Educators' Notes

One Planet Matters

Investigating soil

Summary:

This activity pack is aimed at educators, providing information and guidance for you to lead soil-focused investigations with your learners.

These activities will allow your learners to investigate:

1. What kind of soil do I have in my garden or playground?
   - Is it sandy, clay, silty, or loam soil?
   - What do these different soil types mean?

2. How well does the soil in my garden or playground drain water?

These activities can be completed as a class, and are also a great Eco-team activity. One Planet Matters also runs workshops where we can come in and conduct these activities with your learners. Get in touch to discuss how this works.

Key Stage / Age group: KS2

Time needed: Short (20 min) activities as well as activities to run over several days .

Location: Outside, anywhere where you can take some soil samples. We recommend choosing a few different spots in varying locations either on school grounds, or nearby. You could also ask pupils to bring in soil samples from their gardens to compare. Some note-taking can be done indoors.

Curriculum links:

KS2 - Year 3 - Rocks and Soils
KS2 - Geography - Biomes and vegetation belts

Activity Links:

- This activity could be done early on as it would inform the information needed related to growing -See growing survey document.
- We would also recommend splitting one of your growing beds into 2 and using one as a no dig bed and the other in a more traditional way and explore the difference in soil structure. You can access our no- dig and monthly jobs resources here.
- You can also link to composting and making a wormery as both of these elements will enhance your soil structure.

Soil investigations

Contents:

QUESTION 1 - What kind of soil do I have in my garden or playground?

Testing soil composition

Soil composition describes what the soil is made of. This is important because different plants need different types of soil in order to grow well.

Some plants need soil that has lots of nutrients in it, and some need soil with less nutrients.

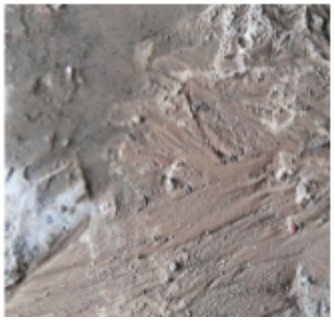
Some plants need slow-draining soil that holds onto water for longer, while others will die in slow-draining soil as their roots will rot in the water.

Some plants need well-draining soil that doesn't hold onto water, while others will wilt and die if they are in soil which drains too quickly.

There are three main types of soil: clay, sandy, and loam. Most soil will have both clay and sand in it, as well as silt. When we talk about whether soil is 'clay' soil, 'sandy' soil, or 'loam' soil, we are just talking about the ratios of clay, silt, and sand in the soil.


Clay soil


Sandy soil


Silty soil


Loam soil

Here is what each of them means for how well it retains water and nutrients:

- **Clay:**
  - **Water drains slowly** from clay soil, but the soil holds onto **lots of nutrients**.
  - This is because there is a higher ratio of clay in the soil than sand, and clay is a very heavy material which has very **few air gaps** in it for water and nutrients to move through.

- **Sandy:**
  - **Water drains quickly** from sandy soil, but the soil also **struggles to hold onto nutrients**.
  - This is because there is a higher ratio of sand in the soil than clay, and sand has **lots of air gaps** in it, so water and nutrients move through the soil very easily.

- **Silty:**
  - Silt is generally found near rivers and other bodies of water, and you may recognise it by its **slippery texture**.
  - Silty soil has smaller particles (so **less air gaps) than sandy soil**, but larger particles (so **more air gaps) than clay**. This means that it falls in the middle of the two in terms of how well it retains water and nutrients.

- **Loam:**
  - This is often seen as the **best soil for growing most plants**, as it is nutrient-rich but doesn't stay soggy for too long.
  - Loam is soil which has a **good balance of sand and clay in it, as well as silt**. This balance means that water and nutrients can move through the soil, but not as quickly as with sandy soil, and not as slowly as clay soil.

The optimal ratio of sand, silt and clay in loam soil is: **20% clay, 40% sand, and 40% silt**. This is seen as the healthiest balance for growing most plants in - especially vegetables!

METHOD 1 - SOIL SQUEEZE!

You can use the **squeezing method** to test which type of soil you have in your green space.

You will often have slightly differing types of soil in different areas of your garden, so it is interesting to compare.

It could also be interesting to test the soil from different people's gardens - just bring a cup or so into school and compare it with one another, and with the soil found on school grounds.

What you'll need:

- A spade or shovel (if the soil is very hard)
- Your hands
- A cup of soil from various areas in your garden of school green area

How to:

1. Take some soil from a few spots in your green area, and add some water to it - make sure it isn't too soggy, so let some water drain out.

2. Then take a handful of the soil from each location, and squeeze!

3. Open your hand and take a look at the soil. Does it:
    a. Hold its shape when held, and crumble when poked?
    b. Hold its shape when held, and hold its shape when poked?
    c. Crumble as soon as you open your hand?

4. Can you tell which type of soil you have? Have a guess, and then check if you were right:

    a. This means you have loam soil
    b. This means you have clay soil
    c. This means you have sandy soil

METHOD 2 - SOIL SHAKE!

Now that you have an idea of what type of soil you have in different areas, you can use the soil shake method to see exactly how the different layers of sand, silt, and clay sit together in each soil sample. This will help you to see the ratios of each material in your soil.

Pre-test questions:

- ❖ Make a hypothesis: before you start, can you guess what ratios you will see between sand, silt and clay in each soil sample?

Here's how to find out using the soil shake method:

What you'll need:

- Soil samples from different areas of your garden or green space - or perhaps from different green spaces
- 500ml jars with lids - enough for each soil sample
- Water
- Cup measurement
- Labels (or masking tape) and a pen
- Ruler
- Pen and paper for marking results

How to:

1. First, collect just over a cup of soil from each location you are using.
2. Remove any large bits of material from the soil samples - including twigs, stones, and leaves - and then put 1 cup of soil from your different locations into the different jars. Make sure you label your jars so you don't forget which soil sample is which!
3. Add water to each jar so that there are a few centimetres of water above the soil line. Shake each jar for a few minutes to make sure every little bit of soil has been soaked.
4. Leave the jars for 48 hours to settle, checking on it after a few hours, and after 24 hours. At these time points, note down any layers forming at the bottom of your jar, either onto the jar itself, or onto a separate piece of paper. Note down what you notice about how long the sediment takes to settle - this will help you to identify whether you have heavier sediment (sandy) or lighter, finer sediment (clay) dominant in your soil sample.

5. Once settled, come back and see how the layers have formed! Then answer these questions:
    - Can you see distinct layers in the soil?
    - How many layers can you see in each jar?
    - Can you describe the different layers? How are they different in colour? Do they look different in texture? What other differences can you see?
    - Can you tell which layers are sand, silt, and clay?

6. Measure each layer in millimetres. Then, using the diagram and information on the page below, work out what kind of soil do you think you have in each jar.

7. Once you have worked out what kind of soil you have, answer these questions:
    - Were you surprised?
    - Did you get the same answer in method 1 and method 2?

Analysing your results for the jar shake test 1 - Defining your soil layers

Read through these characteristics of what each soil type looks like in water to help you define each layer of sediment.

❖ **Sandy soil** - the water should look relatively clear, and you should see a layer of sandy particles which have sunk to the bottom of the jar. These sandy particles are the largest, so they will settle the quickest at the bottom of the jar, usually taking only a few minutes to form a layer. They should also be the easiest to define as they will be grainy in texture.

❖ **Clay soil** - if there is a lot of clay in your soil, then after about 24 hours the water should look cloudy, with a small layer of soil on the bottom of the jar. This is because clay takes a longer time to settle than soil types with larger particles (like sand). After 48 hours, the clay soil should have settled. It is normally light in colour and the sediment is very fine.

❖ **Silty soil -** if you have silty soil, it can look similar to clay soil in the jar - it will also look smooth as the particles are very small. However, the layer of silt will settle faster than the clay layer, so you could mark the silt layer a few hours to a day after shaking the jar, once the silt layer has settled but before the clay layer settles. Another way to tell silt and clay apart in your experiment is to check the colour - silt is normally a lot darker than clay.

❖ **Loam soil** - if you have loam soil, the water should look clear and you should end up with layers of sediment at the bottom of the jar. You should see the finest sediment (clay) at the top, then a thicker layer of silt below the clay, and a layer of the larger grainy sand sediment at the bottom.

If you want an extension task - and this will be for you as the educator to set up in a way that takes the information and makes it user friendly, but here is an activity that could be used to measure the

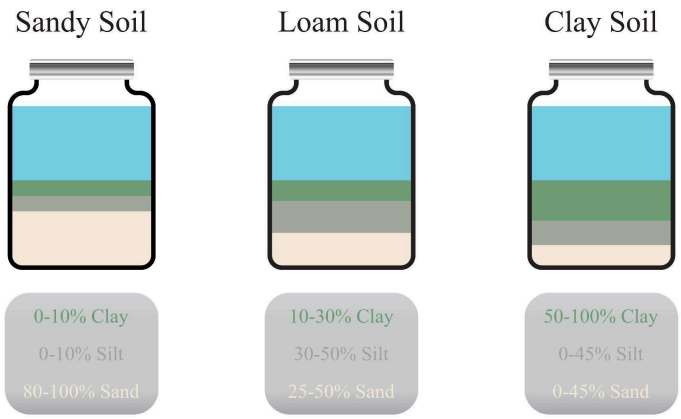
2 - Working out your soil type

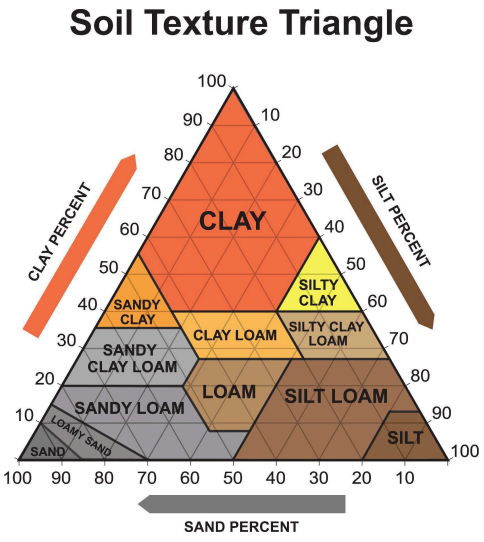
Using your measurements, work out what percentage of soil each layer makes up.

Here's how:

Divide the thickness of each layer (in millimetres) by the thickness of the whole layer of sediment (in millimetres). Then multiply this by 100 to get the percentage of each layer.

Then use these measurements along with the images to the right to define what type of soil you have. To work out your exact soil texture, use the soil texture triangle.
Match up the percentages of each material (sand, clay, and silt) and see where they overlap on the soil texture triangle.





If you want an extension task which might be suitable for older Primary School pupils then you may want to adapt elements of the activity below.

How well does the soil in my garden or playground drain water?

Pre-test questions:

- ❖ Now that you know what your soil composition is, can you make a hypothesis about how easily water drains from your soil?
- ❖ Can you remember why knowing how easily your soil holds onto water is important?

What you'll need:

- A shovel or garden spade
- A long ruler (over 30cm) or tape measure
- A bucket or hose
- A straight pole or stick (longer than 30cm)
- A stopwatch / alarm / clock
- Pen and paper

How to:

1. Dig a hole which is 30cm deep and 30cm wide. If you are testing soil drainage in several different spots, make sure each hole is as close to the 30cm x 30cm measurements as possible.
    - ❖ This is also a great opportunity to collect soil samples from different areas and do the soil shake test above!

2. Fill the hole(s) with water from your hose or bucket. You will need approximately 20 litres of water to fill each hole. Leave this water overnight to seep into the surrounding soil.

3. The next morning, once the water has seeped into the soil, place your pole over the hole - this will help you to measure how much water has drained over time as it shows you where the top water level mark is. Then fill up the hole(s) with water again, right up to the pole.

4. Note the time and distance between the top of the water and the bottom of the pole - your first measurement should be 0cm, as the hole will be full of water. As you come back and do more measurements, however, the distance between the waterline and the pole should increase as the water drains. You may want to draw up a table like the one below:

Hour	Drainage measurement (cm)	Drainage (cm / hour)
0	0	0
1	6	6
2	11.4	5.4
3	15.5	4.1
4	18.6	3.1
5	21.5	2.9
6	24	2.5
7	26.2	2.2
8	28	1.8
9	29.5	1.5

5. Come back every hour to measure the distance between the waterline and the bottom of the pole. Fill in the table - the above measurements are an example of what you may end up with.
    - ❖ Note: It doesn't matter if you are only able to observe the water for less time than the 9 hours specified above. It also doesn't matter if you don't see the moment the water fully drains from the hole - the above table shows, for example, that perhaps your final measurement will be when there is still water inthe hole. This does not matter, as in order to work out your soil drainage rate, you will look at the average amount that the water level dropped over the number of hours you were recording for.

6. To work out your results, divide the total amount of water drained from the hole by the amount of time you were taking measurements for. So for the example table above, this would

   be: 29.5 ÷ 9 = 3.27777777778

   This means that the example drainage rate would be 3.27cm per hour.

Interpreting your results:

Now that you know the drainage rate of your soil, you can use this information to decipher whether your soil is seen as having good drainage, or if it is considered slow or fast draining soil. We will also look at what this means for growing plants, and how to optimise soil drainage based on the type of soil you have.

Drainage rate (cm / hour)	Result
<2.5cm / hour	**Slow-draining soil** This is most likely to be soil with a heavy clay content, as the compact clay makes it harder for water to pass through. This can lead to plants dying, because watering soil pushes out oxygen, so if the soil is saturated with water for too long then the plants will be deprived of oxygen. As well as this, waterlogging can cause roots to rot and the plants to suffer this way. To help with drainage, you could mix some organic matter into the soil. We don't recommend mixing sand into clay soil to make it drain better, as this makes more of a concrete-like mixture! Shredded leaves and compost are better examples of organic matter that will help to optimise drainage.
2.5-7.5cm / hour	**Well-drained soil** This soil likely has a good balance of different materials, making it loam soil. Water drains not too quickly and not too slowly, so the roots of plants have enough time to absorb nutrients but are not left waterlogged. This generally leads to the healthiest plants.
>7.5cm / hour	**Fast-draining soil** This is most likely with sandy soil types, where water drains too quickly for many plants to absorb enough nutrients. To slow down the rate of water drainage in this type of soil, you could add some organic matter such as compost, shredded bark or leaves. Adding organic matter balances out both fast and slow draining soil.

Additional information:

https://www.rhs.org.uk/soil-composts-mulches/soil-types http://www.landis.org.uk/soilscapes/

http://www.soil-net.com/

https://www.gardeningknowhow.com/garden-how-to/soil-fertilizers/what-is-well-drained-garden-soil.htm