lobes usually radiate out from a central point on the leaf. However, lobed leaves sometimes have 'fingers' or bumps all along their edges.

Compound

Compound leaves look like several smaller leaf parts (called **leaflets**) have been joined together on a single stem.

GLOSSARY

chlorophyll - absorbs energy from sunlight to help a plant create its own food
photosynthesis - the process a plant uses to turn water and carbon dioxide into food

GEOMETRY ACTIVITY 1

ENQUIRY OF LEARNING How can we identify native trees in autumn?

LEARNING QUESTION How will I draw an aspen tree leaf?

In this activity, students use a circle as a guide to draw an aspen leaf. The compass work involved in creating guidelines for the drawing is simple, making this activity suitable for those who are just starting to become familiar with the use of compasses in geometric drawing. However, if compasses aren't available, students can use the template in Resource 1A and start following the instructions from Step 2.

This activity requires close observation and attention to detail, as students need to look carefully at the shape and outline of an aspen leaf in order to recreate it in their drawing with accuracy. It's therefore ideal for helping students to develop these skills. This activity can also be used to support students' learning about native trees as part of the learning enquiry 'How can we identify native trees in autumn?', planning for which can be found on The Harmony Project website.

By the end of this set of six activities, students should be more confident identifying the leaves of the six trees that are the focus for the learning.

YOU WILL NEED

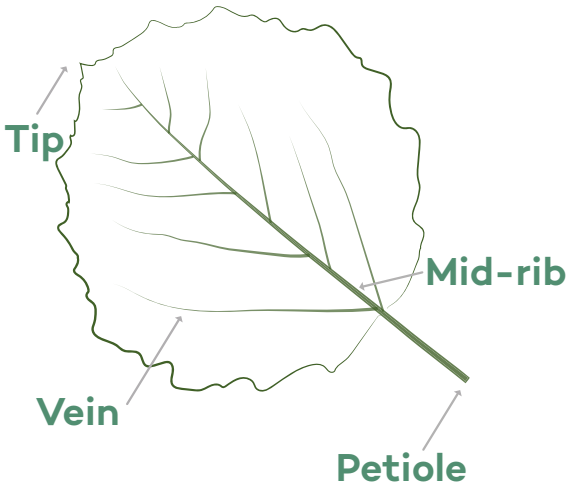
A ruler
A compass
An HB pencil
A good quality eraser
Coloured pencils
Optional: Copies of Resource 1A (for children requiring support)

DID YOU KNOW?

An aspen leaf has a nearly round or heart-shaped structure with finely serrated edges. What sets it apart from other leaves is its ability to flutter and tremble with the slightest breeze due to its flattened **petiole** (the stalk that joins the leaf to the stem). This movement is called 'quaking', giving rise to the nickname 'quaking aspen'. In autumn, aspen leaves undergo a stunning transformation, turning from green to vibrant shades of gold.

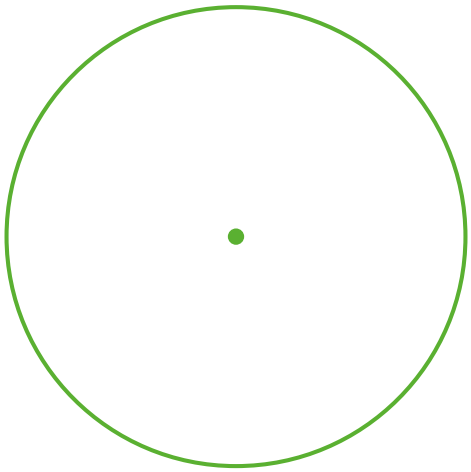
GET TO KNOW THE LEAF PARTS

The aspen has a simple leaf, which is almost round. The edges have a jagged pattern that is known as **serration**. The diagram below shows the common parts of the leaf. Find an example from outdoors or work with a clear photo to draw the leaf yourself.



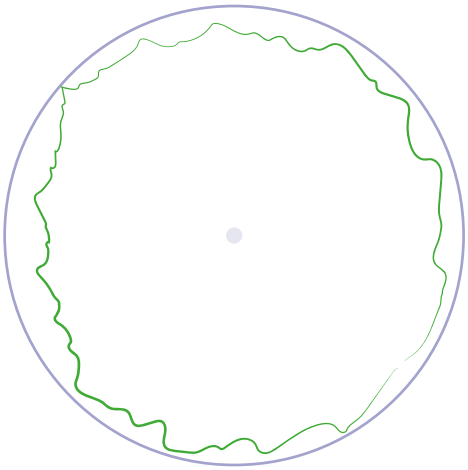
STEP 1 Draw a circle

Draw a dot in the centre of an A4 sheet of paper. Place the point of your compass on the dot and draw a circle with a radius of 6cm. Alternatively, use the circle template in Resource 1A and start following these instructions from Step 2 onwards.



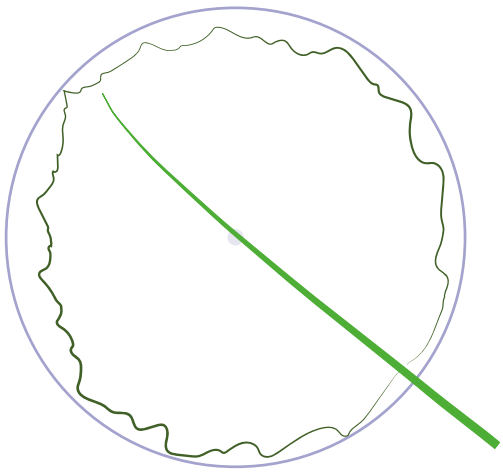
STEP 2 Draw the outline of the leaf

Looking at a real aspen leaf or a photograph of one, draw the outline of the leaf, thinking about how closely it follows the outline of the circle. Is it slightly more narrow at the sides? Is it symmetrical? Is it serrated?



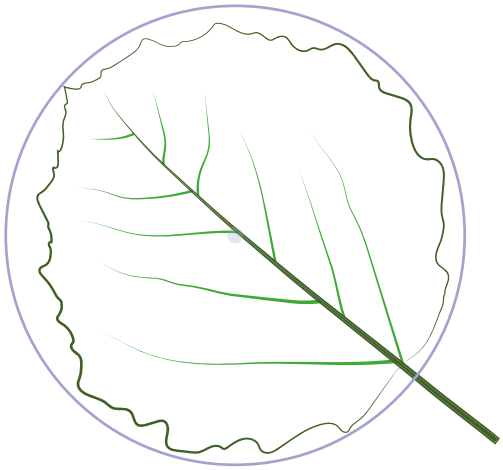
STEP 3 Draw the mid-rib

Draw the mid-rib (the long, thick vein that runs through the centre of a leaf along its length) and the petiole (stalk) in one movement. The line you draw should be narrower at the tip and thicker at the base.



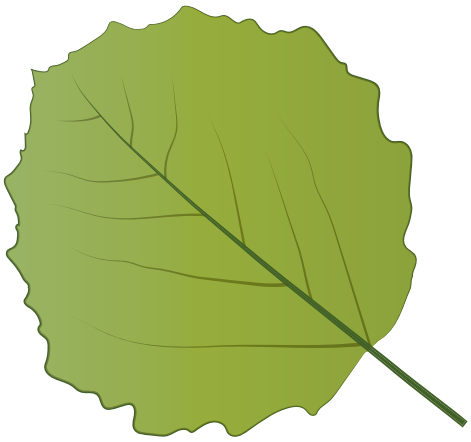
STEP 4 Draw the veins

Add the delicate veins that branch out from either side of the mid-rib. What sort of pattern do they make? Pay attention to the angle at which they branch. On an average aspen leaf, there should be five smaller veins branching off the mid-rib.

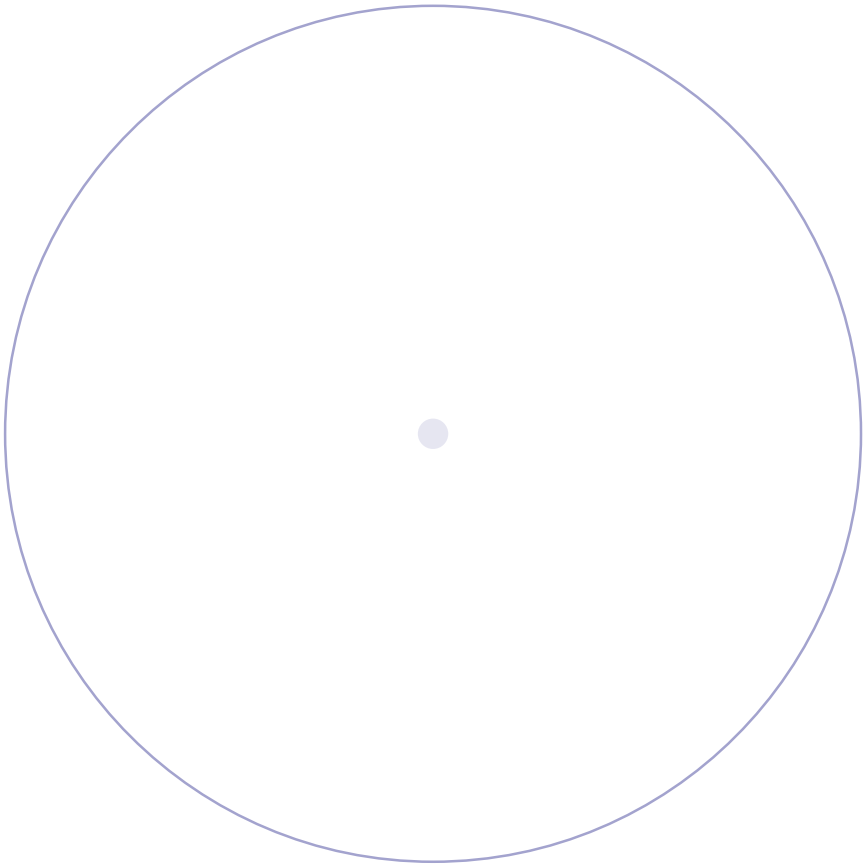


STEP 5 Add colour

Use colouring pencils to add either summer or autumn colours to the leaf. Look for examples in pictures or go outdoors and collect real leaves to guide your colour choices.



PHOTOCOPIABLE RESOURCE 1A



GEOMETRY ACTIVITY 2

ENQUIRY OF LEARNING How can we identify native trees in autumn?

LEARNING QUESTION How will I draw a pear tree leaf?

In this activity, students draw overlapping circles to create a **vesica piscis** shape to use as a guide to draw the leaf of a pear tree. The compass work involved in creating the guidelines needed for the drawing is simple, and builds on the compass skills developed in the first activity in this pack. However, if compasses aren't available, or for students requiring additional support, the template in Resource 2A can be used. In this case, students should start following the instructions from Step 4.

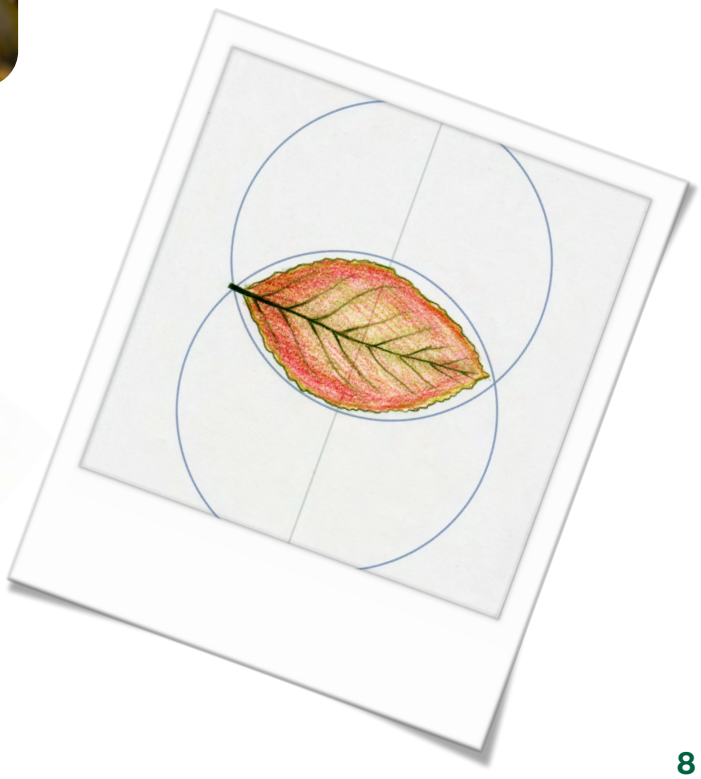
This activity requires close observation and attention to detail, as students need to look carefully at the shape and outline of an pear leaf in order to recreate it in their drawing with accuracy. It's therefore ideal for helping students to develop these skills. This activity can also be used to support students' learning about native trees as part of the learning enquiry 'How can we identify native trees in autumn?', planning for which can be found on The Harmony Project website.

YOU WILL NEED

A ruler
A compass
An HB pencil
A good quality eraser
Coloured pencils
Optional: Copies of Resource 2A (for students requiring support)

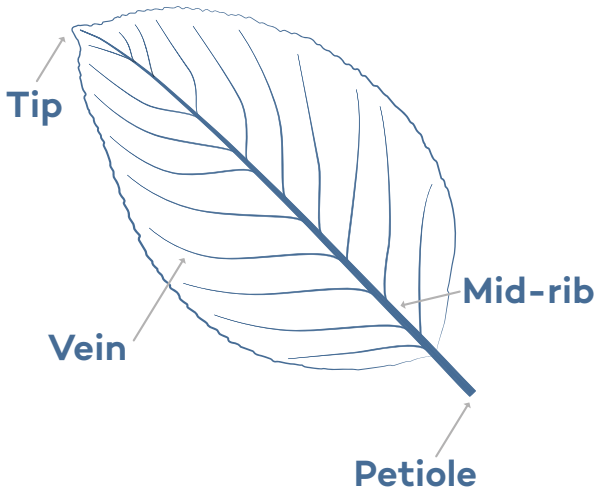
DID YOU KNOW?

The pear leaf is a perfect example of a simple leaf with a distinctive shape. It is elliptical, with a pointed tip and tapered base, and it can be drawn using a vesica piscis shape as a guide. This is the shape that is created where two circles overlap. The leaf of a pear tree has edges that are often finely serrated. Pear tree leaves are known for their glossy, green appearance. In autumn, these leaves can turn beautiful shades of yellow, orange, and red.



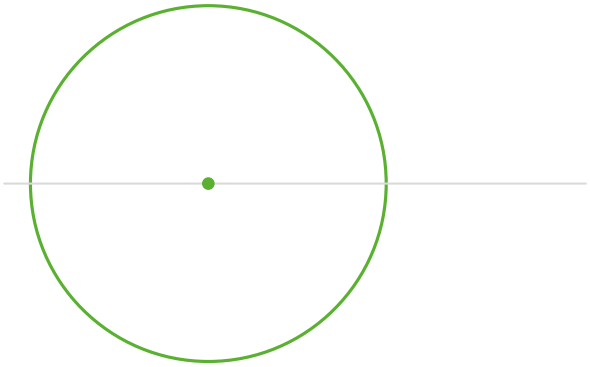
GET TO KNOW THE LEAF PARTS

The pear tree has a simple leaf, which is roughly oval in shape. The edges have a very finely jagged pattern that is known as **serration**. The diagram below shows the common parts of the leaf. Find an example outdoors or work with a clear photo to draw the leaf yourself.



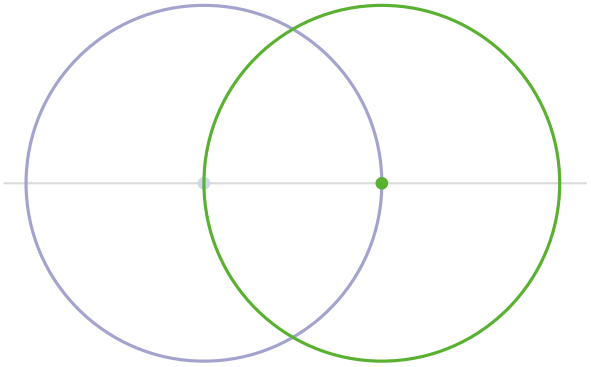
STEP 1 Draw the first circle

Use a ruler to draw a horizontal line across the centre of a sheet of A4 paper arranged in landscape format. Then, place the point of a compass on the line you have drawn roughly 12cm in from the left hand side of the page. Draw a circle with a radius of 6cm, as shown below.



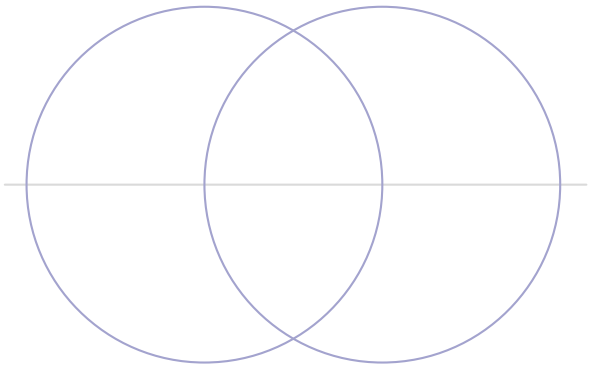
STEP 2 Draw the second circle

Place the point of the compass at the point where the horizontal line cuts through the circumference of the first circle on the right-hand side of the page (this is shown below by the green dot). Draw a second circle with a radius of 6cm.



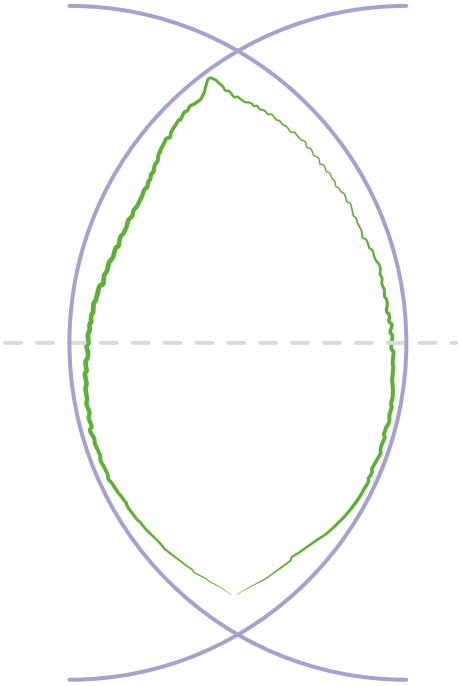
STEP 3 Locate the vesica piscis

The vesica piscis shape in the centre of the drawing where the two circles you have drawn overlap will guide your drawing of a pear leaf in Steps 4 to 7.



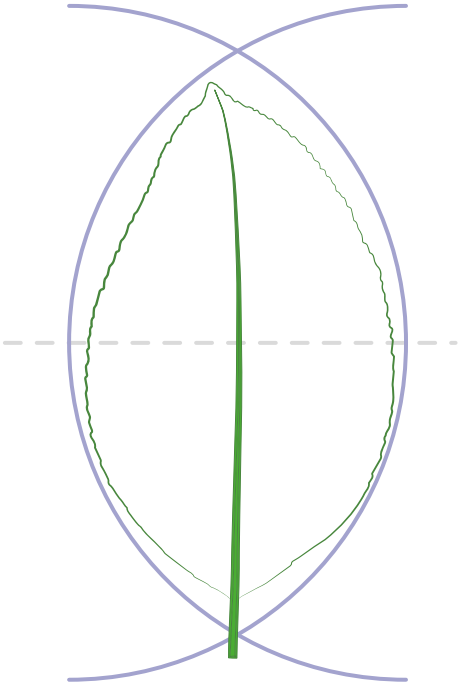
STEP 4 Draw the outline of the leaf

The outline of the pear leaf closely follows the shape of the vesica piscis but is narrower at the top and bottom, as shown below. The edges are very slightly serrated. If you are using the template in Resource 2A, start following the instructions from this step.



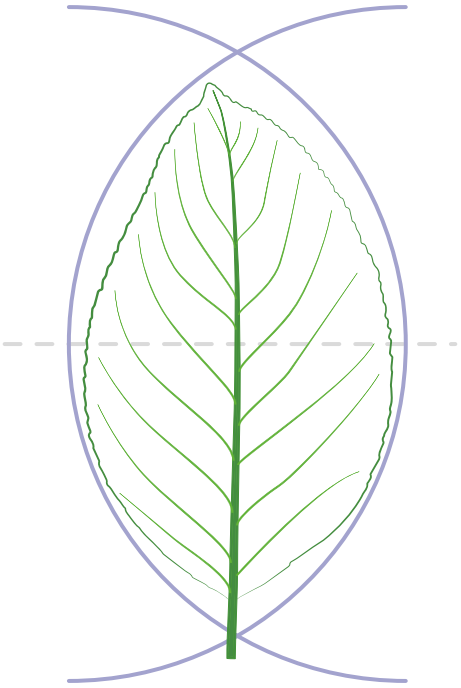
STEP 5 Draw the mid-rib and petiole

Draw the mid-rib (the long, thick vein that runs through the centre of a leaf along its length) and the petiole (stalk) in one movement. The line you draw should be narrower at the tip and thicker at the base.



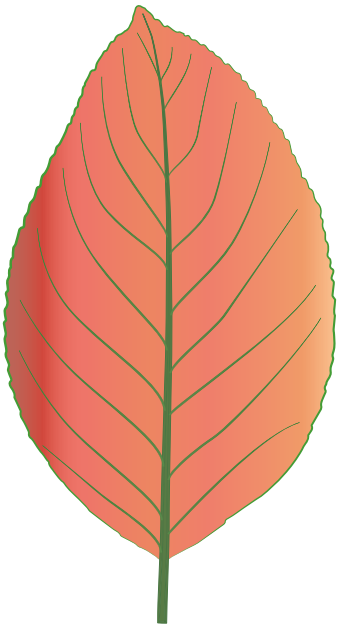
STEP 6 Draw the veins

Add the delicate veins that branch out from either side of the mid-rib. What sort of pattern do they make? Pay attention to the angle at which they branch. On the average pear leaf, there are roughly nine smaller veins branching off the mid-rib.

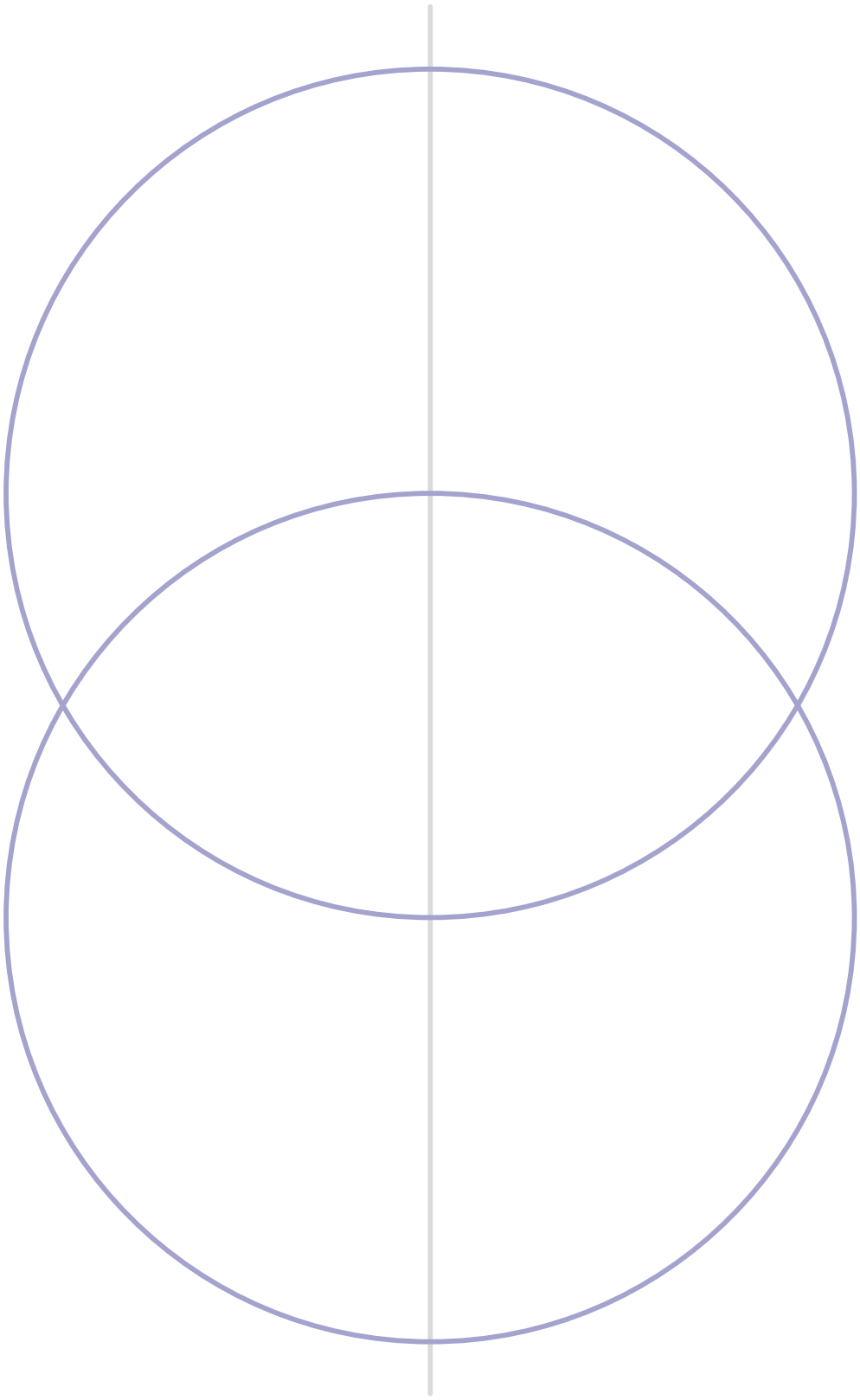


STEP 7 Add colour

Use colouring pencils to add either summer or autumn colours to the leaf. Look for examples in pictures or go outdoors and collect real leaves to guide your colour choices.



PHOTOCOPIABLE RESOURCE 2A



GEOMETRY ACTIVITY 3

ENQUIRY OF LEARNING How can we identify native trees in autumn?

LEARNING QUESTION How will I draw a silver birch tree leaf?

In this activity, students draw three overlapping circles to create a guide to draw the leaf of a silver birch tree. The compass work involved in creating the guidelines needed for the drawing builds on the compass skills developed in the first two activities in this pack. However, if compasses aren't available, or for students requiring additional support, the template in Resource 3A can be used. In this case, students should start following the instructions from Step 4.

This activity requires close observation and attention to detail, as students need to look carefully at the shape and outline of a silver birch leaf in order to recreate it in their drawing with accuracy. It's therefore ideal for helping students to develop these skills. This activity can also be used to support students' learning about native trees as part of the learning enquiry 'How can we identify native trees in autumn?', planning for which can be found on The Harmony Project website.

By the end of this set of six activities, students should be more confident identifying the leaves of the six trees that are the focus for the learning.

YOU WILL NEED

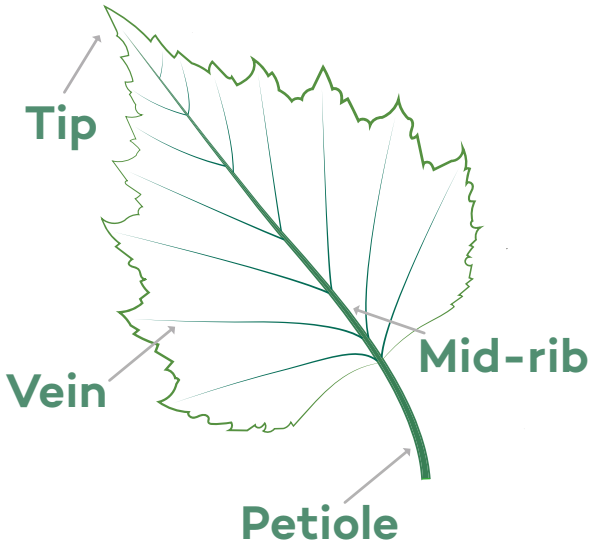
A ruler
A compass
An HB pencil
A good quality eraser
Coloured pencils
Optional: Tracing paper; copies of Resource 3A (for students requiring support)

DID YOU KNOW?

The silver birch leaf is a simple leaf with a slender, triangular shape and serrated edges. Each leaf is supported by a short petiole (stalk), which allows it to flutter gracefully in the breeze. It has a distinct silver-white colour on the underside of the leaf. During autumn, silver birch leaves turn yellow, making them a beautiful sight in autumnal landscapes.

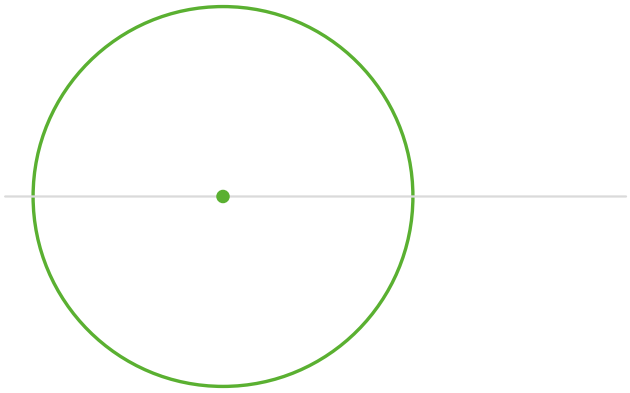
GET TO KNOW THE LEAF PARTS

The silver birch has a triangular shaped leaf with slightly serrated edges. The diagram below shows the common parts of the leaf. Find an example from outdoors or work with a clear photo to draw the leaf yourself.



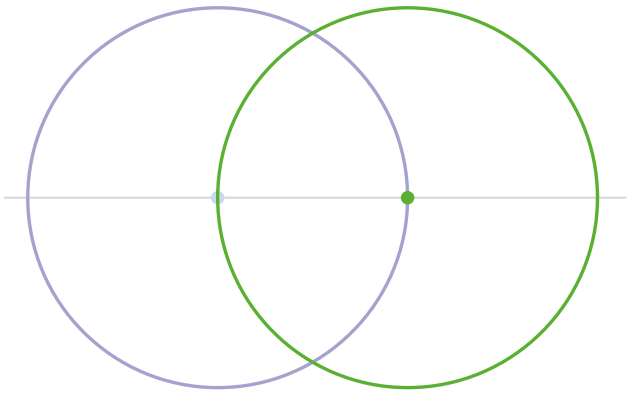
STEP 1 Draw the first circle

Use a ruler to draw a horizontal line across the centre of a sheet of A4 paper. Then, place the point of your compass on the line you have drawn somewhere to the left of the page centre and draw a circle with a radius of 6cm, as shown below.



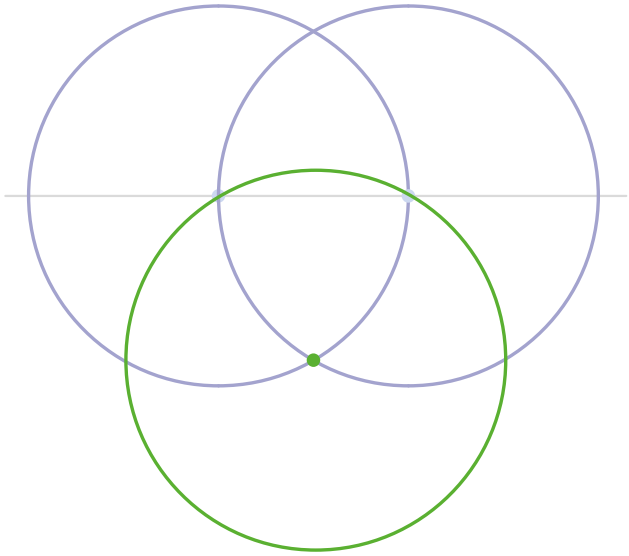
STEP 2 Draw the second circle

Place the point of the compass at the point where the horizontal line cuts through the circumference of the first circle on the right-hand side of the page (this is shown below by the green dot). Draw a second circle with a radius of 6cm.



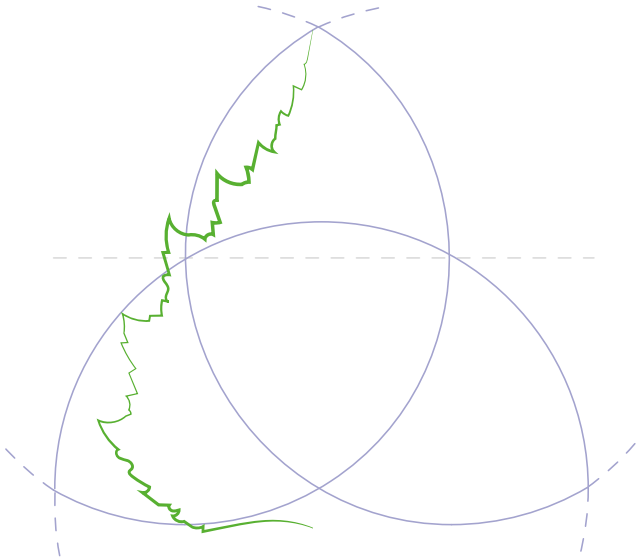
STEP 3 Draw the third circle

Place the point of the compass at the point where the circumferences of the two circles you've drawn intersect at the bottom of your drawing. This is shown below by the green dot. Draw a third circle with a radius of 6cm.



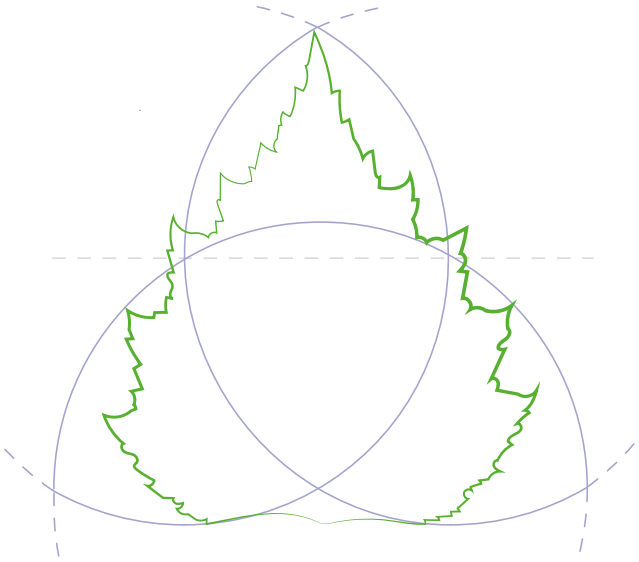
STEP 4 Draw half the outline of the leaf

Using the template you created in Steps 1 to 3 to help you, draw the outline of one half of the silver birch leaf, as shown below. If you are using the template in Resource 3A, you can start following the instructions from this step.



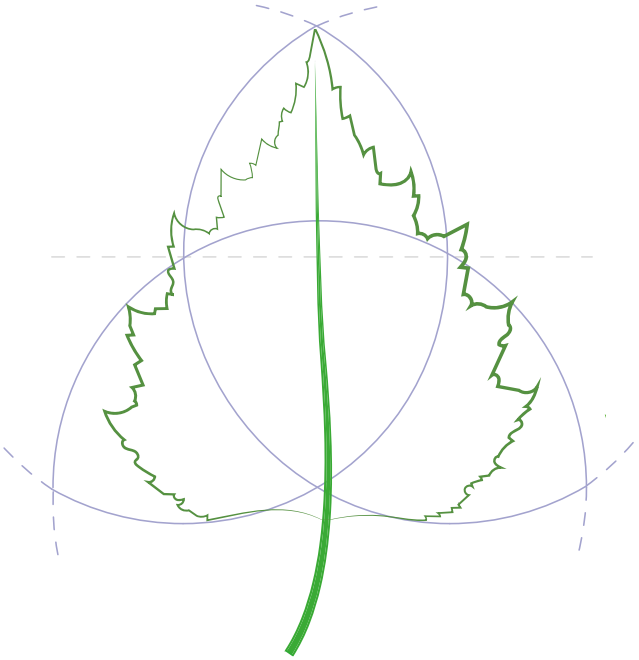
STEP 5 Complete the outline of the leaf

Either working freehand, or using tracing paper for increased accuracy, draw the second half of the leaf outline. It may help to very faintly draw a horizontal line from the top to the bottom of the first vesica piscis shape you created before you complete the second half of the leaf outline.



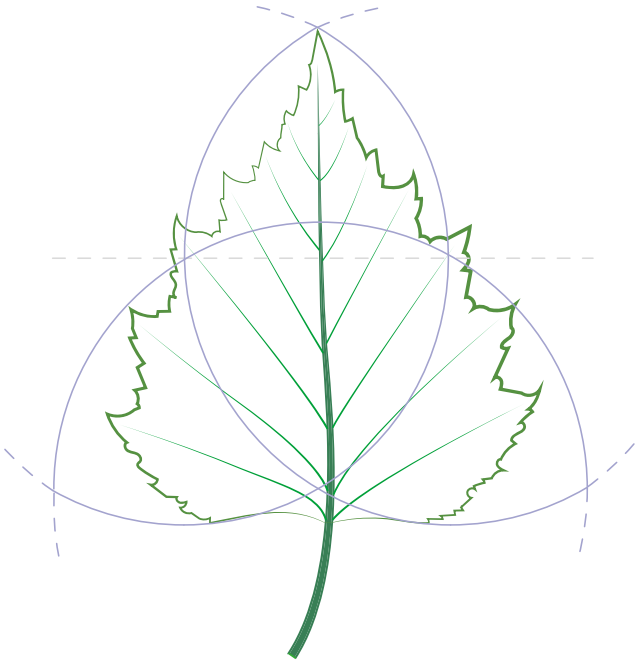
STEP 6 Draw the mid-rib and petiole

Draw the mid-rib (the long, thick vein that runs through the centre of a leaf along its length) and the petiole (stalk) in one movement. The line you draw should be narrower at the tip and thicker at the base.



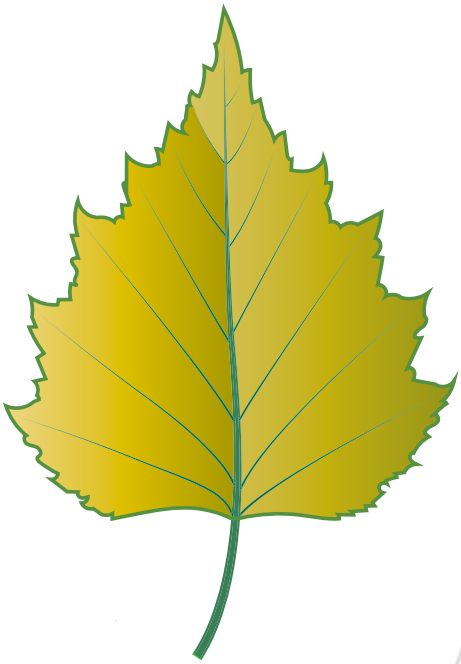
STEP 7 Draw the veins

Add the delicate veins that branch out from either side of the mid-rib. What sort of pattern do they make? Pay attention to the angle at which they branch. On an average silver birch leaf, there are roughly six smaller veins branching off the mid-rib.

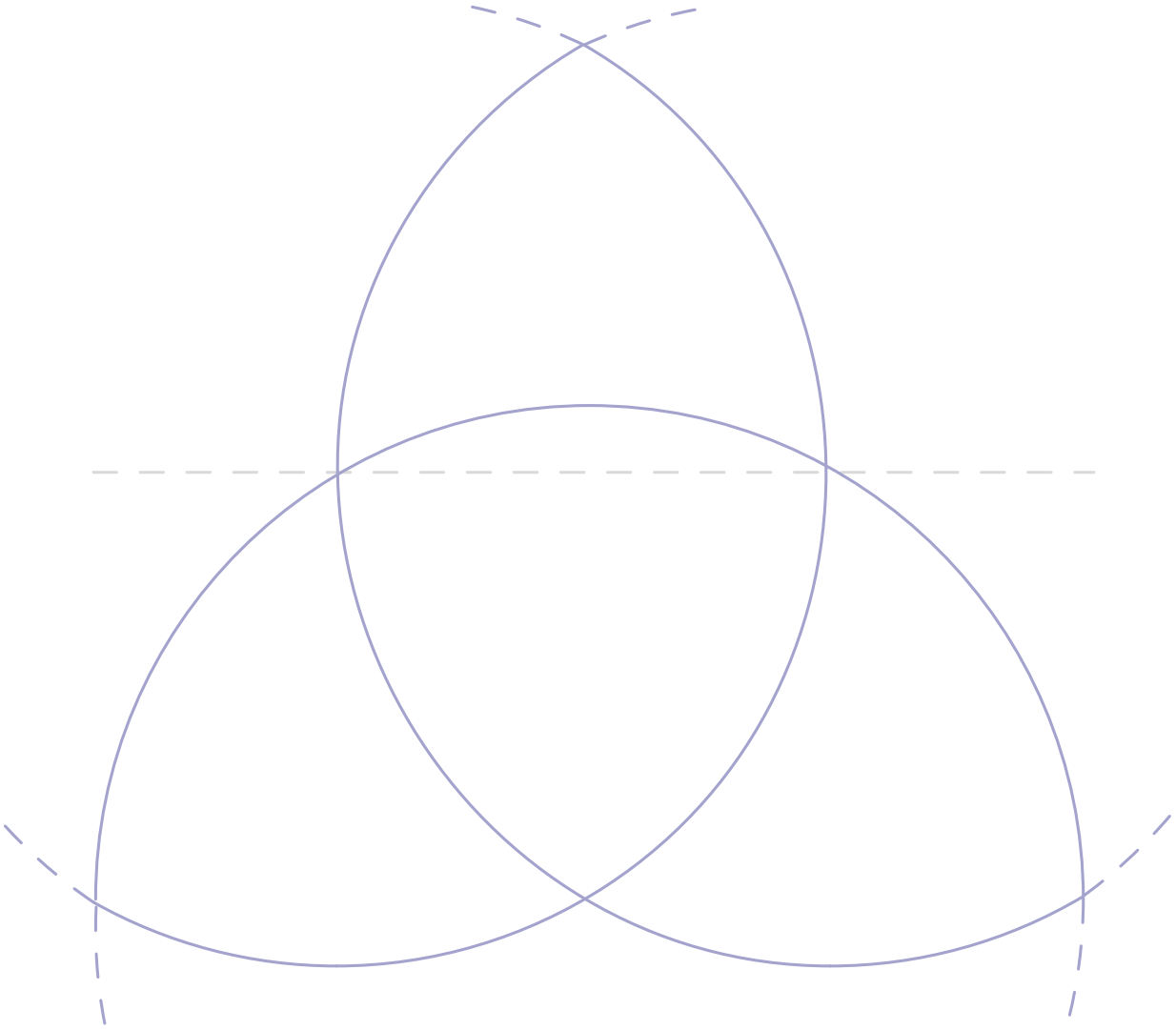


STEP 8 Add colour

Use colouring pencils to add either summer or autumn colours to the leaf. Look for examples in pictures or go outdoors and collect real leaves to guide your colour choices.



PHOTOCOPIABLE RESOURCE 3A



GEOMETRY ACTIVITY 4

ENQUIRY OF LEARNING How can we identify native trees in autumn?

LEARNING QUESTION How will I draw a sycamore tree leaf?

In this activity, students use the template in Resource 4A as a guide to draw the leaf of a sycamore tree.

This activity requires close observation and attention to detail, as students need to look carefully at the shape and outline of a sycamore leaf in order to recreate it in their drawing with accuracy. It's therefore ideal for helping students to develop these skills. This activity can also be used to support students' learning about native trees as part of the learning enquiry 'How can we identify native trees in autumn?', planning for which can be found on The Harmony Project website.

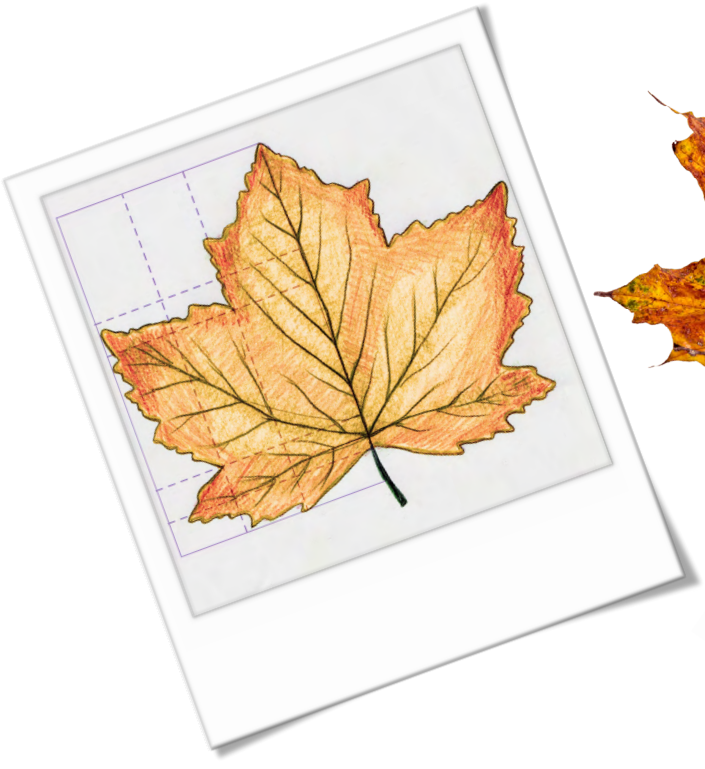
By the end of this set of six activities, students should be more confident identifying the leaves of the six trees that are the focus for the learning.

YOU WILL NEED

Copies of Resource 4A (enough for one each)
An HB pencil
A good quality eraser
Coloured pencils
Optional: Tracing paper

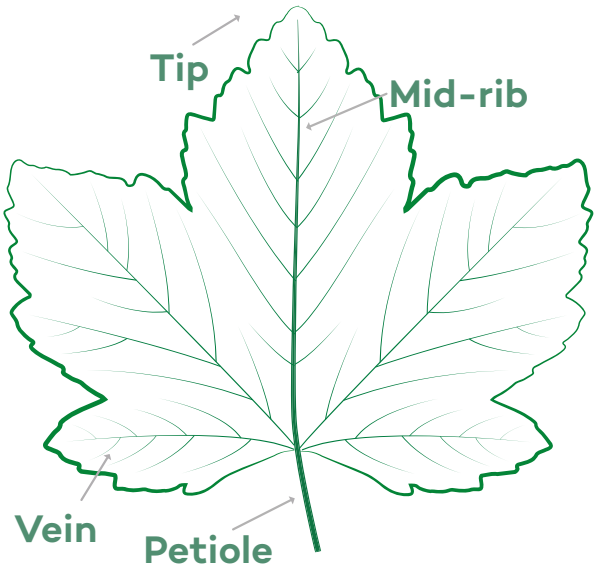
DID YOU KNOW?

The palmate structure of sycamore leaves (like a hand with several lobes – often 5 or 7 – radiating from the centre) makes them easily recognisable. These leaves often grow up to 8 inches wide, providing plenty of shade during the summer months. In autumn, sycamore leaves turn a warm, golden hue.



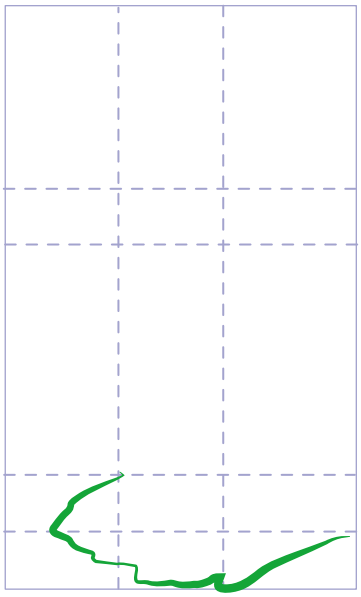
GET TO KNOW THE LEAF PARTS

The palmate leaf of the sycamore often has five lobes. The edges have a jagged pattern that is known as **serration**. The diagram below shows the common parts of the leaf. Find an example outdoors or work with a clear photo to draw a sycamore leaf yourself.



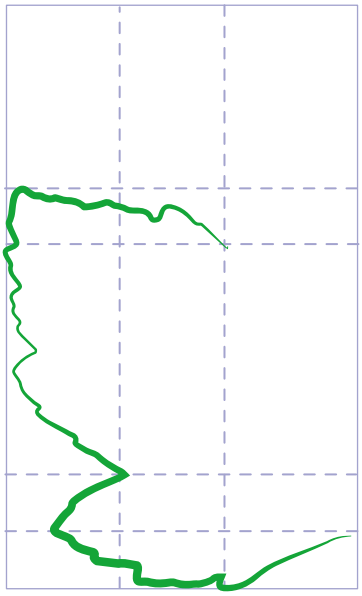
STEP 1 Draw the first lobe

Arrange the template on Resource 4A in portrait orientation. You will use this to draw one half of the sycamore leaf, as outlined in Steps 1 to 4, working clockwise around the leaf from the bottom left-hand lobe. Start by drawing the first lobe of the leaf, as shown below, paying attention to the serrated edges.



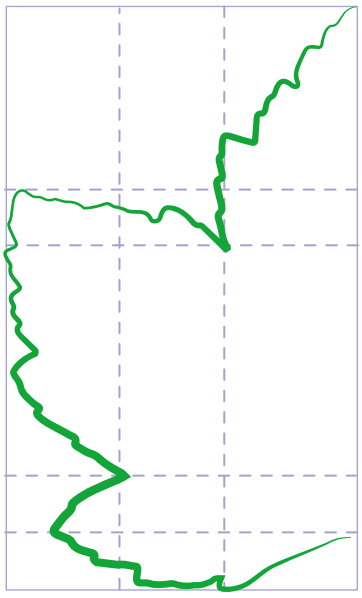
STEP 2 Draw the second lobe

Use the middle section of the template to draw the next lobe of the leaf. If you look carefully, you will see that this lobe is larger than the first and has two smaller lobes emerging from it, one on either side.



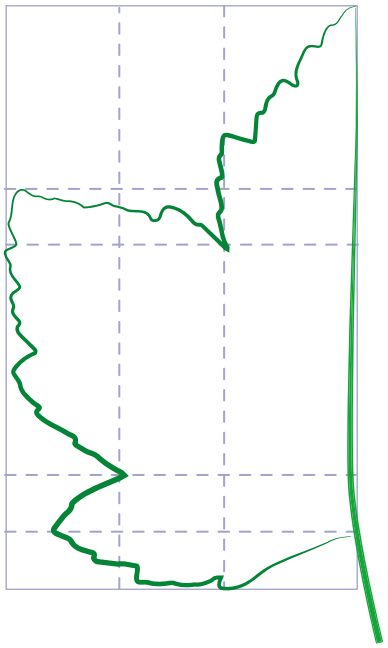
STEP 3 Draw half of the central lobe

Complete your drawing of the first half of the leaf by adding half of the central lobe to the two sections of the template in the top right-hand corner.



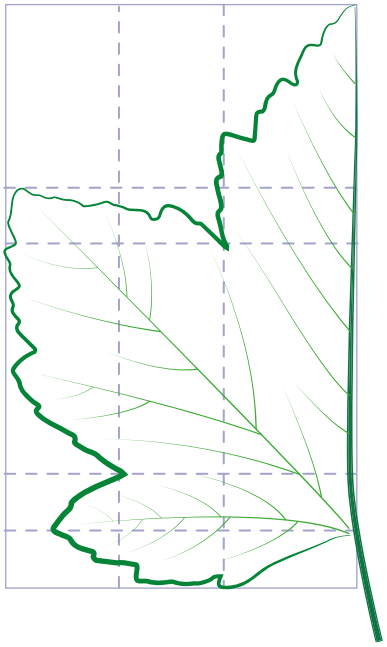
STEP 4 Draw the mid-rib and petiole

Draw the mid-rib (the long, thick vein that runs through the centre of a leaf along its length) and the petiole (stalk) in one movement. The line you draw should be narrower at the tip and thicker at the base.



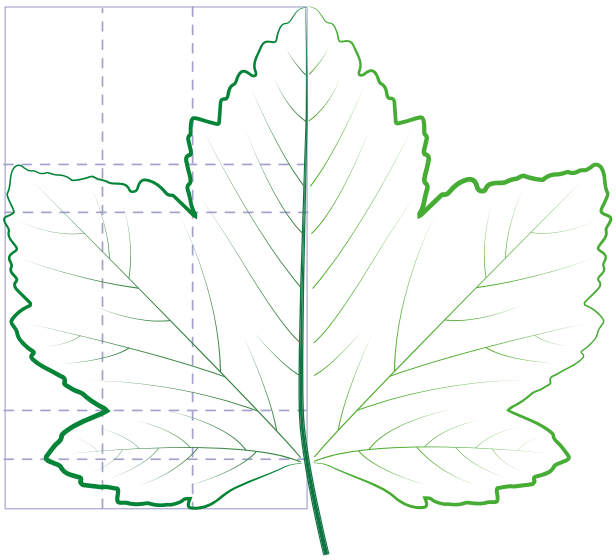
STEP 5 Draw the veins

Add the delicate veins that branch out from either side of the mid-rib. What sort of pattern do they make? Pay attention to the angle at which they branch. On a sycamore leaf, each lobe has its own arrangement of veins branching out from a central vein.



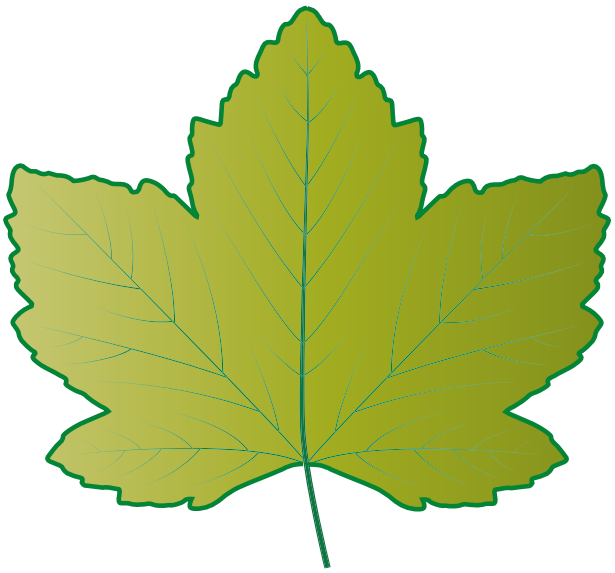
STEP 6 Reflect the outline

Either working freehand, or using tracing paper for increased accuracy, draw the second half of the leaf outline.

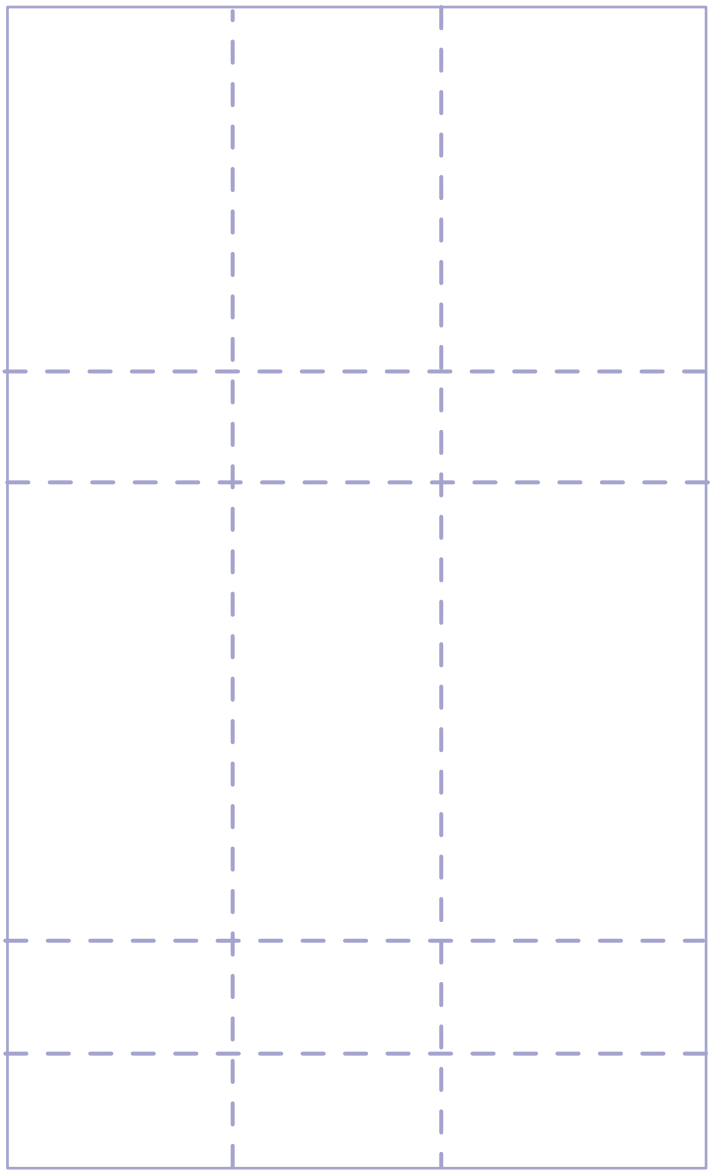


STEP 7 Add colour

Use colouring pencils to add either summer or autumn colours to the leaf. Look for examples in pictures or go outdoors and collect real leaves to guide your colour choices.



PHOTOCOPIABLE RESOURCE 4A



GEOMETRY ACTIVITY 5

ENQUIRY OF LEARNING How can we identify native trees in autumn?

LEARNING QUESTION How will I draw a horse chestnut tree leaf?

In this activity, students use the template in Resource 5A as a guide to draw the leaf of a horse chestnut tree.

This activity requires close observation and attention to detail, as students need to look carefully at the shape and outline of a horse chestnut leaf in order to recreate it in their drawing with accuracy. It's therefore ideal for helping students to develop these skills. This activity can also be used to support students' learning about native trees as part of the learning enquiry 'How can we identify native trees in autumn?', planning for which can be found on The Harmony Project website.

By the end of this set of six activities, students should be more confident identifying the leaves of the six trees that are the focus for the learning.

YOU WILL NEED

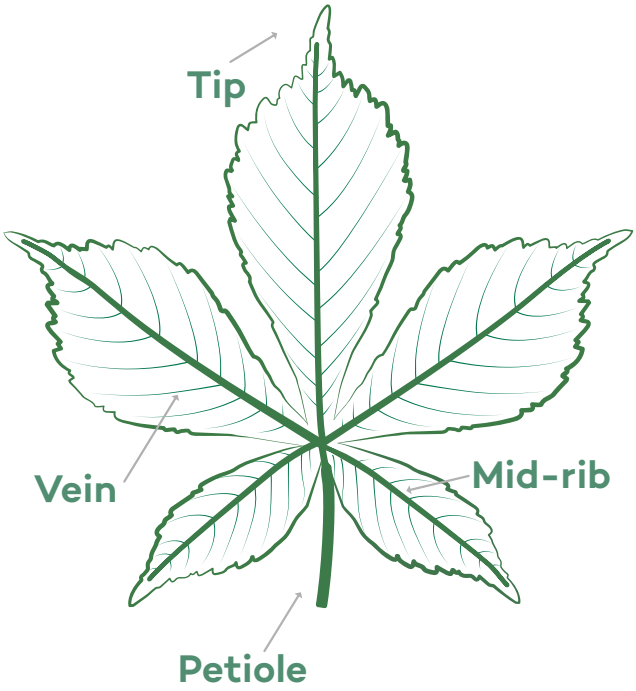
Copies of Resource 5A (enough for one each)
A ruler
An HB pencil
A good quality eraser
Coloured pencils
Optional: Tracing paper

DID YOU KNOW?

The horse chestnut leaf is a palmate leaf; it resembles a hand with outstretched fingers. Each leaf has five to seven leaflets radiating from a central stem. Each of these leaflets can grow up to 12 inches wide. When autumn arrives, horse chestnut leaves transform into vibrant shades of yellow and red.

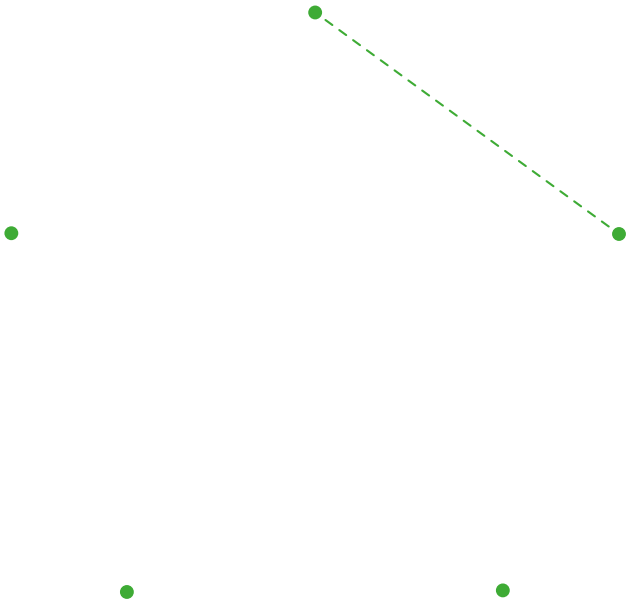
GET TO KNOW THE LEAF PARTS

The palmate leaf of the horse chestnut often has five leaflets. The edges have a jagged pattern that is known as **serration**. The diagram below shows the common parts of the leaf. Find a horse chestnut leaf outdoors or work with a clear photo to draw the leaf yourself.



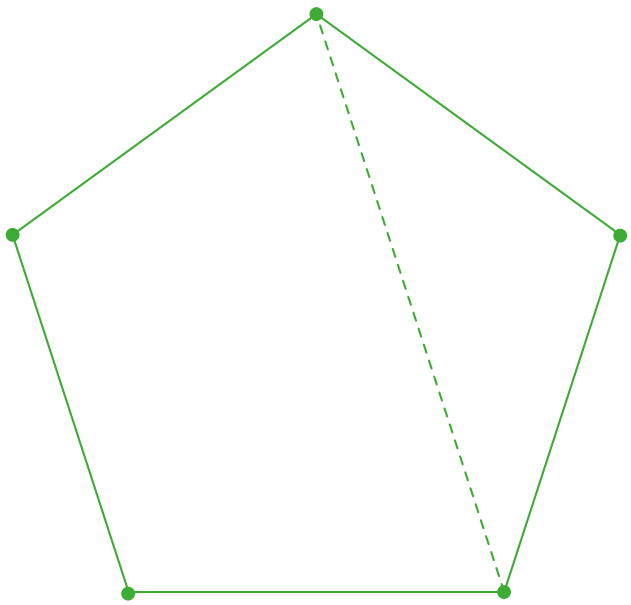
STEP 1 Draw the outline of a pentagon

Start by using a ruler to join adjacent dots on the template on Resource 5A to create the outline of a pentagon.



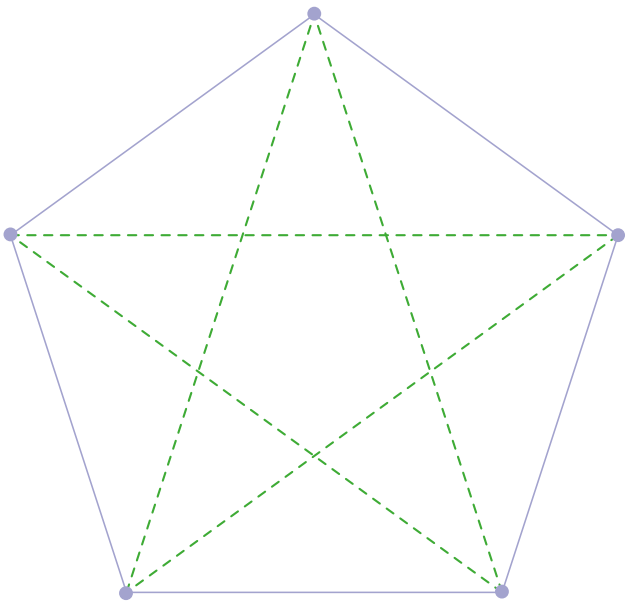
STEP 2 Join two dots with a line

Use a ruler to draw a line joining the dot at the top vertex of the pentagon to the dot at the bottom right vertex.



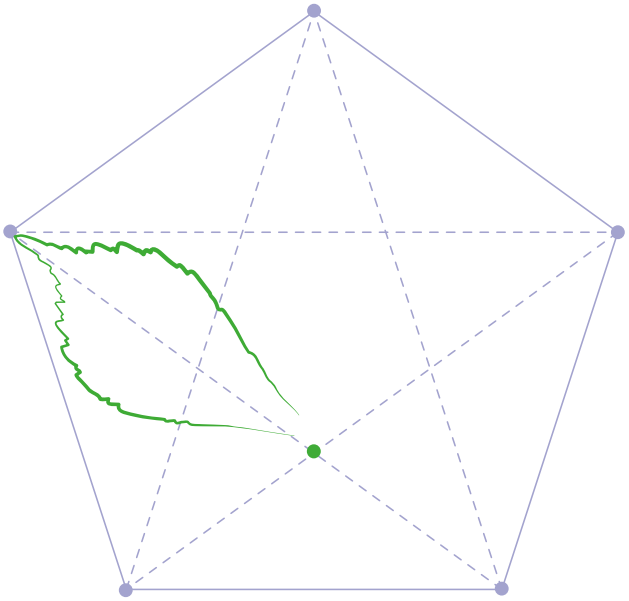
STEP 3 Join every other dot

Continue joining every other dot until you have drawn a five-pointed star, as shown below. You will use this as a template to complete your drawing of a horse chestnut leaf in Steps 4 to 10.



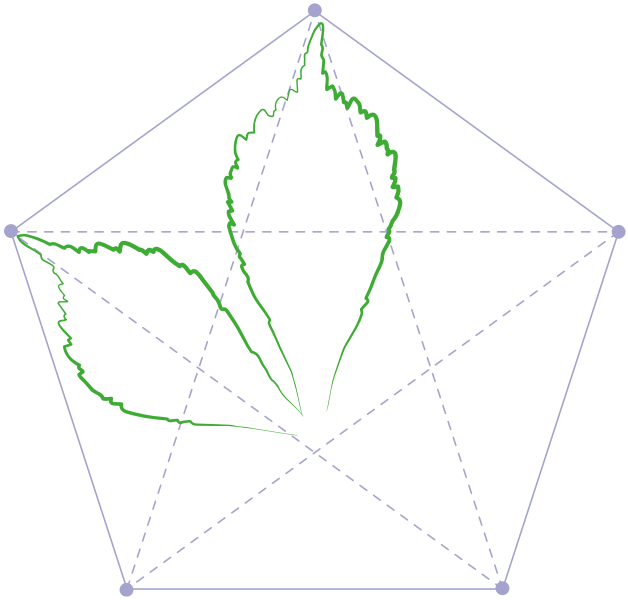
STEP 4 Draw the first leaflet

The leaflets that make up the complete leaf will radiate from roughly the bottom vertex of the smaller pentagon at the centre of the template. This is marked with a green dot below. Using this as a guide, draw the outline of the first leaflet, as shown below.



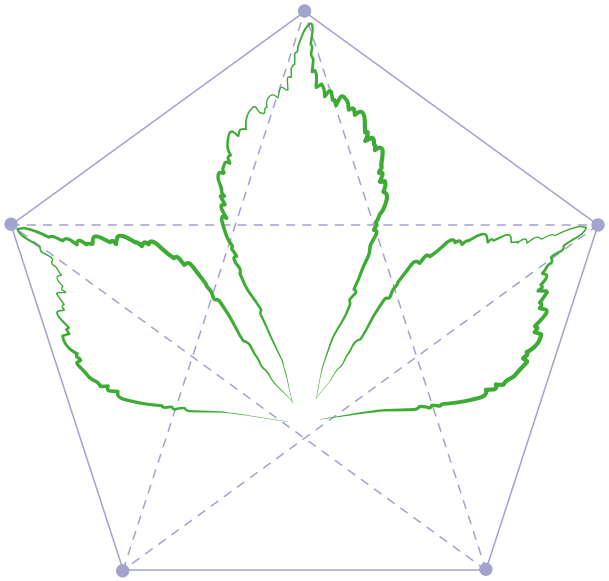
STEP 5 Draw the second leaflet

Next, draw the central leaflet, using the template to help you position it, as shown below.



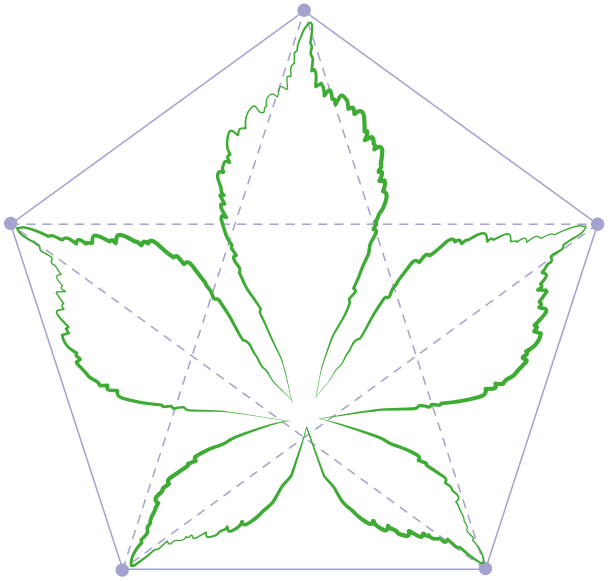
STEP 6 Draw the third leaflet

Add the outline of the third leaflet as a mirror image of the first, as shown below. You could use tracing paper to help you with this step.



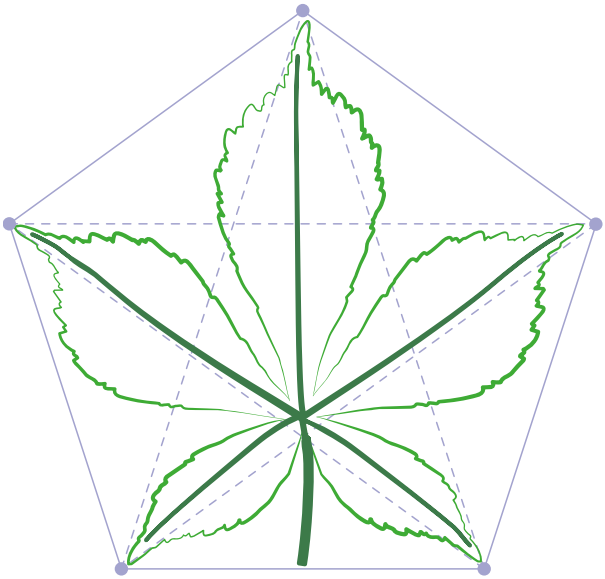
STEP 7 Draw the remaining two leaflets

Add the outline of the two smallest leaflets to complete the leaf drawing, as shown below.



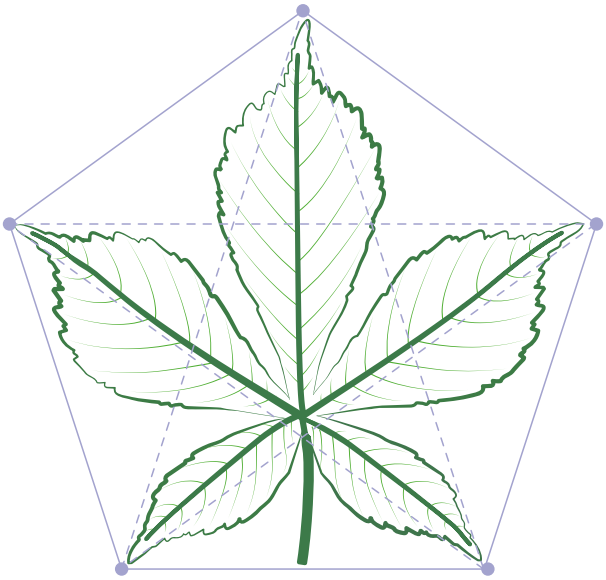
STEP 8 Draw the mid-ribs and petiole

On this type of leaf, each of the leaflets has its own mid-rib (the long, thick vein that runs down the centre of the leaflet from its tip to the point where it joins the petiole, or stalk). Draw each of these mid-ribs (they should be narrower at the tip and thicker at the base), then add the petiole.



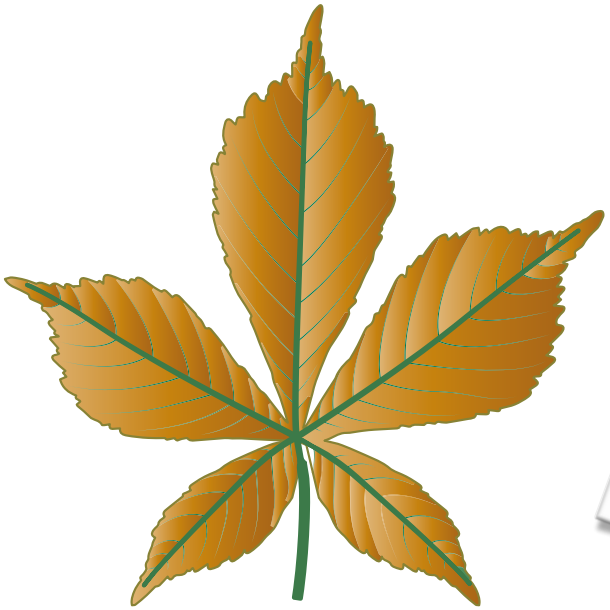
STEP 9 Draw the veins

Add the delicate veins that branch out from either side of the mid-ribs. What sort of pattern do they make? Pay attention to the angle at which they branch.



STEP 10 Add colour

Use colouring pencils to add either summer or autumn colours to the leaf. Look for examples in pictures or go outdoors and collect real leaves to guide your colour choices.



PHOTOCOPIABLE RESOURCE 5A

GEOMETRY ACTIVITY 6

ENQUIRY OF LEARNING How can we identify native trees in autumn?

LEARNING QUESTION How will I draw an oak tree leaf?

In this activity, students use the template in Resource 6A as a guide to draw the leaf of an oak tree.

This activity requires close observation and attention to detail, as students need to look carefully at the shape and outline of an oak leaf in order to recreate it in their drawing with accuracy. It's therefore ideal for helping students to develop these skills. This activity can also be used to support students' learning about native trees as part of the learning enquiry 'How can we identify native trees in autumn?', planning for which can be found on The Harmony Project website.

By the end of this set of six activities, students should be more confident identifying the leaves of the six trees that are the focus for the learning.

YOU WILL NEED

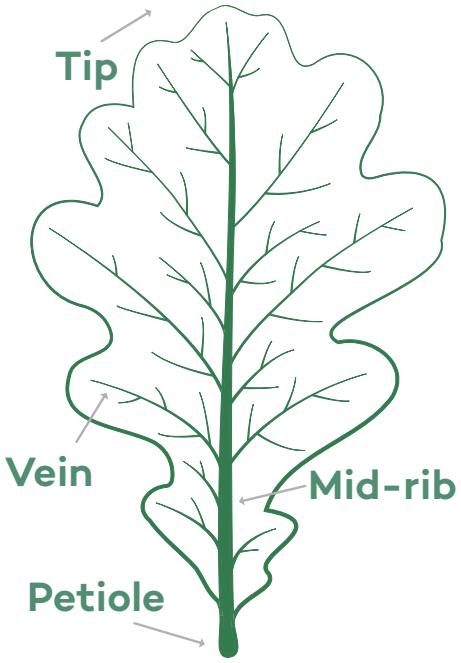
An HB pencil
A good quality eraser
Coloured pencils
Copies of Resource 6A

DID YOU KNOW?

The oak tree has lobed leaves with a distinctive wavy-edged appearance. In autumn, oak tree leaves turn from green to a golden yellow-brown, before falling from the tree.

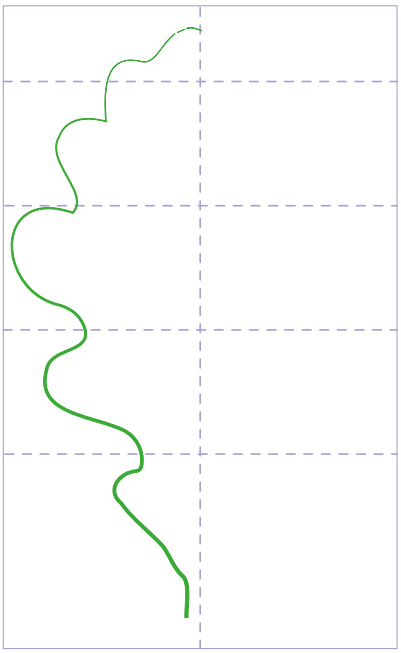
GET TO KNOW THE LEAF PARTS

The leaf of the oak tree has smooth edges and often has five or more distinct lobes. The diagram below shows the common parts of the leaf. Find an example outdoors or work with a clear photo to draw an oak leaf yourself.



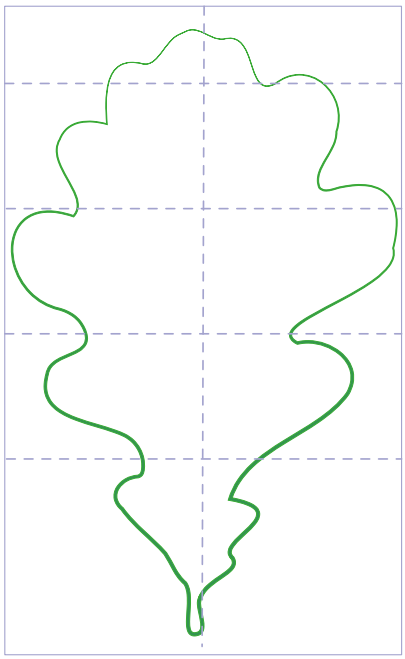
STEP 1 Draw half of the outline

Working in the left half of the template in Resource 6A, draw one half of the outline of the oak leaf, as shown below.



STEP 2 Complete the outline

Working freehand to make your leaf drawing look more natural and accurate, complete the second half of the leaf outline.

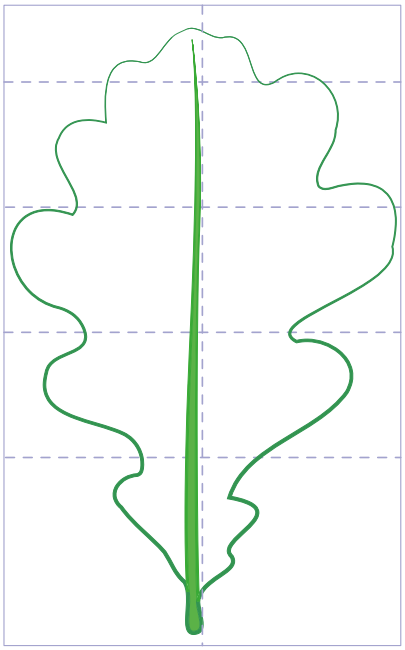


TEACHER TIP

If you look closely at an oak leaf, you will notice that it isn't symmetrical. For this reason, you should avoid using tracing paper to complete the leaf outline so that you achieve a more realistic drawing.

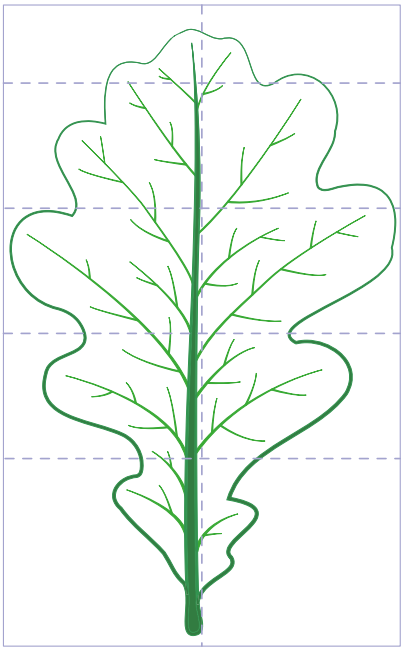
STEP 3 Draw the mid-rib and petiole

Draw the mid-rib (the long, thick vein that runs through the centre of a leaf along its length) and the petiole (stalk) in one movement. The line you draw should be narrower at the tip and thicker at the base.



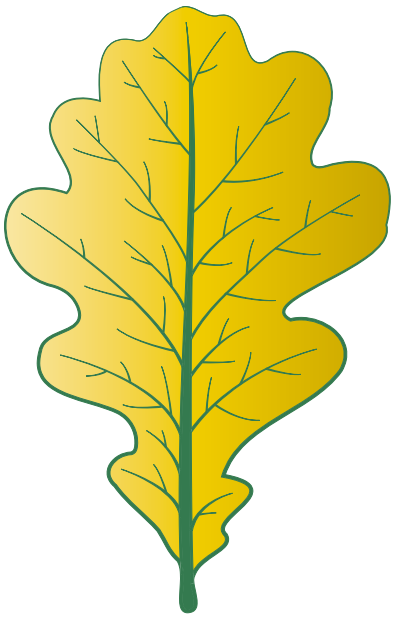
STEP 4 Draw the veins

Add the delicate veins that branch out from either side of the mid-rib. What sort of pattern do they make? Pay attention to the angle at which they branch. On an average oak leaf, there are roughly six smaller veins branching off the mid-rib.



STEP 5 Add colour

Use colouring pencils to add either summer or autumn colours to the leaf. Look for examples in pictures or go outdoors and collect real leaves to guide your colour choices.



SUSTAINABLE PRINTING

The Harmony Project is committed to working towards a sustainable future. With this publication, we are collaborating with Impress, a carbon balanced printer.

Full production of this publication is carbon balanced and the paper used is FSC certified and fully recyclable.

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