



Forestry England

Investigating your local woodland: Soils

Teacher notes



Introduction

Our climate is changing and our woodlands need to adapt to ensure they are resilient and thrive into the future. Choosing to plant the right tree species in the right places will help woodlands to cope with the pressures they face from hotter, drier summers and warmer, wetter winters. It is also predicted that there will be an increased number of storms and floods, as well as new pests and diseases.

Forestry England has identified 30 tree species for the future that we recommend planting more of. This is due to their adaptability to the predicted future climate, resistance to pests and diseases, growing speed (for the provision of timber), and availability of seeds.

Aim

The aim of this investigation is for students to take on the role of a Forester and identify the soil characteristics of your local woodland. They can then choose appropriate tree species, from the 'species of the future' list, which would be suitable for planting at that location.

These are the suggested key elements of the investigation:

1. Introduce the topic for investigation
2. Plan fieldwork
3. Desk-based research
4. Experiential fieldwork
5. Topic fieldwork
6. Data presentation and analysis
7. Evaluation

Prior knowledge required

- Soil formation.



Specific location and logistics requirements

- This investigation should ideally be conducted in a local woodland, with the landowner's permission, or alternatively could be carried out in your school grounds.
- Several soil samples should be taken to provide an accurate representation. This could either involve groups taking three samples each or by combining results for the class.
- Wipes and sanitiser or access to washing facilities will be required.
- A full risk assessment should be carried out – please see our guidance [here](#).

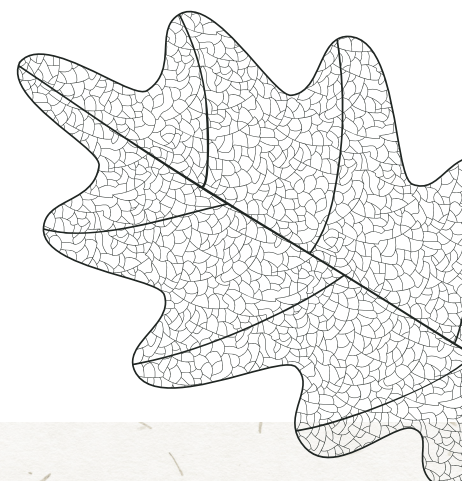
1. Introduce the topic

Use the PowerPoint to help refresh students' knowledge on soil formation and introduce the importance of planting the right tree in the right place, taking into account a variety of factors including the changing climate. Students can then pick their enquiry question.

There are teachers notes included in the [PowerPoint](#).

Suggested enquiry titles include:

1. What are the soil characteristics in a (named) local woodland?
2. Which trees are best suited to the soil in a (named) woodland?



2. Plan fieldwork

With the students' enquiry titles in mind, you will need to discuss possible fieldwork techniques that will enable them to collect relevant data. See if they have any ideas, before making suggestions about what they can do. You could include discussing ideal scenarios versus constraints of time and resources.

We suggest: a colour smear; looking at the soil composition; investigating the texture; pH and drainage. Notes on these are included in the PowerPoint.

Once they have finalised their methods, students can adapt the [student instruction sheet and results table](#), or create their own.

We recommend encouraging students to think about the risks associated with visiting a woodland, including those specific to their fieldwork and the importance of [biosecurity](#).

3. Desk-based research

Students can find out more about their local woodland by conducting some preliminary desk-based research. The following are suggestions of how desk-based research into the location, characteristics and management of the woodland may be carried out. If using a Forestry England forest, students may find the [Forest management plans](#) helpful.

Location

- Describe the location of the woodland.
 - Use OS maps to draw an annotated sketch map.
 - Use Digimap for Schools, or similar GIS tools, to obtain and annotate maps of the area.
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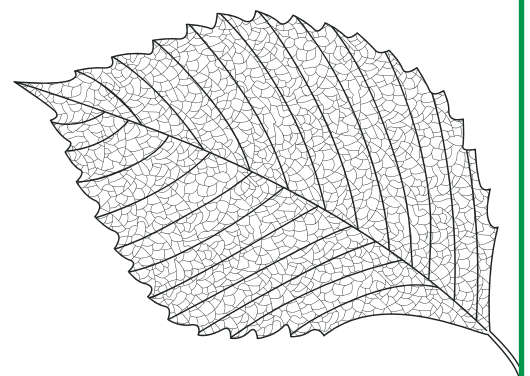
Characteristics

- Carry out internet research to find out more about the woodland. For example, the types of trees, animals and plants found there and if it contains other habitats, such as ponds or areas of grassland.
 - Old maps can show how the woodland has developed and changed over time.
 - Google Earth or Google Maps can be used to find satellite photos of the area, which could be annotated.
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People and management

Use internet research and maps to find out the following information about the woodland.

- Who owns the woodland?
- How do people use the woodland both now and in the past? You might find evidence of footpaths or car parks on maps. A website may include visitor information or advertise events.
- Is there any evidence that the woodland is being managed and, if so, who is it being managed for? For example, the forest might be managed to enable people to visit safely, part or all of the woodland might be used for timber production, or there may be habitat restoration or preservation taking place.



4. Experiential fieldwork

We encourage you to include some experiential fieldwork, allowing students to directly experience the benefits of connecting with forests. They can use their experience to learn skills that will help them with their mental and physical wellbeing.

Trees lead to better human health, it's that simple, and there is strong evidence to back this statement up. The key impacts include improved air quality, higher levels of physical exercise, a reduction in serious health conditions and higher levels of reported happiness and mental wellbeing. Not just spending time in nature, but actually noticing and connecting to it, is especially beneficial. You can find out more about the benefits of forests [here](#).

Ask the students to check in with how they are feeling, before and after these activities so they can see whether any of them have an impact on their wellbeing. You can have a go too!

Students will need:

- [Experiential fieldwork recording sheet](#).
- Clipboard and pen/pencil.

1. Soundscape

This involves students listening to the sounds of the woodland. This is enhanced if students close their eyes. They can record what they hear (birdsong, trees blowing in the wind, branches creaking) on the student recording sheet. You could use phone apps to identify birdsong.

2. Colourscape

This involves students observing and recording the colours of the woodland. Some students may like to create colour smears as a means of recording.

3. Smellscape

This involves students focusing on the smells of the woodland. They might pick up the smell of wood, pine trees, dampness after rainfall, etc. Less pleasant smells may include vehicle exhausts or agricultural slurry!

4. Haiku poem

A Haiku is a three-line Japanese poem with a 5-7-5 syllable structure. It is not intended to rhyme. Students need to write down a list of adjectives that describe the woodland. From this list, following the syllable rules, they can select words to complete their own Haiku poem. Students can be invited to read their poems to the rest of the class.

Peaceful, green and still

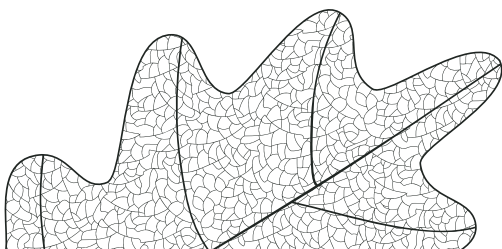
Oak, beech and birch comfort me

In this special place

5. Photo – what makes this place special?

Students can be tasked to take a single photo that (for them) shows what makes this woodland special. It could be a close-up photo, for example of a leaf, or a panoramic shot.

If they are happy to share, ask students to explain why they picked their particular scene.



5. Topic fieldwork

Fieldwork equipment

Students will need the following:

- [Student instruction sheet and results table.](#)
- Clipboard and pencil.
- Small trowel or auger for collecting soil and a tray or laminated sheet to put the soil on.
- Tree identification guide.
- [British society of soil science's texture flow chart.](#)
- Water – to enable texture to be determined.
- pH kit (including test tubes) to enable pH to be determined. *There are several pH kits available either from garden centres or through specialist fieldwork providers.*
- Disposable gloves and safety glasses (for the pH test).
- Moisture meter (optional).
- Cylinder – open at both ends – and water to conduct the infiltration experiment. *A plastic drink bottle is a cheap option. Ideally, the whole class should use the same size containers to enable results to be compared.*
- Stopwatch.
- Ruler.
- Camera (optional).
- Any other equipment for any additional methods to those we have suggested.



Collecting a soil sample

Investigating soil typically involves digging a soil pit. This can be damaging to the environment, and a less intrusive method involves using a soil augur, which extracts a core of soil. Once small samples have been taken from the core, the bulk of it can be replaced, thereby minimising any disruption to the soil structure.

Please collect soil samples in the least-intrusive and least-damaging way possible. This could involve collecting a sample from an exposure, for example, where a tree has blown over to expose roots and soil. The use of a trowel is perfectly acceptable to dig a small hole, ensuring that the soil and top clod of earth is then replaced after.

When extracting the soil sample, care should be taken to not mix up the layers. A tray or laminated sheet are useful for placing the sample on in the same way that it comes out of the ground.

Data collection

1. Remind your students of the aims of the investigation.
2. If possible, use a soil augur to extract a soil core. Identify the key characteristics of the soil core. Can any distinct horizons be identified? What are some of the observational characteristics of the soil (colour, texture, moisture)?
3. Work through the student's instruction and recording sheet, explaining that they will test two samples of soil from each of their three sites – one at 5cm below the surface and one at 20cm.
4. Carefully demonstrate each method so that students can see what to do and ask any questions.
5. Divide the class and assign groups to their study areas to conduct experiments.

Demonstration

1. Brief description of the sample site

The surroundings of the site can help to explain some of the results. The species and health of existing trees can also help determine which tree species to plant, although they may not all be as resilient to the predicted changes and challenges that lie ahead.

2. Colour smear

This can help to determine the type of soil and its nutrient content, as darker soil generally indicates more organic matter and therefore more nutrients.

3. Soil composition

The presence of organic content and stones/rocks in soil can tell you quite a lot about its characteristics and suitability for different tree species.

4. Texture

Soil texture is a description of the size and shape of soil particles.

- Sandy or gritty soils have large grains and lots of air spaces which means they are free draining.
- Clay soils have microscopic grains and feel smooth. They are not free draining.

Use the [British society of soil science's texture flow](#) chart to identify the texture of the soil. Students will need a small sample of soil and some water. They will need to wash/clean their hands afterwards.

5. pH

Use a pH kit to assess the pH (acidity) of the soil sample. This needs to be done with care and following the instructions supplied with the kit. Students should be encouraged to follow standard scientific procedures and safety protocols as in a school science lesson. This is a good example of cross-curricular work.

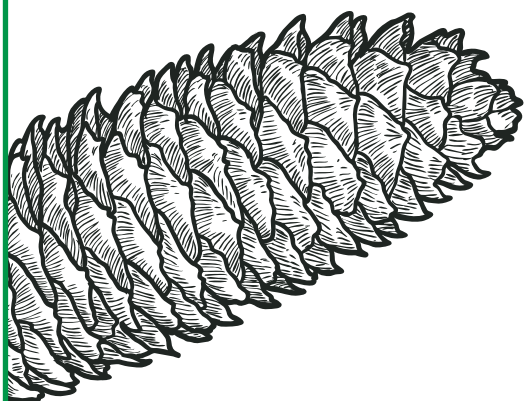
6. Moisture

Students need to make a note of how wet the soil feels as this could impact the drainage experiment. If you have moisture meters, these could be used to take a reading.

7. Drainage

This is a simple experiment where a known quantity of water is poured into a container which is placed into the soil (ideally beneath vegetation). The rate at which water soaks into the soil can be measured using a stopwatch. If infiltration is slow, stop after two minutes and use the ruler to measure the water level from the ground. Students can then calculate by how many centimetres the water level has dropped. Sandy soils would be expected to allow water to infiltrate faster than clay soils.

Students should make notes of how well they think the experiments work and whether or not there were any issues.



6. Data presentation and analysis

Data presentation

1. Students can cut out and annotate their colour smears, researching to find what the colour suggests about the type of soil and its characteristics. They can add any notes about what they could see in the soil.
2. Students can combine results and draw a bar graph to display the soil texture results. Plot frequency on the y-axis and soil texture types on the x-axis. This will show which type of soil texture is dominant in the study site.
3. Students can calculate the average pH value for their own samples. Whole class data could be used to calculate an overall average.
4. Students can calculate the average time taken for the water to infiltrate into the soil, or the rate of drainage. Group data could be used to calculate an overall average.

Data analysis and conclusions

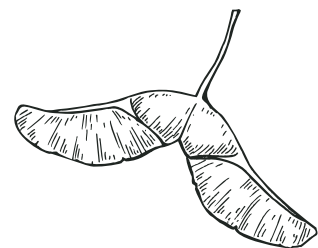
Students need to evidence the results from their fieldwork to draw conclusions about the type of soil at the woodland, to answer their enquiry titles. What do the results suggest about the nutrient content of the soil, its acidity (a chalky/limestone soil will be alkaline whereas a richly organic soil will be more acidic) and the texture/drainage characteristics?

Students can use the table in the appendix to consider what trees would be suitable for planting at that location. Any observations made of the existing trees can be used to discuss the health of those species and their suitability for that location – now and for the future. Additional research could be carried out to check other requirements of the tree species selected, for example shade tolerance, and what particular uses the different tree species have.

7. Evaluation

Students should assess the reliability and accuracy of their results using any comments made on their recording sheets.

- How accurate was the data collected? Were the samples representative?
- Were the methods appropriate?
- How reliable were the results?
- How could accuracy and reliability be improved?



Resources

You can find out more about tree 'species for the future' [here](#).

[Forestry England website](#) provides facts and information about the uses of different tree species.

Forest Research have an extensive [tree database](#) giving more details on the site requirements of different tree species.

Forest Research have an [Ecological Site Classification tool](#) which is a web-based decision support system to help forest managers and planners select tree species that are ecologically suited to particular sites.

Forestry England's [Forest management plans](#) set out how we aim to manage the woodlands in our care over the next 30 or more years.



For other Forestry England educational resources, visit:

forestryengland.uk/learning



Forestry England

Appendix

Species for the future

Conifer species

Tree species	Preferred soil type	pH	Nutrient requirement	Drainage
Coast redwood	Loamy, moist, well-drained	5.5–6.5	Poor – moderate	Moist
Corsican pine	Sandy or loamy	4.5–6.0	Moderate	Well-drained
Douglas fir	Deep, moist, well-drained	5.0–6.5	Moderate – rich	Well-drained
European silver fir	Deep, calcareous or loamy	5.5–7.0	Poor – moderate	Moist
Grand fir	Moist, fertile loam	5.0–6.5	Poor – moderate	Well-drained
Japanese red cedar	Moist, acidic loam	5.0–6.0	Moderate	Well-drained
Lodgepole pine	Range from podsoles to peats, can tolerate acidic soil.	4.5–6.0	Poor	Can tolerate dry
Macedonian pine	Siliceous soils. range from flushed peats through to podsoles and sand dunes	5.0–6.5	Poor – moderate	Dry – moist
Maritime pine	Sandy, acidic soils	4.0–6.0	Poor – moderate	Dry – moist
Norway spruce	Moist, sandy loams	5.0–6.5	Poor – moderate	Moist
Scots pine	Light soil of low fertility	4.5–7.0	Poor – moderate	Dry
Sitka spruce	Moist, acidic soils	4.0–5.5	Poor – moderate	Moist
Western hemlock	Acid brown earths	4–6.3	Poor – medium	Dry – Medium
Western red cedar	Rich brown earths	5.0–6.5	Moderate – very rich	Moist

Broadleaved species

Tree species	Preferred soil type	pH	Nutrient requirement	Drainage
Aspen	Moist, loamy soils	5.5–7.0	Poor – rich	Slightly dry – wet
Beech	Deep, fertile loam	5.0–6.5	Poor – moderate	Moist
Common alder	Deep loams and alluvial	5.5–7.0	Moderate – rich	Tolerates wet soil
Downy birch	Acidic, moist soils	4.5–6.0	Poor – moderate	Moist
Field maple	Calcareous or loamy soils	6.0–7.5	Moderate	Well-drained
Grey alder	Wet fertile clays	5.5–7.0	Poor – medium	Moderately dry – wet
Hornbeam	Moist fertile soils	5.5–7.0	Moderate	Fresh to moist
Pedunculate oak	Heavy clay or loam	4.7 – 7	Medium – rich	Moist to waterlogged
Red oak	Sandy loam, acidic soils	4.5–6.0	Poor – moderate	Dry – moist
Rowan	Acidic, peaty or loamy soils	4.5–6.0	Poor – moderate	Moist
Sessile oak	Acidic, well-drained soils	4.5–6.0	Poor – moderate	Well-drained but moist
Silver birch	Sandy, acidic soils	4.5–6.0	Very poor – moderate	Well-drained
Sweet chestnut	Acidic, sandy loam	5.0–6.5	Poor – moderate	Slightly dry – fresh
Sycamore	Deep, moist, fertile soils	5.5–7.5	Moderate	Fresh – moist free draining
Wild cherry	Deep, fertile loam	6.0–7.5	Moderate – very rich	Fresh
Wild service tree	Calcareous, loamy soils	6.0–7.5	Moderate	Fresh – moist