Soil-Net.com

Cranfield UNIVERSITY

Free web-based educational resource for soils

NORWICH SCHOOL OF ART & DESIGN

The Soil-Net web project presents a schools educational resource to better inform the education of young people about soil. Visit http://www.soil-net.com

FREE!

Everyone is affected by soil - as one of the three major natural resources, alongside air and water, soil is vital to the existence of the planet. It's right there, just under our feet!

The Soil-Net Website is available for free, helping Primary and Secondary school students (Key Stages 1-4) learn about the importance of soils and the environment.

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defra
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The Soil-Net project is led by Cranfield University's National Soil Resources Institute (NSRI), together with the Norwich School of Art and Design (NSAD), sponsored by Defra

www.soil-net.com

About Soil-Net

Soil is important in all our lives. As one of the three major natural resources, alongside air and water, soil is vital to the existence of life on earth. Soil-Net.com help you learn about what soil is, the teeming life in soil, what soil does and about the many environmental threats facing our soils. Remember, soil is all around us, just under our feet! Be sure to visit Soil-Net.com.

Primary

Designed for Key Stages 1 and 2 (ages 5-11), Soil-Net offers a series of exciting, interactive and animated movies that teach about soil and its importance. Follow Badger and class in soil school as they learn about what soil is, why soil matters, how soil forms and differs and how soil supports the plants and animals on earth. Activity and topic sheets accompany the on-screen fun.

Secondary

Designed for Key Stages 3 and 4 (ages 11-16), Soil-Net offers a broad coverage of soils information; introducing soils, examining the global cycles, presenting the functions soils perform, looking at the diversity of world soils and considering the threats and concerns facing our soil resources. A series of case studies and informative activities and downloads are also provided.

Teachers and Parents

An important part of Soil-Net provides in-depth advice and assistance for teachers and parents supporting children learning about soil, based on real classroom trials. Curriculum links are provided for Science, Geography, Citizenship and History. Teaching resources include extensive soils activities for classroom and outdoors, a series of 3D virtual soil walks and an eco-lifestyle quiz.

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Soil-net.com

Activity: Soaking Soils

http://www.soil-net.com

Use the coloured water provided

Sprinkle the water into the jar

Start the stopwatch and time how long it takes for the coloured water to appear at the base:

Jam Jar One

What type of soil is it?:

How long did the coloured water take?:

What else did you note?:

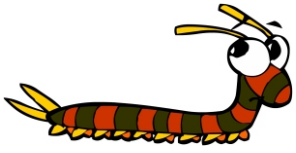
Jam Jar Two

What type of soil is it?:

How long did the coloured water take?:

What else did you note?:

Were there any differences? If so, what were they?:



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Soil-net.com Teacher Notes

Activity: Soaking Soils

http://www.soil-net.com

This activity, helps students to begin to understand the relationship between soil and water. Adding water to soil and observing infiltration rates teaches how differing pore sizes in soil affect water transmission rates.

The learning outcome of this exercise is that '**the larger the particle, the quicker the water passes through because the pores (gaps) are larger**'.

Prepare a series of clear-sided identical jam jars for each group of students. Fill one with fine playground 'silver sand'. Fill another with earth from the school grounds. If possible, also try samples of other soil types from the area – soils can vary enormously within a short distance. Label jars with the sources. Have another jar of pea-gravel.

Have mixtures with and without stones, make mixtures with varying amounts of sand. Use sieved and un-sieved soils. Have some soil that is damp to start with and some that is powder dry.

Prepare measured beakers with a mixture of water and a bright dye (e.g. diluted red paint). Students are given one beaker per jar and a stopwatch. They must gently pour water onto each jar, time and record how long it takes before the dye appears at the base.

Soils with a larger soil particle size should wet first. Heavier soils, such as clay, may never fully wet through. Times may vary considerably.

For an alternative exercise, try repeating with one jar with loose sand shaken up, and one jar with packed sand, well pressed down. You should see a marked difference. Does dribbling the water in, or pouring all at once affect the experiment? There are lots of opportunities for class discussions!

Note that this experiment may prove difficult - the key thing is to discuss the **concepts** involved, which are:

1. Soils contain air gaps or 'pores' through which rainwater passes (and air exists for animals to breathe).
2. Soils is a mixture of different particle sizes; sand has large particles (and relatively large pore sizes), whereas clay has very very fine particles (and relatively small pore sizes)
3. When it rains, water (i) soaks (infiltrates) down into the soil and water remains in the soil for plant roots. Some water (ii) flows over the surface to rivers and some water (iii) passes deep down to the aquifer.
4. Soil may also have cracks and fissures in it which act as 'preferential channels' down which water can flow. Baked cracking clay has these cracks. Sieved versus un-sieved soil may demonstrate this.
5. The gravel jar clearly demonstrates large pore size = fast infiltration. In reality water can 'stick' to the soil particles (like a magnet attracts iron filings) - so clay may wet up and take a long time to dry. Soils all have different characteristics.

Lesson glossary: texture, cracks, soaking, sand, silt, clay, pore

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Activity: What is soil made of?

http://www.soil-net.com

Why is each of these important in soil?

silt

sand

clay

organic matter

water

air

animals

Which one of these is there most of in soil?

Soil-net.com Teacher Notes

Activity: What is soil made of?

http://www.soil-net.com

This activity helps students to understand the components that make up soil and their importance.

Sand particles: form lightweight, free-draining soils; cannot hold onto nutrients

Clay particles: hold water well; can become heavy and waterlogged when wet; can hold onto nutrients**.**

Silt particles: hold water; can be hard to drain; can hold only limited nutrients**.**

All soil contains sand, silt and clay particles, but in differing proportions. Sand particles are the biggest, then silt and finally clay.

Water: clings to soil particles; is taken up by plant roots**.**

Air: fills gaps in soil; allows the plant roots and animals to 'breathe'.

Just under half, about 35 to 40%, of a good soil is made up of water and air! So 'Which one is there most of' - could be air!

Organic matter: includes manure, leaf mould and compost; releases nutrients slowly as it rots; improves water holding. You can say it helps stick the soil together!

Animals: includes insects, bacteria and earthworms; help to break down dead materials**.**

Soil is all around us; in the school playground, at the park and in our gardens. We need to look after our soil.

Suggested key words for class discussion:
Sand, Nutrients, Water holding, Silt, Drainage, Organic matter, Clay, Particles, Air, Animals, Rot, Dead material

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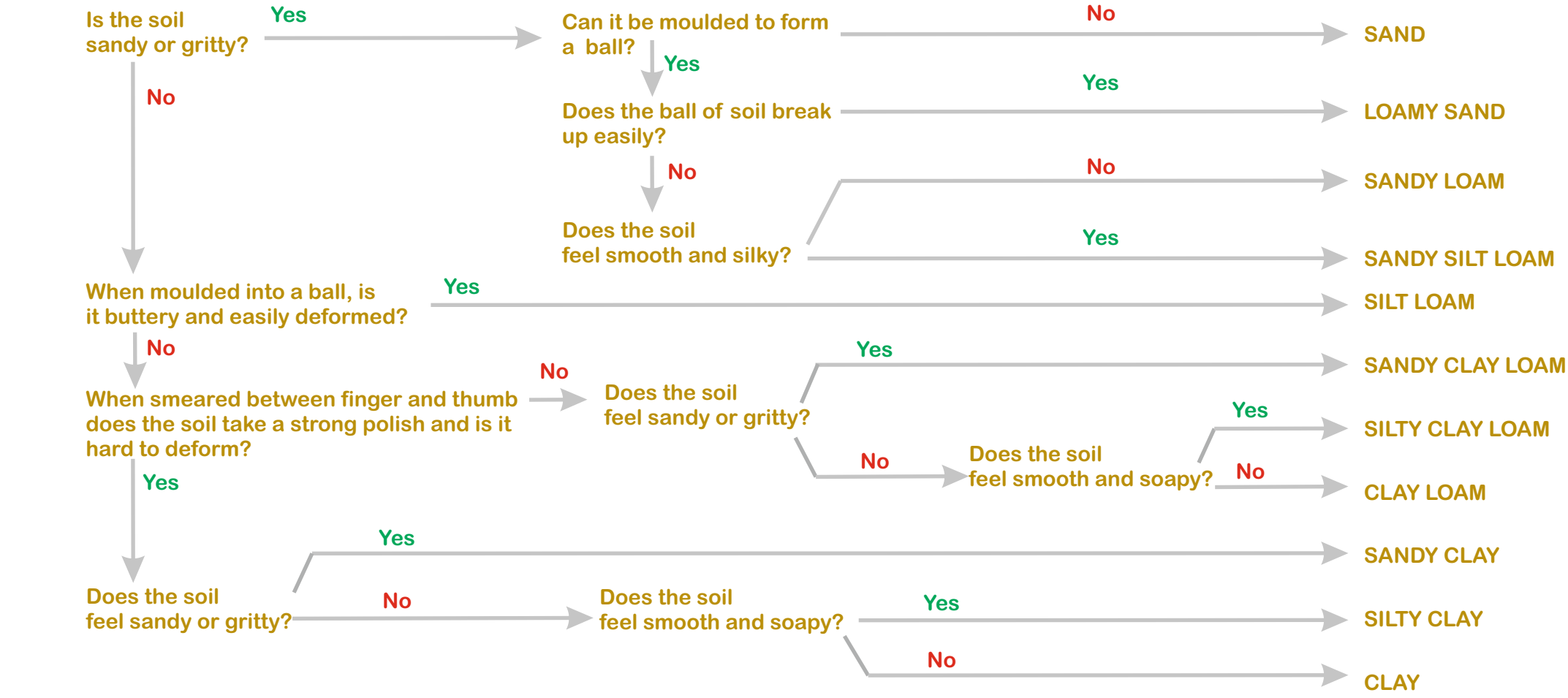
Activity: Hand Texturing of Soil

What type of soil do you have?

Take a small clump of moistened soil and knead between fingers and thumb



What type of soil do you have?

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Activity: Hand Texturing of Soil

http://www.soil-net.com

This activity helps students to understand the components that make up soil.

Moisten the soil with a little water first. Provide students with a range of different soils.

Sandy soils: form lightweight, free-draining soils; cannot hold onto nutrients

Clayey soils: hold water well; can become heavy and waterlogged when wet; can hold onto nutrients

Silty soils: hold water; can be hard to drain; can hold limited nutrients

Make sure that you follow your Education Authority Health and Safety Guidelines in doing this exercise. The soils to be hand textured should ideally be heat sterilised before the exercise. Wash hands after!

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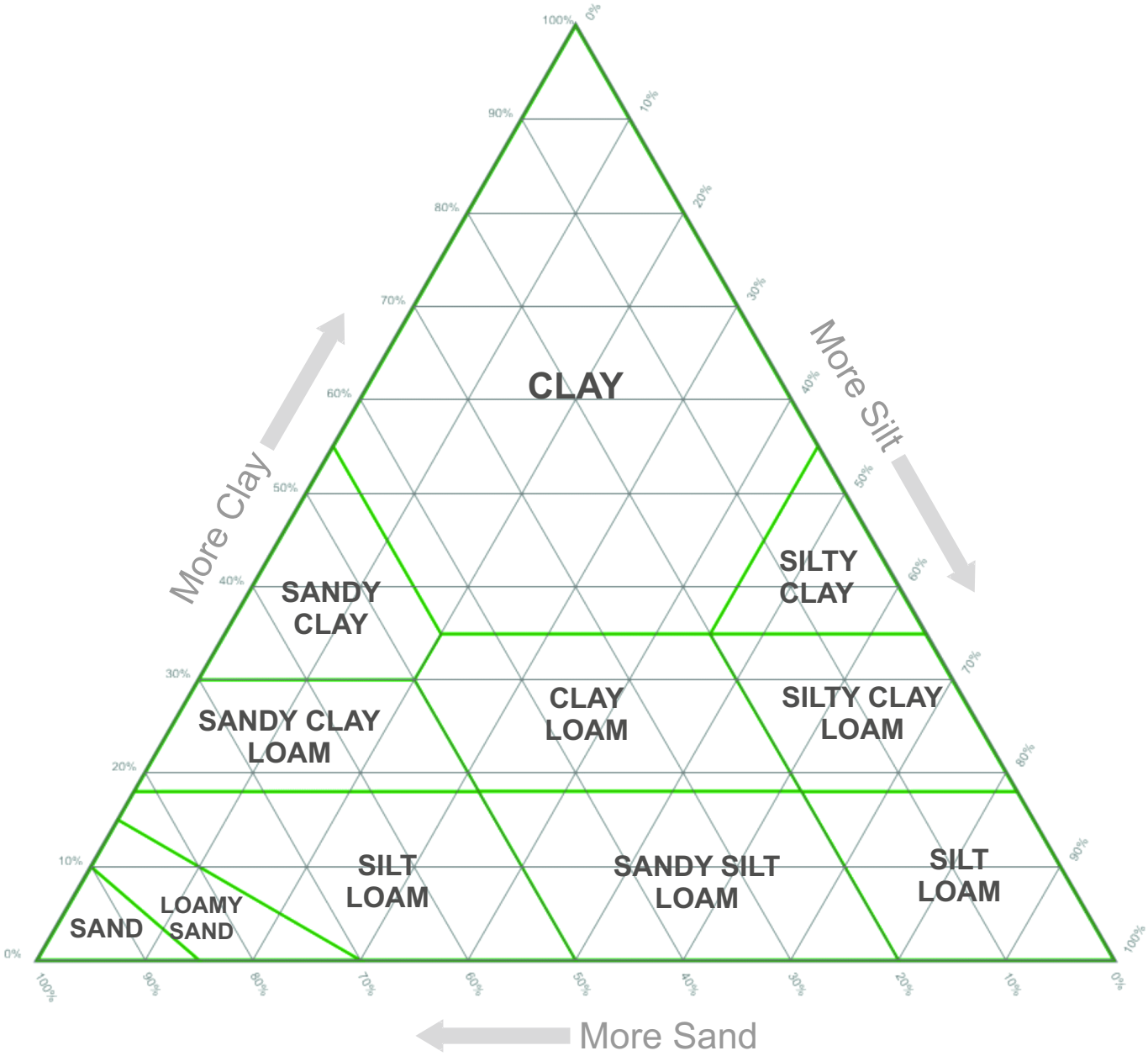
Activity: Soil Texture Triangle

http://www.soil-net.com



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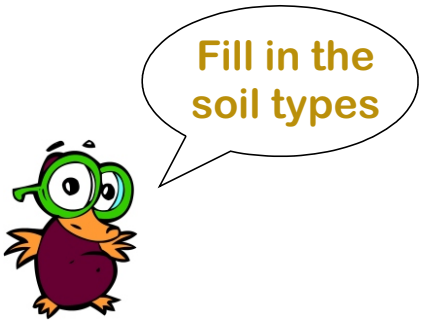
Activity: Testing Soil

http://www.soil-net.com



Start

Use moistened soil

Is soil sticky?

Yes

Roll it into a ball...

No

Yes

Can you roll a ball?

Will it break easily?

Yes

No

Yes

No

Now do the test. What type of soil do you have?

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Soil-net.com Teacher Notes

Activity: Testing Soil

http://www.soil-net.com

Key words for this lesson: **Sand, Silt, Clay, Loam**

This activity helps students to understand the components that make up soil.

Moisten the soil with a little water first. Provide students with a range of different soils.

Sandy soils: form lightweight, free-draining soils; cannot hold onto nutrients

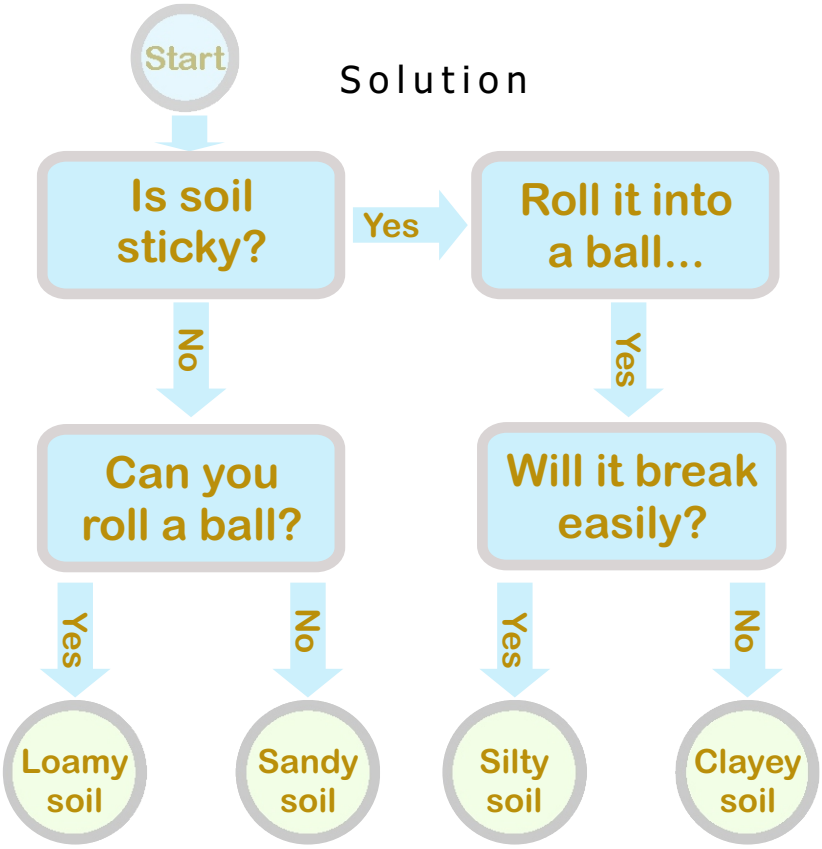
Clayey soils: hold water well; can become heavy and waterlogged when wet; can hold onto nutrients

Silty soils: hold water; can be hard to drain; can hold limited nutrients

Make sure that you follow your Education Authority Health and Safety Guidelines in doing this exercise. The soils to be hand textured should ideally be heat sterilised before the exercise.

Note that there are other soils too - see the Soil Types factsheet for more information on these.

Solution



First of all, have the students try guessing which soiltype is which of the four and complete their sheets, (the students copy has the soil types omitted). This makes for a good class discussion. Once these are filled in, have the students try testing some soil.

Remember, it may be best to remove stones first from the soil. Alternatively, use dried soil samples and sieve - link to **Science 3a, (investigate) Separating Materials** - the separated soil can then be moistened enough to bind it.

Note the use of a sorting key is good practice - **Science 4a, Variation and Classification**.

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Activity: What Makes Plants Grow?

http://www.soil-net.com

Why is each of these important to a plant?

Sunlight

_____
_____
_____

Oxygen

_____
_____
_____

Carbon Dioxide

_____
_____
_____

Soil Anchorage

_____
_____
_____

Soil Minerals

_____
_____
_____

Soil Water

_____
_____
_____

What happens if a plant cannot receive any of these?

_____

_____

What else might a plant need to grow well?

_____

_____

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Activity: What Makes Plants Grow?

http://www.soil-net.com

This activity helps students begin to understand the relationship between plants, plant growth/health and the soil.

Text books may often underplay the crucial impact soil has upon plants, in providing a source of nutrients for the roots, in providing water and in providing an anchorage for the roots.

In addition to the qualities noted, plants may also need shelter from wind and excessive temperatures. Plants suit themselves to their environments - for instance the 'leaves' of succulents can retain water in hot climates; cacti can do this as well as protecting themselves from grazing animals.

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Activity: The Jam-Jar Experiment

http://www.soil-net.com

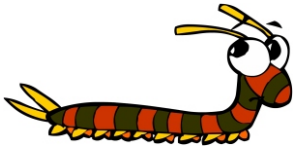
Take a clean, straight-sided jam jar and fill it about a third of the way up with the soil with which you are experimenting. Also have ready another jar of clean water and a stirring stick.

Now add the clear water until the jar of soil is almost full. First just watch the mixture for a while - do you see air bubbles rising? How much air is there in soil?. Now stir up the mixture and leave the jar for 2 or 3 hours for the contents to settle out and the water starts to clear.

When the water settles different layers should appear. Sand particles are the biggest and weigh more than silt - so the bottom layer will be the sand part of the soil. Any pebbles will also be at the bottom. Next up is the silt layer. Silt particles are smaller than sand and weigh less so they appear over the sand. If you were able to separate out any clay particles they are the smallest and will be on top. Organic plant materials will be on top.

Time started: _____

Time stopped: _____



Describe what happened.

_____

_____

_____

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Activity: Jam-Jar Experiment

http://www.soil-net.com

Soil is made up of a mixture of sand, silt, clay particles and rotted plant (organic) material. Different soil types have differing percentages of each. The jam-jar soil experiment helps an understanding of what the proportions of these are for the soil with which you work. You should try this experiment with soils from different areas and compare the results to see how soils vary. Try it also with the soils you get in bags from garden centres for growing seeds and see how that varies from your garden soil.

This activity helps students to begin to understand the mineral constituents of soil, sand, silt, clay as well as organic matter. Adding water to soil in a jar and observing settlement after shaking teaches how different soils possess differing proportions of these 'ingredients'.

Prepare a series of clear-sided jam jars for each group of students. Try and provide a selection of differing soil types - earth from the school grounds and nearby areas for example. Try 'making' soil by mixing potting compost with playground sand to see it separated out again. It is good, if possible, to try samples of other soil types from the area – soils can vary enormously within a short distance. Label jars with the sources.

Once the jars are settled, encourage the students to use a measuring tape to measure the height of the total soil and water (say 10cm), and then the height of each layer (say the silt is 1cm). Then they can work out the percentage of each part of the soil. For silt for example the sum is 10cm divided by 1cm all multiplied by 100 to get the percentage (so 10/1 x 100 = 10%). Ask the students to finish off by drawing a pie chart of the different proportions, and as noted above compare the results with other soils.

When the water has settled out, you should be able to see different layers appearing. Sand particles are the biggest and weigh more than silt - so the bottom layer will be the sand part of the soil. Any pebbles will also be at the bottom. Next up is the silt layer. Silt particles are smaller than sand and weigh less so they appear over the sand. If you were able to separate out any clay particles they are the smallest and will be on top.

If your soil is really thick clay then you may just be left with clay lumps at the bottom, Next up you will have the water. This is likely to be discoloured. The colouring is likely to be rotted plant (organic) material that is soluble (it's dissolved). Finally, at the top will be floating organic material which isn't fully rotted.

Good class discussion points include: discuss (record) observations, e.g. Air bubbles rising, before stirring, then what happens after stirring.

Students enjoy making their own mixtures of soil up from sand, silt and clay, and other ingredients, then separating them again. Suggest they try at home also as it does take a long time for the soil to settle.

Lesson glossary: structure, texture, mixture, sand, silt, clay, organic, air

Soil-net.com Additional Notes

Activity: Jam-Jar Experiment

http://www.soil-net.com

- Soil is made up of a mixture of Sand, Silt, Clay and rotted plant (Organic) material. Different soil types have differing percentages of each.

- The Jam Jar experiment helps you to understand what the proportions of these are for the soil you work with.

- You should try this experiment with soils from different areas and compare the results to see how soils vary.

- Try it also with the soils you get in bags from garden centres for growing seeds and see how that varies from your garden soil.

Step One
Take a clean, straight-sided jam jar and fill it about a third of the way up with the soil you are experimenting with. Also have ready another jar of clean water and a stirring stick.
[Start off with the jar a third filled with soil]

Step Two
Now add the clear water until the jar of soil is almost full. Look for air bubbles before stirring - how much air is in soil? [Add water and stir thoroughly]

Step Three
Now use a stirring stick to stir up the mixture really thoroughly.
[Store the mixture thoroughly]

Step Four
Now leave the jar for 1-2 hours so the contents settle out and the water can start to clear.
[Now the water has settled out, you should be able to see different layers appearing]

- Sand particles are the biggest and weigh more than Silt so the bottom layers will be the Sand part of the soil. Any Pebbles will also be at the bottom.

- Next up is the Silt layer. Silt particles are smaller than Sand and weigh less so they appear over the Sand.

- If you were able to separate out any Clay particles they are the smallest and will be on the top. If your soil is really thick clay then you may just be left with sticky lumps of Clay at the bottom of the jar.

- Next up you will have the water. This is likely to be discoloured. The colouring is likely to be rotted plant (Organic) material that is soluble (it's dissolved).

- Finally, at the top will be floating Organic material which isn't fully rotted.

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Activity: Jam-Jar Experiment

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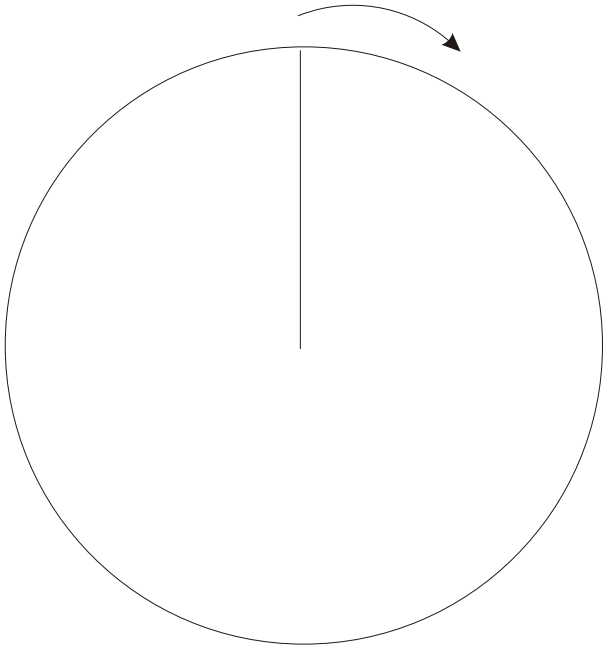
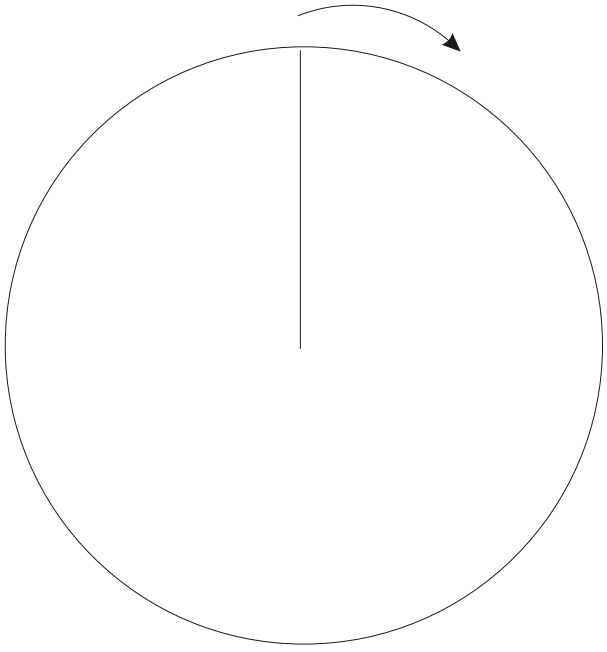
Percentages of the soil parts

What you can do now is use a measuring tape to measure the height of the total soil and water (say 10cm), and then the height of each layer (say the silt is 1cm). Then you can work out the percentage of each part of the soil. For Silt, for example, the sum is 10cm divided by 1cm, all multiplied by 100 to get the percentage (so 10/1 x 100 = 10%). Finish off by drawing a pie chart below of the different proportions, and as noted above compare the results with other soils.



Pie chart colour key:	
Sand	
Silt	
Clay	
Pebbles	
Water	
Floating organic material	

Soil Sample:.....



Pie chart colour key:	
Sand	
Silt	
Clay	
Pebbles	
Water	
Floating organic material	

Soil Sample:.....

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Activity: Soil Chemistry Challenge

http://www.soil-net.com

Acid and Alkaline Soils

Soils are classified as A....., N..... or A.....

This factor has an important impact on what plants can be

gr.....

What makes a soil Acid or alkaline?

It is the number of H.....i.....in the soil that determines

whether a soil is A.....or A.....

The gre..... the number of hydrogen ions, the more

a.....is the soil.

The pH Scale

This measures the acidity or alkalinity on a scale of 1 to 14.

7 is n.....

below 7 is a.....

above 7 is a.....

There is a word list to help you on Page 3!

Remember that between each value on this scale there is a 10-fold difference (because it is a logarithmic scale).

There is a huge difference between each number on the scale

A number above 7 is alkaline, below 7 is acid.

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Activity: Soil Chemistry Challenge

http://www.soil-net.com

How do you measure the pH value?

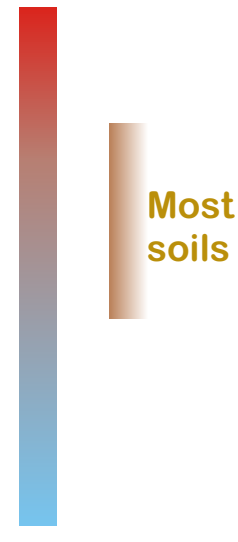
You can use a S……T…… kit. You take a measured sample of d……soil, place it in a tube and add a measured amount of B……S……, and soil testing solution. The mixture will turn a different c…… depending on the p…… This colour change is m…… with a chart of colour changes to give the correct pH.

You can change the pH of the soil to some extent.

Over a period of time soils tend to become more acid and l…… is added to raise the pH of a soil. The amount added depends on the type of Soil.

To get a better idea of pH, see how other common substances' pH compare to the typical ranges for soil (3.5 to 8.5 - the range is surprisingly broad!):

Substance	pH
Battery acid	1 (Acid)
Lemon Juice	2
Vinegar (Acetic acid)	3
Tomato juice	4
Black coffee	5
Urine	6
Blood and pure water	7 (Neutral)
Seawater	8
Egg white	9
Milk of Magnesia	10
Ammonia	11
Bleach	12
Oven cleaner	13
Drain cleaner	14 (Alkaline)



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Activity: Soil Chemistry Challenge

http://www.soil-net.com

Impact of pH on Plants

Most plants will row best in a pH of 6-7 although many will tolerate a wider band

Plants that like acid soil are called Calcifuges

Plants that prefer an alkaline soil are called Calcicoles

Name some plants for each type:

Calcifuges/Acid preferred

Rh.....
Ca.....
Er.....(heather)

Calcicoles/Alkaline preferred

Cle.....
Di.....
Vi.....

Rhododendron	Hydrogen ions
Matched	Colour
pH	Camellia
Acid	Soil Testing Kit
Clematis	Barium sulphate
Erica	Viburnum
Diathus	Lime
Dry	Neutral
Alkaline	greater
Grown	Word bank

Soil-net.com Teacher Notes

Activity: Soil Chemistry Challenge

http://www.soil-net.com

Acid and Alkaline Soils
Soils are classified as **Acid**, **Neutral** or **Alkaline**
This factor has an important impact on what plants can be **grown**

What makes a soil Acid or alkaline?
It is the number of **Hydrogen ions** in the soil that determines whether a soil is **Acid** or **Alkaline**
The **greater** the number of hydrogen ions the more **Acid** is the soil.

The pH Scale
This measures the acidity or alkalinity on a scale of 1 to 14.
7 is **Neutral**
below 7 is **Acid**
above 7 is **Alkaline**

How do you measure the pH value?
You can use a **Soil Testing** kit. You take a measured sample of **Dry** soil, place it in a tube and add a measured amount of **Barium Sulphate**, and soil testing solution. The mixture will turn a different **Colour** depending on the **pH**. This colour change is **Matched** with a chart of colour changes to give the correct pH.

You can change the pH of the soil to some extent. Over a period of time soils tend to become more acid and **Lime** is added to raise the pH of a soil. The amount added depends on the type of Soil.

Impact of pH on Plants
Most plants will row best in a pH of 6-7 although many will tolerate a wider band. Plants that like acid soil are called Calcifuges. Plants that prefer an alkaline soil are called Calcicoles. Name some plants for each type:

Calcifuges/Acid preferred
Rhododendron
Camelia
Erica (heather)

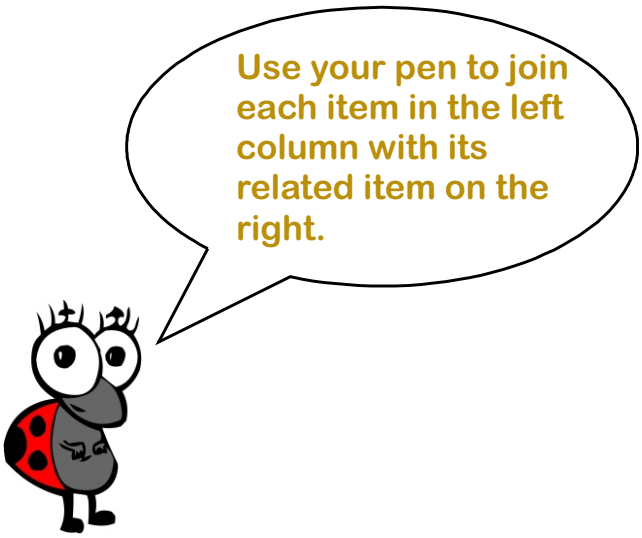
Calcicoles/Alkaline preferred
Clematis
Diathus
Vibernum

Soil-net.com

Activity: Soil Chemistry Connections

http://www.soil-net.com

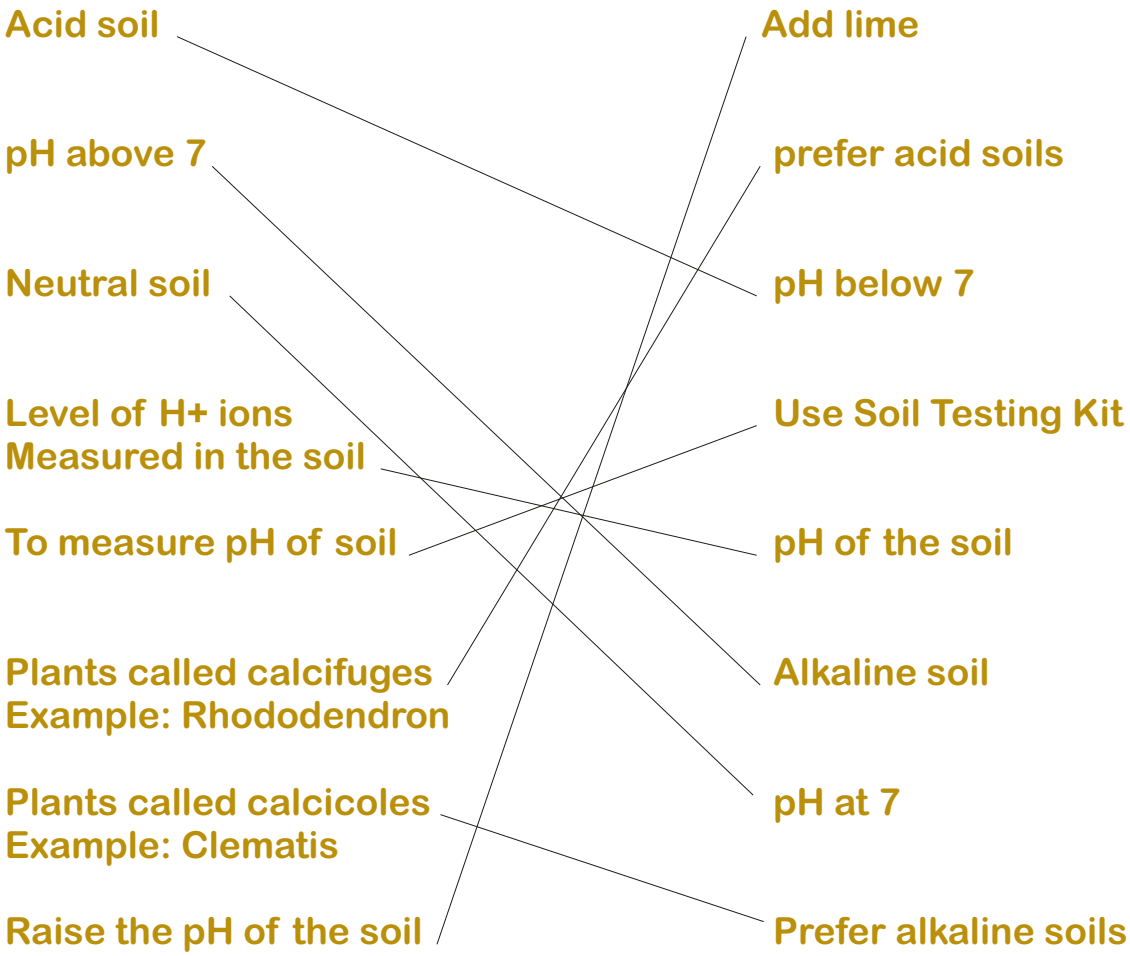
Acid soil	○	○	Add lime
pH above 7	○	○	prefer acid soils
Neutral soil	○	○	pH below 7
Level of H+ ions Measured in the soil	○	○	Use Soil Testing Kit
To measure pH of soil	○	○	pH of the soil
Plants called calcifuges Example: Rhododendron	○	○	Alkaline soil
Plants called calcicoles Example: Clematis	○	○	pH at 7
Raise the pH of the soil	○	○	Prefer alkaline soils



Soil-net.com Teacher Notes

Activity: Soil Chemistry Connections

http://www.soil-net.com



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Activity: What's in Soil?

http://www.soil-net.com

What's in the soil?	Why is it important?
Sand Drains well but cannot hold onto nutrients [Large Particles]	Sand is an important part of the soil because it provides drainage
Silt Can hold water, but can be hard to drain. Can hold limited nutrients. [Medium particles]	Silt is an important part of the soil because it holds onto limited nutrients and holds onto water
Clay Holds water well but can become heavy and waterlogged when wet. Can hold nutrients. [Small particles]	Clay is an important part of the soil because it holds water well and can hold onto nutrients
Air Fills all the gaps in soil and allows plant roots and animals to breathe. 35 to 40% of a good soil is air! [A Gas]	Air is important in the soil because it allows the plant roots and animals to breathe
Water Clings to soil particles and is taken up by the plant roots	Water is important in the soil because without it the plants and animals would die
Organic matter Releases nutrients slowly as it rots and improves water Holding	Organic matter is important in the soil because it improves water holding and helps stick the soil together
Animals Includes insects, bacteria and earthworms	Animals are important in the soil because they help rot down dead material

Soil-net.com Teacher Notes

Activity: What's in Soil?

http://www.soil-net.com

This activity helps students to understand the components that make up soil and their importance.

Sand particles: form lightweight, free-draining soils; cannot hold onto nutrients

Clay particles: hold water well; can become heavy and waterlogged when wet; can hold onto nutrients**.**

Silt particles: hold water; can be hard to drain; can hold only limited nutrients**.**

All soil contains sand, silt and clay particles, but in differing proportions. Sand particles are the biggest, then silt and finally clay.

Water: clings to soil particles; is taken up by plant roots**.**

Air: fills gaps in soil; allows the plant roots and animals to 'breathe'.

Just under half, about 35 to 40%, of a good soil is made up of water and air! So 'Which one is there most of' - could be air!

Organic matter: includes manure, leaf mould and compost; releases nutrients slowly as it rots; improves water holding. You can say it helps stick the soil together!

Animals: includes insects, bacteria and earthworms; help to break down dead materials**.**

Soil is all around us; in the school playground, at the park and in our gardens. We need to look after our soil.

Suggested key words for class discussion:
Sand, Nutrients, Water holding, Silt, Drainage, Organic matter, Clay, Particles, Air, Animals, Rot, Dead material

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Activity: Play Soildoku!

http://www.soil-net.com

Silt	Clay		Water		Sand
Air		Silt		Organic Matter	
Clay		Water		Sand	Silt
	Water				Clay
Water		Sand		Clay	
	Silt	Clay	Organic Matter		Air

Play Soildoku: Fill in the missing parts of soil into the empty boxes. There must be a complete set of the six parts of soil in each row and column.

Air Water Sand Silt Clay Organic Matter

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Activity: Play Soildoku!

http://www.soil-net.com

This activity helps students to understand the components that make up soil and their importance.

Sand particles: form lightweight, free-draining soils; cannot hold onto nutrients

Clay particles: hold water well; can become heavy and waterlogged when wet; can hold onto nutrients**.**

Silt particles: hold water; can be hard to drain; can hold only limited nutrients**.**

All soil contains sand, silt and clay particles, but in differing proportions. Sand particles are the biggest, then silt and finally clay.

Water: clings to soil particles; is taken up by plant roots**.**

Air: fills gaps in soil; allows the plant roots and animals to 'breathe'.

Just under half, about 35 to 40%, of a good soil is made up of water and air! So 'Which one is there most of' - could be air!

Organic matter: includes manure, leaf mould and compost; releases nutrients slowly as it rots; improves water holding. You can say it helps stick the soil together!

Animals: note, we can also include soil animals, such as insects, bacteria and earthworms; all helping to break down dead materials**.**

Soil is all around us; in the school playground, at the park and in our gardens. We need to look after our soil.

Suggested key words for class discussion:
Sand, Nutrients, Water holding, Silt, Drainage, Organic matter, Clay, Particles, Air, Animals, Rot, Dead material

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Activity: Play Soildoku!

http://www.soil-net.com

Silt	Clay	Organic Matter	Water	Air	Sand
Air	Sand	Silt	Clay	Organic Matter	Water
Clay	Organic Matter	Water	Air	Sand	Silt
Organic Matter	Water	Air	Sand	Silt	Clay
Water	Air	Sand	Silt	Clay	Organic Matter
Sand	Silt	Clay	Organic Matter	Water	Air

Play Soildoku: Fill in the missing parts of soil into the empty boxes. There must be a complete set of the six parts of soil in each row and column.

Air Water Sand Silt Clay Organic Matter

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Activity: Wormery!

http://www.soil-net.com

What is a Wormery?

How can we learn about what happens in the soil? Soil-Net explains about the astonishing variety of life in the soil. From the smallest microorganisms to the largest mammals - many creatures live within the soil. Perhaps one of the best-known soil creatures is the Common earthworm (Lumbricus terrestris). An average lawn will contain hundreds and hundreds of worms, if not thousands. Just go outside on a rainy day to see how many worms have come up to the surface - they can't respire when it's flooded underground. The best way to study worms is with a wormery. These can be purchased for a modest amount in good toy shops and some garden centres - or easily made using old fizzy drink bottles. The wormery recreates a 'slice' down

How to set up a Wormery

To start a wormery, you will need very little equipment. Here are the materials - the wormery case, some soil, Some fine sand and of course some worms!

Catching and caring for worms

You will need to catch some worms - for a wormery of this size, about 10 worms should do. These worms were collected from garden soils with a small digging trowel. As earth is carefully removed and a hole dug, the worms are revealed. Clearly worms are keen not to be caught And quickly start to move away into the soil. Never pull the worms backwards out of their burrows - instead gently dig them out. Worms have

hundreds of tiny bristles called cilia oriented back down their bodies. These bristles are to give them a good grip as they push through the soil - a bit like the studs on football boots. Pulling them out of a burrow will damage these bristles. Worms do not like bright light either, so keep them covered over until they are ready to go into the wormery. After your experiment is over, in 3-4 days, you can gently release the worms back to where you found them. It is perfectly harmless to touch worms - but remember to wash your hands afterwards. You may notice a mucous (slime!) on the worms - this is a lubricant the worms produce to help them slide through the soil - just like oiling the chain on A bicycle makes it move more smoothly.

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Activity: Wormery!

http://www.soil-net.com

Whilst digging out the worms, keep also a pot of soil ready to fill the wormery. This soil contains the food that the worms will eat whilst they are in the wormery. Worms eat microorganisms - did you know that a teaspoon of healthy soil contains more microrganisms than there are people on the whole planet! That really is amazing - they are too small to see without microscopes though.

You will also need some fine sand - such as is used in a playground sandpit. The sand will be used to lay down 'layers' in the wormery soil. That way, when the worms move through the soil, their activities will be easy to observe.

Very carefully, perhaps using an old spoon to help, fill the wormery up with a layer of soil (say 2-3cm), then a covering thin layer of sand (say 1cm), repeating this pattern up to the top. Finish with the soil layer.

Now you are ready to introduce the worms to their new temporary home. These worms are already moving around - escaping from their pot! Have some grass cuttings ready too.

Next, gently introduce the worms to the soil. They should fairly soon burrow down into the mixture. For further interest, add a thin layer of grass cuttings to the very top of the wormery. You will be able to see how the worms pull the grass down into the soil over time. Aha! So that's where the grass cuttings go to after the lawn is mown!

You want to see what the worms do - but the worms don't like bright light. The solution is that whilst you are not observing the worms, place a cover over the wormery. You can slide this off to observe what has happened before covering the case over again.

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Activity: Wormery!

http://www.soil-net.com

The experiment should be run for about 3-4 days. Don't let the soil dry out - but neither should you soak the soil. A short drizzle of water on the second day should do it. When you pick up the case, never shake it and be careful. When the experiment has finished you should see a result like this. You can see the bands of sand have been disturbed as the worms have moved through the soil. You should also see some of the grass has been tugged down underground.

Now just imagine a garden lawn, or a football pitch, or a country meadow. What your ten worms have done is being repeated by thousands and thousands of worms working endlessly though the soil just under your feet!

Soils eat microorganisms in the soil and are rather like whales eating plankton. Everything goes in - soil and microorganisms! The worms digest the microorganisms and pass the soil out behind them.....oh OK they poo out the soil. This is often pushed up to the soil surface as worm 'casts'.

When the experiment is over, don't forget to gently release the soil and worms back to where you caught them and cover them over with soil.

Further information about worms

For more information about worms, visit the excellent UK Safari website (http://www.uksafari.com/earthworms.htm)

For a bit of fun, visit the world wormcharming website (http://www.wormcharming.com/)!

Soil-net.com

Factsheet: Soil Components

http://www.soil-net.com

What are the different characteristics of soil components?

Sand	Silt	Clay
Forms free draining soils	Forms soils which can be hard to drain	Forms soils which readily become waterlogged
Water runs through it quickly	Holds on to a moderate amount of water	Becomes heavy when wet
Largest mineral particle size - between 2mm and 0.06mm in diameter	Medium mineral particle size - between 0.06 and 0.002mm in diameter	Smallest mineral particle size - diameter less that 0.002mm
Feels gritty to touch	Feels soapy or silky	Feels smooth when dry and sticky when wet
Makes a rasping sound when rubbed together	Makes a squeaky sound when rubbed together	Makes very little sound when rubbed together
Particles do not stick together and cannot be made into a ball	Particles don't easily hold together - a ball of them breaks easily	Particles stick together and are easy to make into a ball
Soils warm quickly in Spring, but cool quickly in Autumn	Soils warm and cool more quickly than clay, but less quickly than sand	Soil takes a long time to warm up in Spring and to cool down in Autumn
Forms soils which cannot hold onto nutrients	Forms soils which can only hold limited nutrients	Forms soils which can hold onto nutrients
No swelling or shrinkage in the soil	Limited swelling or shrinkage in the soil	Soil swells when wet and shrinks when dry
Can be used to make glass	Makes very fertile soils	Can be used to make bricks or pots

Factsheet: Soil Components

http://www.soil-net.com

What are the different characteristics of soil components?

Organisms	Organic Matter
Are responsible for recycling materials	Can increase the amount of air held in some soils
Are responsible for the rotting of dead material	Releases nutrients slowly as it rots
Can produce 20-40 tonnes of casts per hectare	Sticks to soil particles to help form crumbs
Examples include insects, bacteria and earthworms	Examples include manure, straw and peat
Bury stones and leaf litter	Improves water-holding capacity of soil
Convert plant and animal debris to minerals and humus	Creates an open soil structure
Examples include fungi and plant roots	Examples include leaf mould and compost
Absorb water from soil causing it to dry and clays to shrink	Can make soils warmer - increasing heat absorption
Help to reduce damaging effects of pesticides	Helps keep nutrients in the soil
Can create channels for the movement of oxygen and water	Are responsible for the dark brown colours of soil

Soil-net.com

Factsheet: Soil Types

http://www.soil-net.com

What are the main types of soil?

Sandy Soils

Warms up quickly in Spring

Are light and easy to work

Are free-draining

Can dry out in dry weather

Tend to be low in nutrients

Can be worked at almost any time

Need liming little and often

Silty Soils

Deposited by rivers and lakes

Warm up quicker than clay but slower that silt soils in Spring

Keep water longer than sandy soils

Difficult to drain, but less likely to waterlog that clay

Tend to be fertile

Clay Soils

Warm up slowly in Spring

Heavy soils needing well-timed cultivation

Lie wet and prone to waterlogging

Tend to be rich in nutrients

Should not be worked when wet

Need regular liming

Loamy Soils

Contain a mix of sand, silt, and clay particles

Warm up fairly early in Spring

Are easy to work

Usually need draining

Should not be worked when wet

Tend to be rich in nutrients

Calcareous Soils

Come from chalk and limestone rocks

Contain calcium carbonate and flints

Tend to be alkaline

Usually free-draining

May be low in some nutrients

Do not usually need liming

Peaty Soils

Dark in colour, so warm up quickly in Spring

Hold on to water well and can be easy to work

Come from the build up of dead rotted plants, so contain lots of organic matter

Tend to be acid

Usually high in Nitrogen

Also see the Testing Soils sheet

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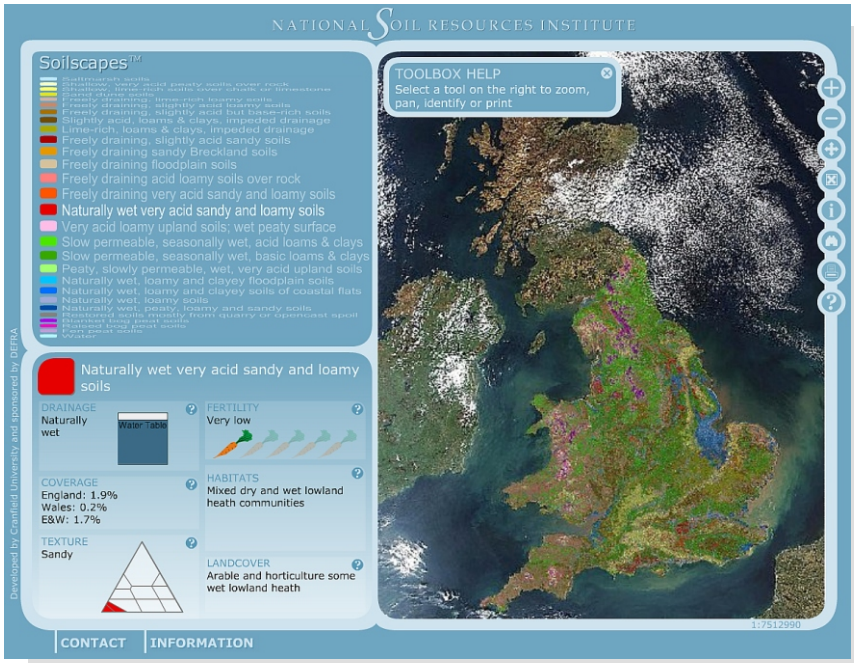
Activity: SoilScapes Viewer

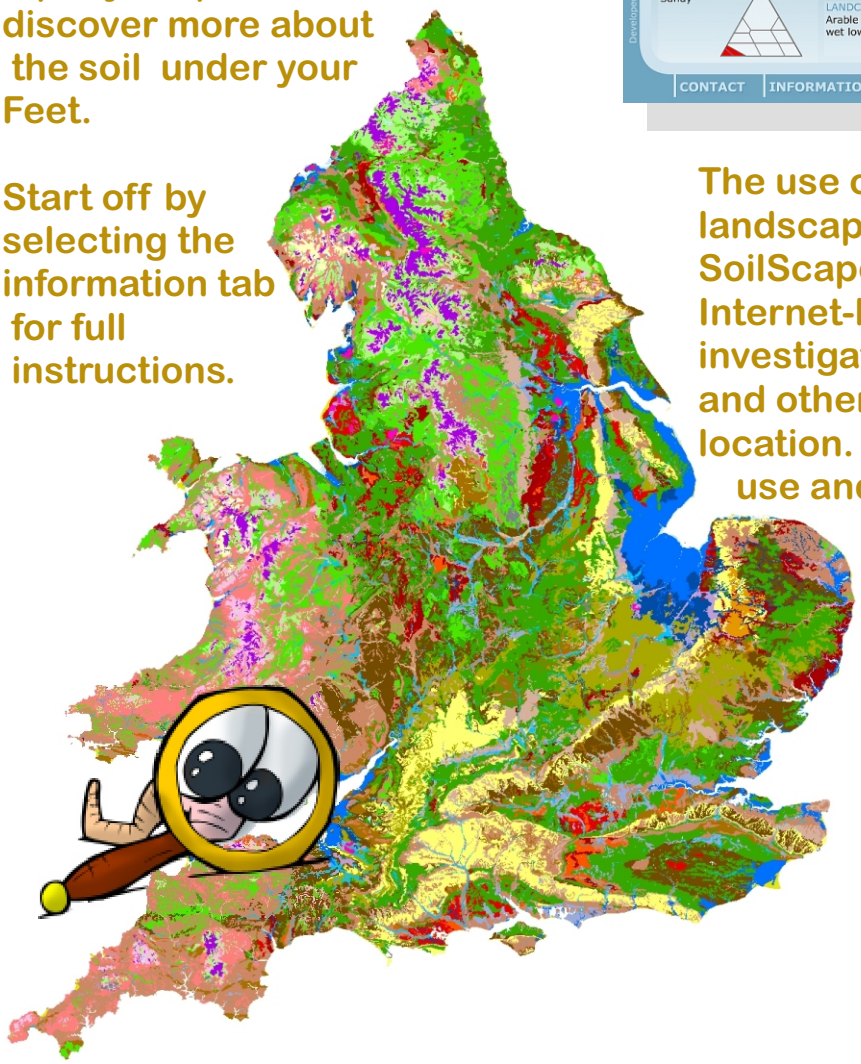
http://www.landis.org.uk/soilscapes/



Do you want to find out about the soils where you live? SoilScapes helps you do just that!

SoilScapes is an interactive online viewer for the soil map for England and Wales. This is a fantastic way to learn more about the soils in your region, and across the two countries. Input your postcode and discover more about the soil under your Feet.

Start off by selecting the information tab for full instructions.



The use of maps is important in describing landscapes and soil environments. SoilScapes provides students access to Internet-based soil mapping tools to allow investigation of location and variation of soil and other environmental properties around a location. This tool also promotes how to use and interpret cartographical elements such as mapping, North arrow, legends, scale and the wider use of secondary sources and ICT-based environmental investigation tools.

Curriculum Keywords: map, soil, north, south, east, west, scale, distance, key, Symbol

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Activity: Eco-Lifestyles Quiz

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

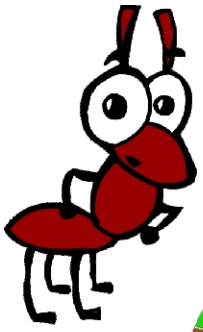
Do you want to find out the impact your lifestyle has on the environment? The Soil-Net EcoQuiz helps you do just that!

Most of us are aware that human activities have led to extensive environmental problems affecting our own lives and threatening future generations of life on this planet. Most notably, the burning of fossil fuels is leading to significant climate change due to greenhouse gas emissions. This is largely responsible for global warming, the melting of the ice caps, rising sea levels, damage to the Ozone layer, and increased violent storms, flooding and landslides. There are other major environmental issues influenced by human pressures.

The Eco-Lifestyle Quiz is designed to help you to test the impacts of your lifestyle on the environment. This quiz tests your use of transport, energy and water, and your shopping, home and waste impacts. Your environmental impacts should not be too great and should be sustainable for the environment.

Could your way of life be more eco-friendly? We cannot always change the negative impacts of the way we live, but if we take more than our fair Earthshare then we may be taking it from the generations who come after us.

Curriculum Keywords: sustainability, lifestyle, recycling, earthshare



Did you know that there are many aspects of our lives and lifestyles which we can change to lessen the impact we have on the environment around us. Find out how 'eco-friendly' your lifestyle is.

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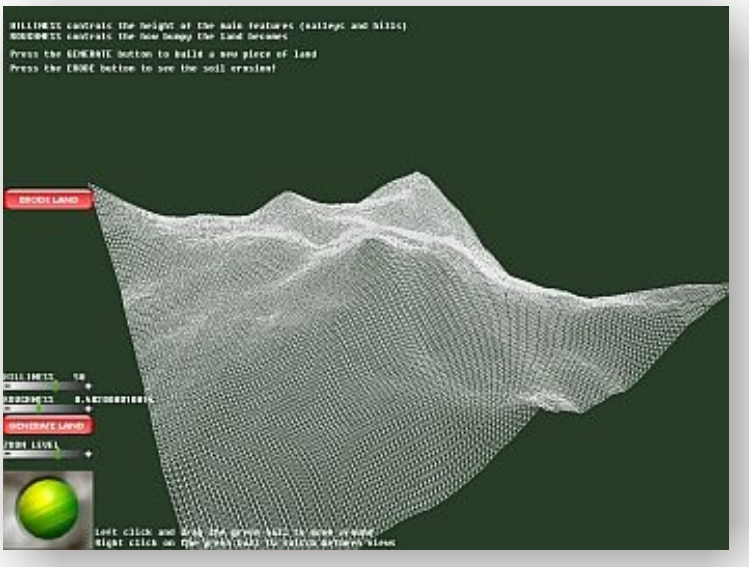
Activity: Terrain Builder

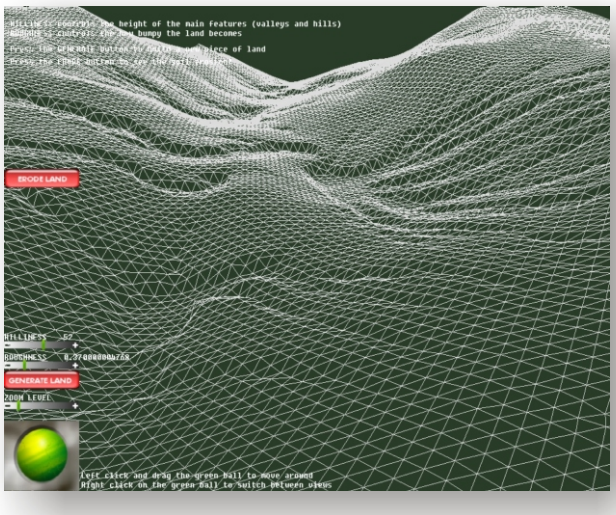
Http://www.soil-net.com/



How does a landscape form?

How does erosion affect the shape of the land?

One way to see this is to have a go with 'TerrainBuilder'. TerrainBuilder is a free software tool which simulates the action of erosion on differing landscapes.



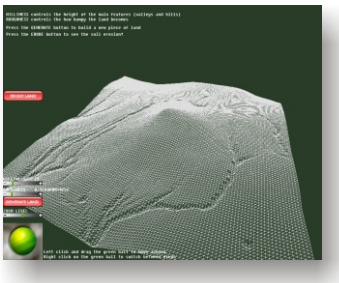
What does TerrainBuilder show?

TerrainBuilder uses a rolling ball algorithm to simulate what water erosion might do to a landscape. As the ball passes across the landscape, channels open up rather like river channels form, and hillsides become depleted and eroded.

It is a bit of fun really - but it does show the principles of erosion at work! When one erosion cycle is complete, press the 'Erode Land' button again to keep going or start again with a different landscape!

Download notes

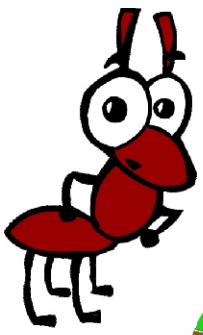
This programme is a stand-alone '.exe' programme. It runs on a PC with no further installation. Visit the soil-net.com Terrain Builder activities page and select 'Save Target as' to save the file 'terrainBuilder.exe' to your PC.



How to run TerrainBuilder

Run TerrainBuilder by double clicking on the file from within Windows Explorer. When you first run TerrainBuilder, you are given a 'flat' landscape. Your first task is to 'build' a landscape to erode, like the picture above. To do this, you adjust the slider bars for 'Hilliness' and 'Roughness'. Once set, press the 'Generate' button to create the landscape. You can keep doing this until you are happy - experiment to get different types of landscape. Then, when you are ready select the 'Erode Land' button to set off the erosion!

You can left click on the green ball to move the landscape around. You can right-mouse click on the green-ball to change the rendering of the surface. The 'Zoom Level' allows you to zoom in and out.



Soil-net.com

Soil-net.com

Activity: Watering Soil

http://www.soil-net.com

Find out how the soil absorbs water.

Use a watering can.
Sprinkle water onto the soil.

Pour very, very slowly.

What do you see?

_____

_____

Now pour faster.

What do you see now?

_____

_____

Can you say why there was a difference in how fast the water drained away into the soil? Have you noticed the same watering plants at home?

_____

_____

_____

Soil-net.com

Soil-net.com Teacher Notes

Activity: Watering Soil

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

This activity helps students understand the important relationship between soil and water. Watering the soil at different rates is equivalent to differing rainfall intensities.

When soil is dry it can absorbs water, like a bath-time sponge. Soil consists of inter-linked 'crumbs' with air and water-filled gaps between them. The ratio of soil crumbs to these gaps varies with different soil types (typically about 35 to 45% air and water).

Water poured onto soil flows down into the air gaps. Clay soils may take longer to wet up, but when they do surface ponding of water can occur, forming puddles. The initial soil wetness present before the experiment is a factor to note to students.

Animals living underground need a lot of air to breathe. If a lot of water soaks into the soil, they must come to the surface to find air. Watering the soil may lead to earthworms appearing.

Discuss how different rainfall intensities can affect the rate of water soaking into soil and water ponding on the surface. Lots of rain falling throughout a day may soak away, whereas the same rainfall falling in one hour may cause surface ponding to form (puddles).

Ask students to try this at home, for instance watering the garden if they have one. Do they notice a difference - is the soil type different? Soil types can vary over very short distances - even a few 100metres!

Soil-net.com

Activity: Wormhunt!

http://www.soil-net.com

Find out how many worms live in the soil.

Use watering cans.

Find a grassy spot outside in the school grounds and, using lots of watering cans, sprinkle water onto the ground

Wet the soil in one place as much as possible.

Do worms appear after a while? How many can you see?

_____

_____

Why might worms come to the surface when it is wet?

_____

_____

If you didn't see any worms –
try looking again on a rainy day....

Soil-net.com

Soil-net.com Teacher Notes

Activity: Wormhunt

http://www.soil-net.com

This activity helps students to understand how many worms there are in good soil – and there is a huge number!

Watering the soil can be hard, as worms can move sideways as well as up to the surface! But if you are lucky and enough water is poured, some worms will make their way up to the surface.

If this doesn't work – try again on a rainy day. Then all you should have to do is count them!

Worms need air (they don't have lungs – but absorb oxygen through their skin). When it is wet they cannot take in oxygen, so they rise to the surface.

It is also said that stamping on the ground can also work – you will have to decide if you want to encourage that!! Perhaps stamping feels like raindrops hitting the soil?

Some folk take worm charming very seriously!!
See http://www.wormcharming.com/

Soil-net.com

Activity: Testing Soil Acidity

http://www.soil-net.com

Find out how acid or alkaline your soil is.

Use an electronic soil acidity meter. Acidity is sometimes called pH - a number between 0 (acid) and 14 (alkaline). Most soil is between pH 5 and 8.

Take some soil and clean water. Mix into a jar

Give it a good stir!

Take care:

- Don't place the probe into water without soil
- Don't scrub the probe tip

Before use, the probe shaft may need cleaning with the pad provided.

Dip the probe into the soil mixture and wait 1 minute, then take a reading.

Write down the pH meter readings.

_____

Soil-net.com

Soil-net.com Teacher Notes

Activity: Testing Soil Acidity

http://www.soil-net.com

Acidity (or pH) is one of the major chemical properties of soil. The acidity directly affects the types of plants that can survive in the soil - acidity affects how plants can take in nutrients from the soil. There is a Soil-Net Case Study on pH and acidity on the website.

This activity is designed to show how portable pH meters can be used to measure acidity. These meters are easily available from gardening or scientific equipment suppliers. We are using an easy-to-use model from **West Meters Ltd.** (see www.westmeters.co.uk), widely available from good garden centres.

Don't place the probe directly into water or it may be damaged. Clean the probe shaft with the pad provided - not the probe tip though. Take the soil sample from a depth of about 5 to 10cm, removing twigs, debris and stones. Use clean water (preferably neutral deionised water or local rainwater). Deionised water is often sold in garages for use with car batteries. Insert probe and wait 1 minute before taking reading. If the pH is 7 or above, remove and gently wipe probe with tissue, then use the pad to reclean shaft - reinsert in soil for 30 seconds before taking second reading. If the pH is below 7, remove and gently wipe probe with tissue (don't use the pad) - reinsert probe for 1 minute before taking second reading. In either case, the answer is the average of the two readings.

Try soil samples from several locations and compare

Soil-net.com Results Page

Activity: Testing Soil Acidity

http://www.soil-net.com

Acidity (or pH) is one of the major chemical properties of soil. The acidity directly affects the types of plants that can survive in the soil - acidity affects how plants can take in nutrients from the soil.

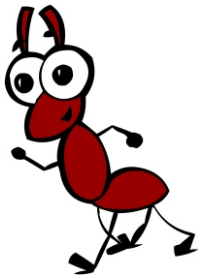
Record your results below. Compare the pH values from soil samples from different locations:

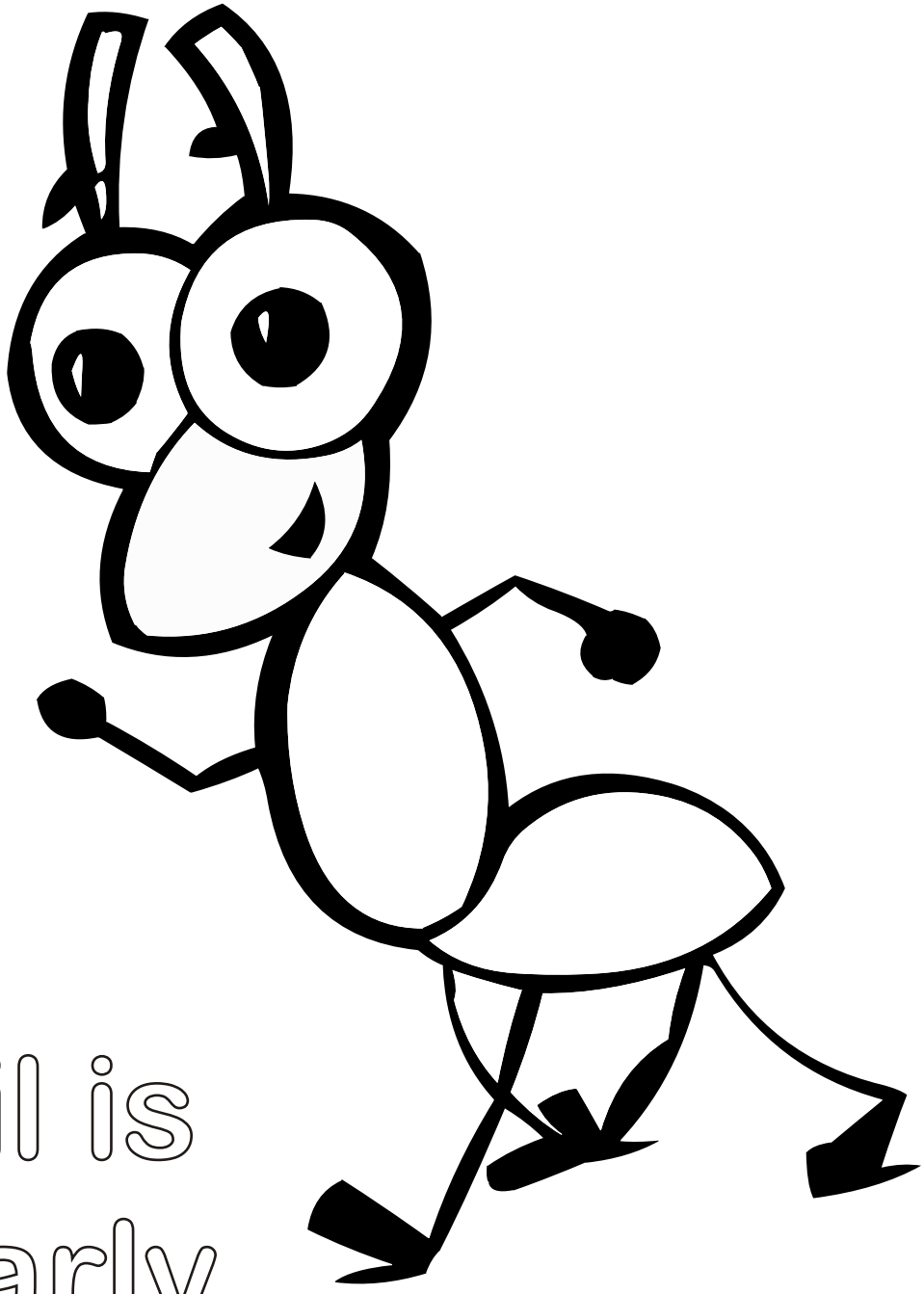
Soil sample	Sample Location	pH result

Soil-net.com

Activity: Colour me!

http://www.soil-net.com





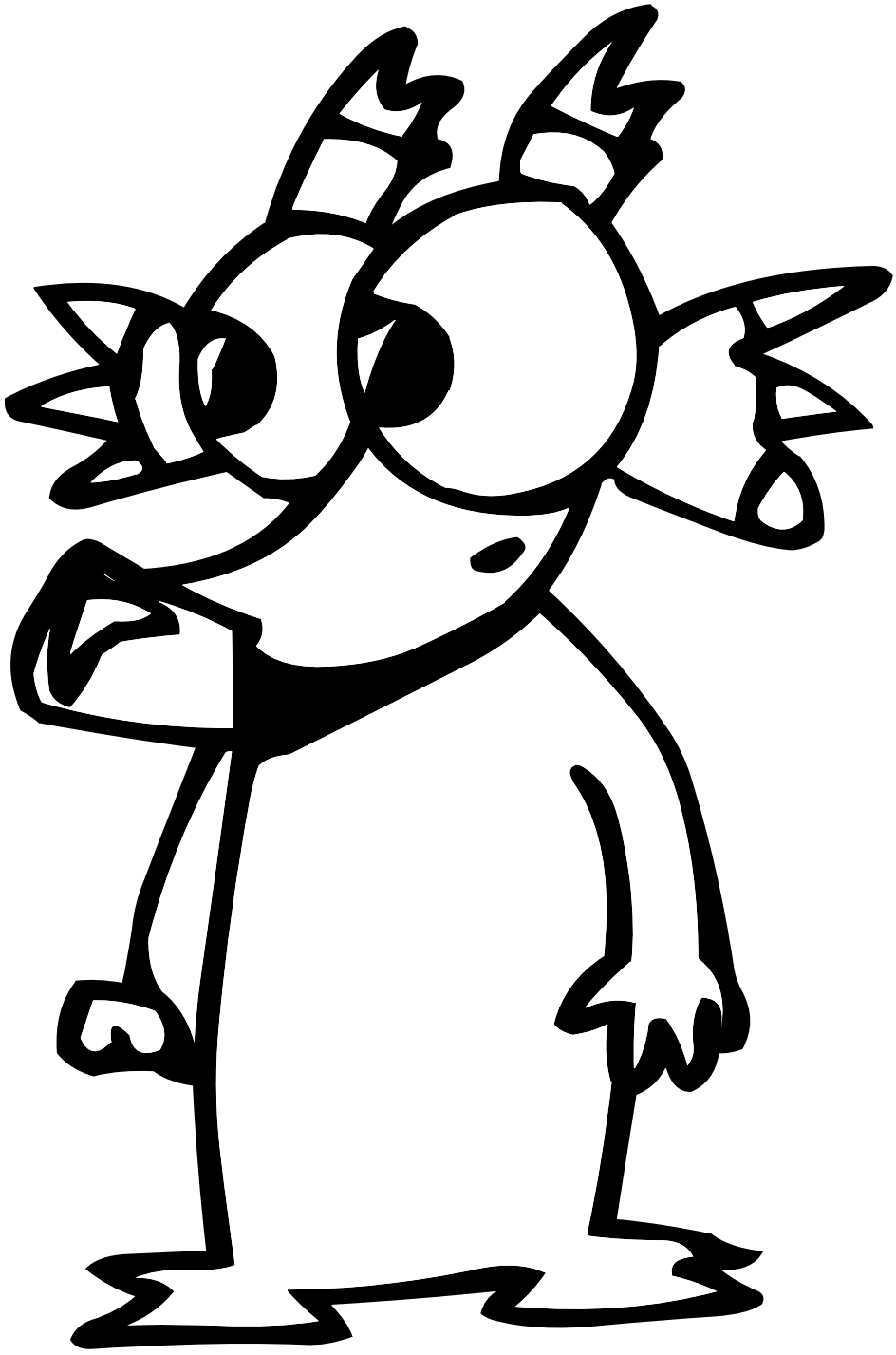
Soil is nearly half air and water!

Soil-net.com

Soil-net.com

Activity: Colour me!

http://www.soil-net.com



Most of our food is grown in soil!

Soil-net.com

Soil-net.com

Activity: Colour me!

http://www.soil-net.com

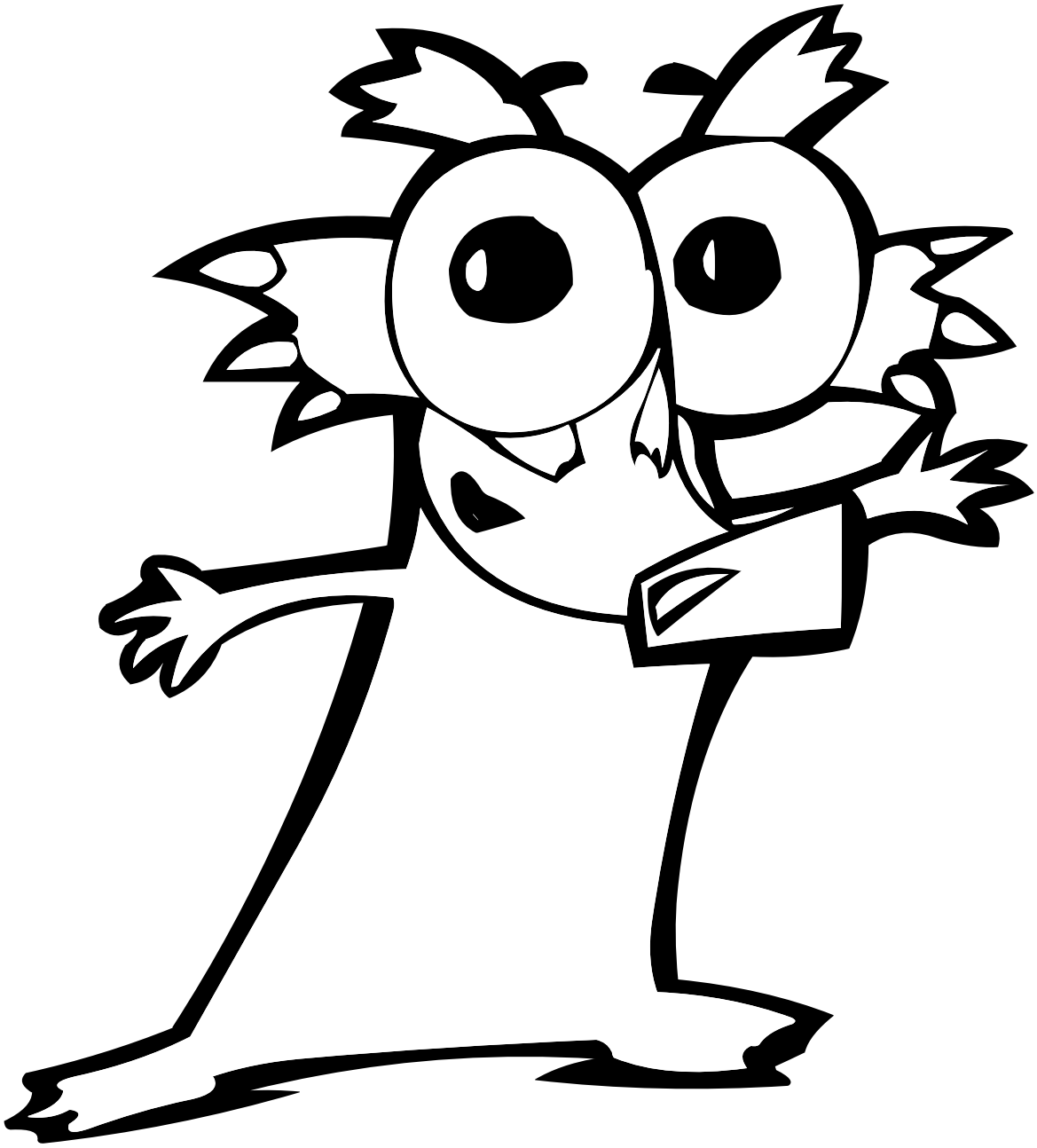
There are thousands of soil types!

Soil-net.com

Soil-net.com

Activity: Colour me!

http://www.soil-net.com



It takes 500 years for a centimetre of soil to form

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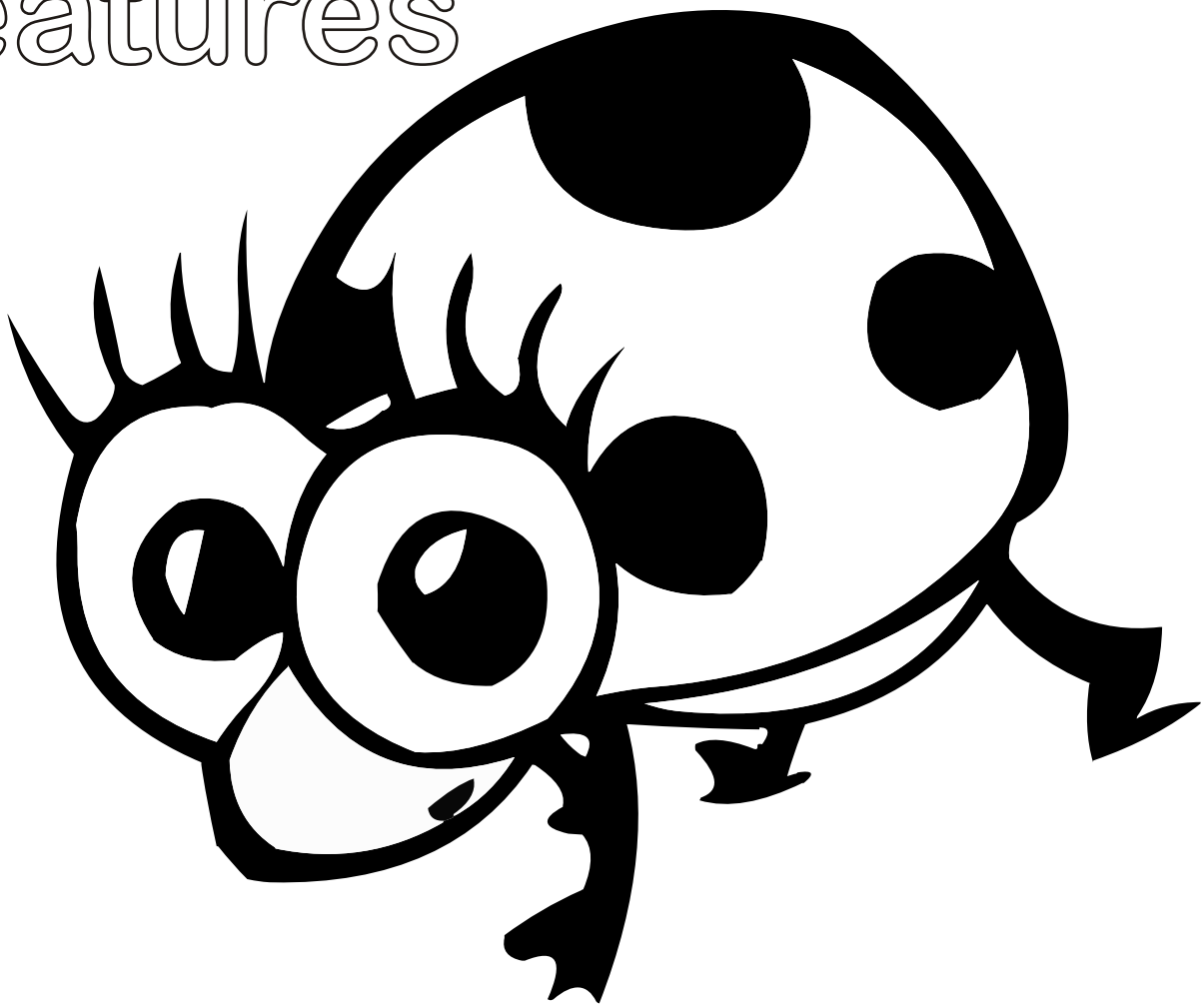
Soil-net.com

Activity: Colour me!

http://www.soil-net.com

A teaspoon 
of soil contains more creatures

...



...than there are people on the whole planet!

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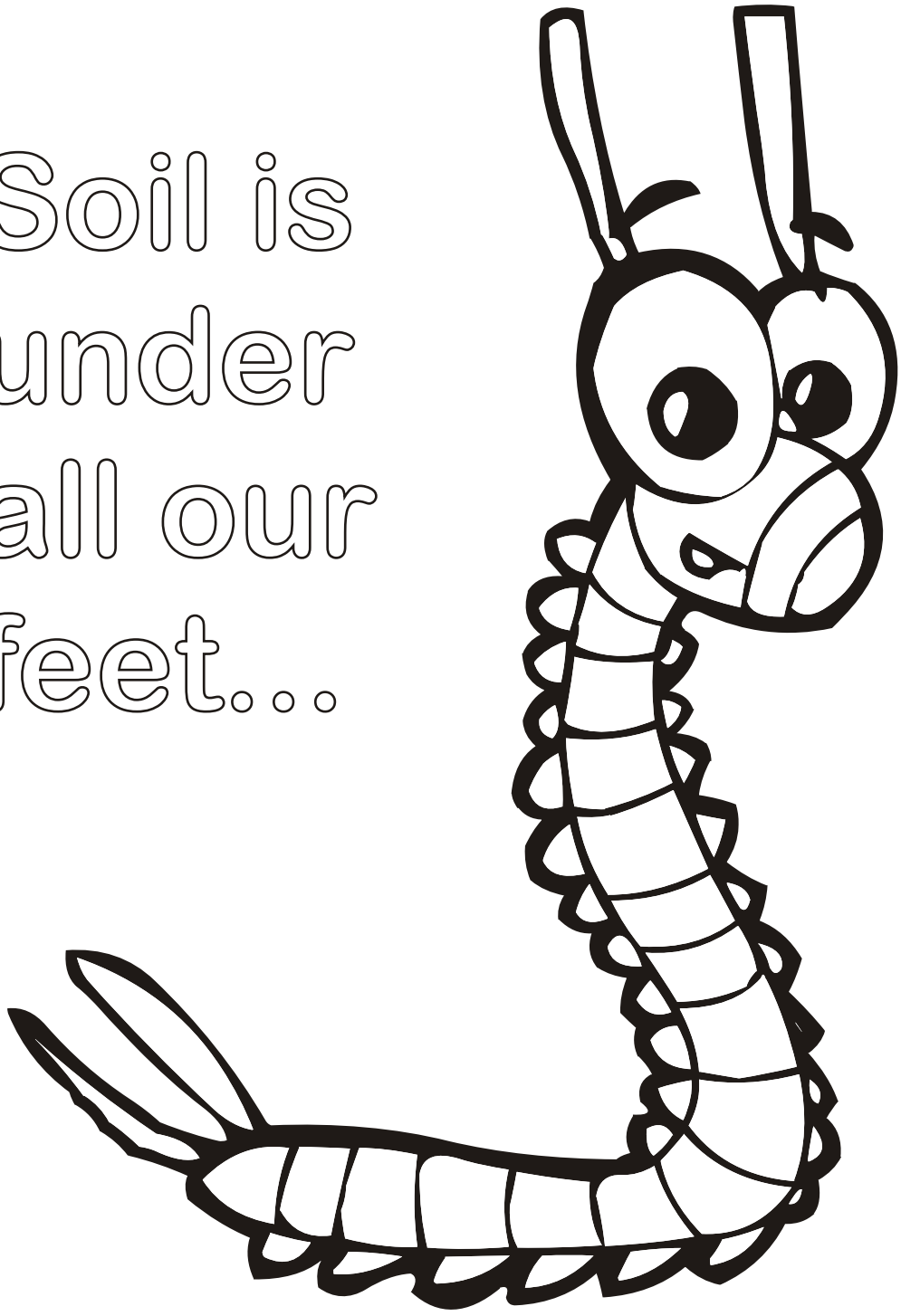
Soil-net.com

Activity: Colour me!

http://www.soil-net.com

Soil is under all our feet...



You just have to look!

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Activity: Colour me!

http://www.soil-net.com

Soil forms really slowly, so we have to look after it!

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Activity: Help Mole get to Soil School!

http://www.soil-net.com

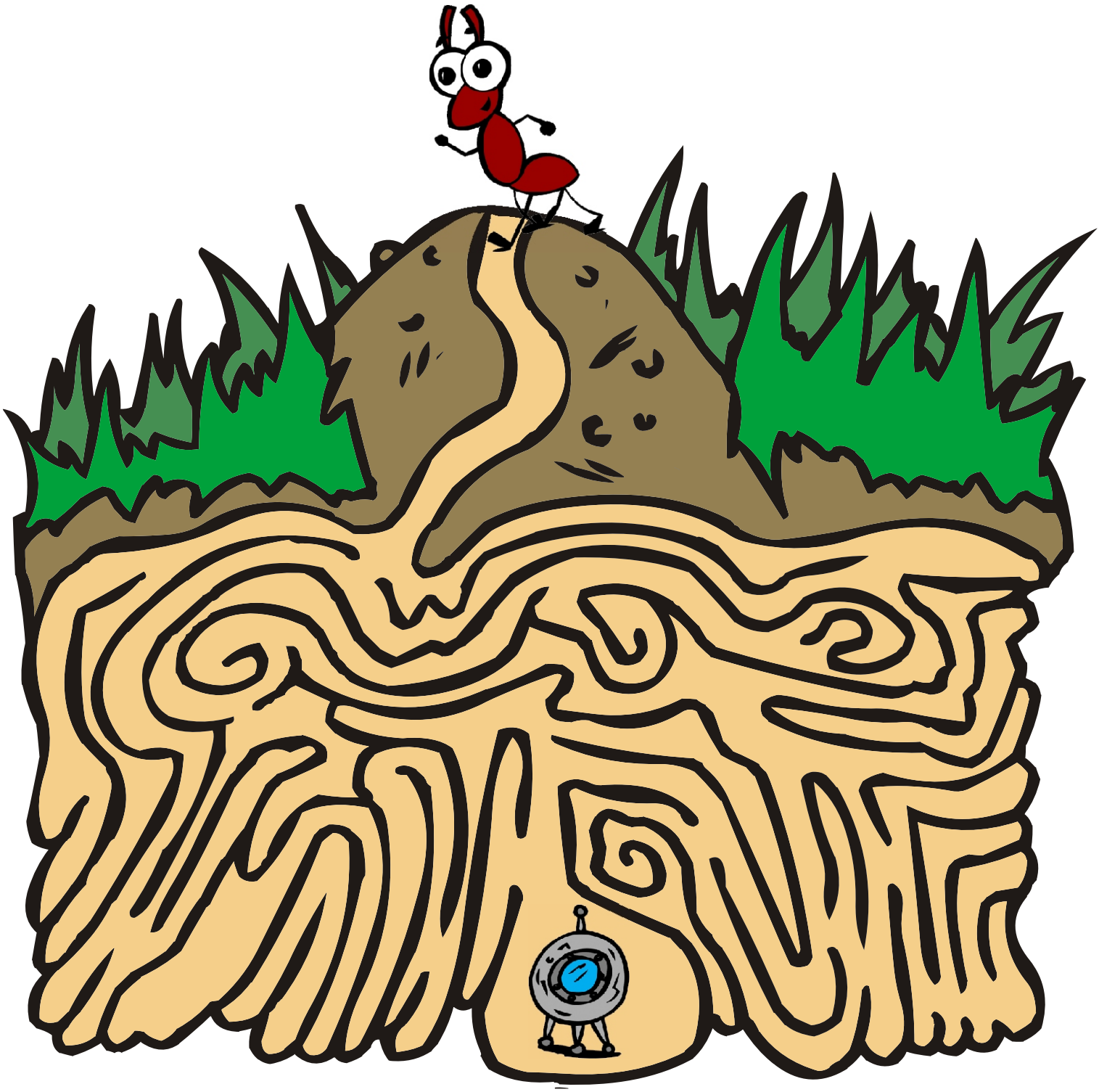
Soil is amazing!

Find out more at http://www.soil-net.com

Soil-net.com

Soil-net.com

Activity: Help Ant get to Soil School!



Soil is amazing!

Find out more at http://www.soil-net.com

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Soil-net.com

Activity: Word Grid

http://www.soil-net.com

Can you find these words?

sand silt clay organic peat mud earthworm root nutrient

R O O T T R P L E
O T U N P O E W U
N C M U D P A D C
S I L T I S T Y D
D M O R G A N I C
W O R I S N E R L
S O I E O D U A A
W R O N I D T T Y
E A R T H W O R M

Can you find all these Components of Soil?

Soil-net.com

Soil-net.com Teacher Notes

Activity: Word Grid

http://www.soil-net.com

Soil is made up of many component parts. This activity helps students hunt each one out from the word grid.

Before the session, explain about the various parts that make up soil.

As a plenary session, try "How many of wour word search words can you remember?" If the link to the initial question and the significance of the vocabulary was understood, students should have no problem remembering the soil parts.

Sand - sand, silt and clay are the mineral components of soil, coming from weathered rock
Silt
Clay
Organic - Soils contain organic materials from rotting plant matter (leaves and branches)
Peat- Peats are special soils made of rotted organic materials, found in marshes and fenland
Mud- This is what gets on your football jerseys!!
Earthworm- Soils contain billions (yes billions) of soil animals, most too small to see
Root- Soils are the anchorage and source of nutrients for plant roots
Nutrient- Soils contain the minerals and nutrients needed to sustain plant growth

Soil-net.com

Activity: Word Grid

http://www.soil-net.com

Can you find these words?

Barley, Wheat, Oats, Maize, Turnips, Carrots, Potatoes, Peas, Beans

P	O	T	A	T	O	E	S	M
D	V	T	H	N	G	C	F	A
J	O	U	Q	P	E	A	S	I
B	A	R	L	E	Y	R	B	Z
B	T	N	D	K	L	R	H	E
E	S	I	G	E	I	O	S	X
A	F	P	W	M	T	T	K	W
N	L	S	J	U	A	S	V	J
S	N	B	D	W	H	E	A	T

Crops that grow in soil

Can you find all these Components of Soil?
The words may be Downwards or Across

Soil-net.com

Soil-net.com

Activity: Word Grid

http://www.soil-net.com

Pansy, Tulip, Lavender, Marigold, Rose, Snowdrop, Beans, Pumpkin

Y	G	L	R	B	E	A	N	S
T	A	M	O	P	D	N	M	H
U	F	R	S	A	I	C	A	X
L	A	V	E	N	D	E	R	L
I	E	J	O	S	U	S	I	C
P	A	N	B	Y	L	A	G	O
V	S	N	O	W	D	R	O	P
R	O	T	A	Y	T	B	L	E
P	U	M	P	K	I	N	D	T

School Garden Plants

Can you find all these Components of Soil?
The words may be Downwards or Across

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Activity: Word Grid

http://www.soil-net.com

Oak, Ash, Beech, Birch, Pine, Cedar, Holly, Maple, Yew, Larch

F L P I N E A T B
S A C R W D V C Y
N R E M A P L E M
B C D P B T O A K
I H A K Y E V D B
R L R S O N E T P
C W E D H S R C W
H O L L Y C L E H
S B X N T A Y I W

Trees that grow in soil

Can you find all these Components of Soil?
The words may be Downwards or Across

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Activity: Word Grid

http://www.soil-net.com

Hockey, Football, Cricket, Rugby, Croquet, Tennis, Bowls, Golf

T	E	N	N	I	S	A	J	H
R	A	G	T	L	E	B	L	O
U	C	S	W	H	G	L	I	C
G	G	O	L	F	A	M	T	K
B	B	E	I	B	L	W	N	E
Y	W	L	T	A	L	N	I	Y
C	R	O	Q	U	E	T	M	A
S	O	K	E	T	B	X	F	J
F	A	C	R	I	C	K	E	T

Sports played on soil

Can you find all these Components of Soil?
The words may be Downwards or Across

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Topic 11: Soils and Health

Glossary

eLements tetanus pollution contamination minerals

micronutrients macronutrients fertiliser pesticide lead

aluminium cadmium selenium

M	I	C	R	O	N	U	T	R	I	E	N	T	S
A	E	O	N	F	E	R	T	I	L	I	S	E	R
C	L	N	E	S	I	I	R	L	E	O	E	T	O
R	E	T	I	M	M	T	I	M	A	E	L	A	L
O	E	A	M	I	A	E	T	S	D	C	E	N	S
N	R	M	C	N	T	C	P	I	M	M	N	U	N
U	E	I	S	E	T	T	E	E	M	M	I	S	L
T	S	N	U	R	I	E	S	I	L	M	U	N	T
R	L	A	P	A	O	E	T	R	I	T	M	S	E
I	U	T	A	L	U	M	I	N	I	U	M	A	N
E	M	I	M	S	S	E	C	I	N	I	S	U	O
N	P	O	L	L	U	T	I	O	N	M	T	T	N
T	I	N	F	A	C	A	D	M	I	U	M	S	E
S	L	M	E	L	E	M	E	N	T	S	R	N	E

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Topic 1: What is soil?

Glossary

Centimetre organism organic nutrients cultivate fertilise

fertile infrastructure anchor anchorage acid soil

E	N	A	N	C	H	O	R	A	G	E	M	N	C
O	U	A	N	U	N	R	F	E	R	T	I	L	E
R	T	N	I	L	T	A	O	H	E	T	C	O	N
G	R	V	C	T	O	E	I	E	T	S	U	U	T
A	I	A	C	I	D	S	O	I	L	C	I	I	I
N	E	A	O	V	O	O	E	G	E	T	R	S	M
I	N	F	R	A	S	T	R	U	C	T	U	R	E
S	T	U	G	T	N	N	N	U	R	L	A	C	T
M	S	D	A	E	E	R	V	A	N	C	H	O	R
H	A	T	N	C	F	E	R	T	I	L	I	S	E
O	L	T	I	R	U	N	I	N	S	H	N	H	C
I	V	R	C	T	E	O	I	I	I	I	N	N	T
E	N	T	C	R	E	N	H	O	E	T	A	M	I
A	A	I	C	I	I	T	A	R	E	A	C	N	N

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Topic 2: Why does soil matter?

Glossary

Food mechanisation fertiliser pollutant climate change

Archaeology infrastructure tropical rainforest shrub

Greenfield soil water archaeology

O	R	O	E	F	R	I	T	C	R	E	R	O	B	R	O	P	L
I	R	C	C	I	A	N	L	T	P	A	T	E	E	T	S	T	N
A	E	F	T	H	A	F	O	O	D	A	B	N	C	T	F	R	H
R	A	P	L	S	H	R	U	B	I	T	T	I	S	G	G	S	C
T	R	O	P	I	C	A	L	R	A	I	N	F	O	R	E	S	T
H	C	L	R	G	N	S	O	C	C	L	C	D	I	E	O	I	A
U	H	L	F	E	R	T	I	L	I	S	E	R	L	E	I	A	A
A	A	U	E	T	G	R	A	I	D	A	L	N	W	N	T	I	A
D	E	T	E	A	L	U	T	M	I	B	L	L	A	F	L	O	O
E	O	A	A	M	E	C	H	A	N	I	S	A	T	I	O	N	O
A	L	N	I	R	A	T	I	T	U	U	R	T	E	E	A	R	I
N	O	T	N	S	L	U	R	E	A	O	E	Y	R	L	A	E	L
L	G	R	A	A	U	R	A	C	R	A	L	I	C	D	T	G	Y
N	Y	E	W	E	O	E	N	H	S	I	A	M	L	O	R	I	O
A	S	D	R	T	E	O	Y	A	T	R	I	H	R	F	R	O	T
T	O	D	N	D	U	U	E	N	I	H	T	D	R	N	D	M	O
T	H	S	N	H	R	F	R	G	A	A	A	R	P	W	O	F	A
E	L	Y	A	R	C	H	A	E	O	L	O	G	Y	E	O	I	L

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Topic 3: How do soils form?

Glossary

Sediment ice age glacier parent rock nutrient vegetation

organic matter soil structure organic rich horizons organic

fauna flora stabilise erosion cultivation

mineral soil soil fertility fertiliser fertile

L	S	O	I	L	S	T	R	U	C	T	U	R	E	N	F	T	C	A
A	O	R	P	S	O	A	U	E	B	L	I	A	I	S	I	E	H	I
O	R	G	A	N	I	C	R	I	C	H	H	O	R	I	Z	O	N	S
Z	G	A	R	F	L	F	N	U	N	F	O	E	V	F	A	U	N	A
L	A	N	E	O	F	E	R	T	I	L	E	I	C	E	A	G	E	E
R	N	I	N	E	E	I	I	E	S	O	L	S	A	R	E	I	A	N
E	I	C	T	I	R	T	N	L	T	R	M	C	C	T	R	I	R	U
Y	C	M	R	Z	T	N	V	L	E	A	S	E	D	I	M	E	N	T
E	S	A	O	M	I	N	E	R	A	L	S	O	I	L	I	E	F	R
E	A	T	C	U	L	T	I	V	A	T	I	O	N	I	I	V	O	I
N	U	T	K	R	I	R	S	T	A	B	I	L	I	S	E	G	O	E
Y	V	E	G	E	T	A	T	I	O	N	I	L	L	E	E	E	T	N
N	U	R	L	T	Y	E	L	N	O	I	I	E	G	R	O	I	K	T
F	R	O	A	B	T	A	A	O	R	V	T	I	A	A	N	F	H	N
L	T	S	C	C	I	A	P	A	I	R	S	O	A	F	R	G	O	T
T	O	I	I	N	E	C	E	E	N	E	T	E	D	E	I	F	R	I
O	S	O	E	R	G	E	E	C	N	E	A	U	E	R	L	A	A	A
T	E	N	R	E	R	I	A	N	L	E	I	L	C	E	N	R	O	Z
A	T	E	S	C	A	S	R	E	E	E	T	E	T	S	A	R	E	I

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Topic 4: How Soils Began

Glossary

Geological ice age glacier sediment organism

Subtropical luxuriant turbulent disruption sustain Ancestors

scoured deposit exposed resilient vegetation fauna

flora stabilize

F	I	N	C	S	D	M	L	O	G	F	R	I	E
R	E	S	I	L	I	E	N	T	E	A	V	T	X
S	E	G	B	E	S	N	A	C	O	U	E	U	P
T	S	C	O	U	R	E	D	L	L	N	G	R	O
A	N	G	I	T	U	S	N	S	O	A	E	B	S
B	F	E	A	C	P	D	L	N	G	N	T	U	E
I	N	S	U	B	T	R	O	P	I	C	A	L	D
L	U	X	U	R	I	A	N	T	C	E	T	E	I
I	E	D	E	P	O	S	I	T	A	S	I	N	M
Z	O	R	G	A	N	I	S	M	L	T	O	T	E
E	S	U	S	T	A	I	N	R	L	O	N	R	N
D	C	I	R	G	L	A	C	I	E	R	N	S	T
I	C	E	A	G	E	U	S	L	X	S	U	D	P

F	L	O	R	A	I	N	N	I	B	G	T	G	I

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Topic 5: Soils Under the Microscope

Glossary

Magnification fragment mineral grain particle constituent organic matter structure decomposed component pores cells sand silt clay soil organisms bacteria fungus mycorrhizae

S	O	I	L	O	R	G	A	N	I	S	M	S	P
L	O	P	A	R	T	I	C	L	E	O	A	S	O
A	F	U	N	G	U	S	E	R	O	I	M	O	R
C	T	S	M	A	N	G	D	H	I	L	Y	C	E
O	B	N	I	N	M	A	E	M	S	M	C	O	S
M	A	G	N	I	F	I	C	A	T	I	O	N	U
P	C	I	E	C	R	C	O	C	R	N	R	S	I
O	T	L	R	M	A	E	M	E	U	E	R	T	L
N	E	T	A	A	G	L	P	S	C	R	H	I	A
E	R	G	L	T	M	L	O	N	T	A	I	T	G
N	I	R	L	T	E	S	S	S	U	L	Z	U	Y
T	A	A	T	E	N	L	E	E	R	S	A	E	E
A	L	I	D	R	T	T	D	A	E	A	E	N	S
S	A	N	D	S	I	L	T	C	L	A	Y	T	I

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Topic 6: Properties of Soil

Glossary

Texture moist acid alkaline pore space soil chemicals

soil structure soil water soaking soil particles

S	O	I	L	P	A	R	T	I	C	L	E	S
O	S	A	D	L	R	C	R	S	P	C	P	L
I	C	I	S	O	T	G	S	N	E	L	K	O
L	P	O	R	E	S	P	A	C	E	O	K	I
S	O	I	L	C	H	E	M	I	C	A	L	S
T	A	C	I	D	A	L	K	A	L	I	N	E
R	S	O	I	L	W	A	T	E	R	O	S	C
U	O	I	O	T	E	C	E	O	A	O	I	R
C	A	R	S	T	S	S	X	P	E	L	P	A
T	K	A	M	O	I	S	T	O	E	E	D	L
U	I	O	H	S	L	I	U	D	S	E	C	P
R	N	O	C	E	U	N	R	T	L	L	L	I
E	G	C	P	S	L	K	E	N	C	O	L	A

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Topic 8: Soils as a Living Being

Glossary

Billion fauna flora organism burrow soil pores

Breathing Fungus bacteria beetle worm centipede

Mole Badger roots organic material

C	O	F	B	F	A	T	A	O	C	M	T	I	A	S
R	N	U	R	D	T	O	A	R	E	O	T	A	C	O
C	R	N	E	S	F	S	R	G	N	L	S	D	B	I
O	R	G	A	N	I	C	M	A	T	E	R	I	A	L
N	H	U	T	A	A	M	N	N	I	E	B	F	I	P
G	A	S	H	G	R	U	B	I	P	E	I	L	B	O
T	R	A	I	R	S	B	S	S	E	B	L	O	L	R
F	A	U	N	A	W	B	D	M	D	U	L	R	G	E
N	A	I	G	O	B	A	C	T	E	R	I	A	L	S
R	O	I	C	E	E	D	O	N	N	R	O	O	T	S
N	R	I	L	R	E	G	O	L	O	O	N	I	N	I
C	M	E	O	M	T	E	I	S	W	W	O	R	M	F
E	O	R	A	E	L	R	A	A	I	M	O	A	B	G
G	L	B	S	S	E	R	C	E	A	G	R	F	S	E
N	R	E	R	A	R	I	T	W	L	W	I	A	L	G

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Topic 8: Soils as a Living Being

Glossary

Billion	fauna	flora	organism	burrow	soil pores
Breathing	Fungus	bacteria	beetle	worm	centipede
Mole	Badger	roots	organic material		

C	O	F	B	F	A	T	A	O	C	M	T	I	A	S
R	N	U	R	D	T	O	A	R	E	O	T	A	C	O
C	R	N	E	S	F	S	R	G	N	L	S	D	B	I
O	R	G	A	N	I	C	M	A	T	E	R	I	A	L
N	H	U	T	A	A	M	N	N	I	E	B	F	I	P
G	A	S	H	G	R	U	B	I	P	E	I	L	B	O
T	R	A	I	R	S	B	S	S	E	B	L	O	L	R
F	A	U	N	A	W	B	D	M	D	U	L	R	G	E
N	A	I	G	O	B	A	C	T	E	R	I	A	L	S
R	O	I	C	E	E	D	O	N	N	R	O	O	T	S
N	R	I	L	R	E	G	O	L	O	O	N	I	N	I
C	M	E	O	M	T	E	I	S	W	W	O	R	M	F
E	O	R	A	E	L	R	A	A	I	M	O	A	B	G
G	L	B	S	S	E	R	C	E	A	G	R	F	S	E
N	R	E	R	A	R	I	T	W	L	W	I	A	L	G

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Topic 9: Soils, Plants and Food Production

Glossary

Taproots prospect the soil irrigation nutrients macronutrients

Micronutrients fertilizers fertile soil fertility crop yield seminal root

lateral root mycorrhizae fine branching root root hairs structure

fungus organic matter decay soil organism

cycle sediment

H	O	T	R	T	R	R	S	P	R	F	E	R	T	I	L	E
M	A	C	R	O	N	U	T	R	I	E	N	T	S	R	O	T
I	R	R	I	G	A	T	I	O	N	R	O	A	O	M	U	O
M	T	A	P	R	O	O	T	S	C	T	F	F	I	I	M	L
I	A	N	R	N	L	E	R	P	A	I	R	U	L	C	Y	L
G	I	T	S	C	Y	C	L	E	R	L	R	N	O	R	C	A
F	I	N	E	B	R	A	N	C	H	I	N	G	R	O	O	T
O	S	E	D	I	M	E	N	T	Y	Z	U	U	G	N	R	E
C	T	R	I	R	H	I	H	T	M	E	T	S	A	U	R	R
S	I	H	S	R	I	I	A	H	S	R	R	D	N	T	H	A
S	T	R	U	C	T	U	R	E	I	S	I	E	I	R	I	L
R	O	O	T	H	A	I	R	S	T	D	E	C	S	I	Z	R
S	E	M	I	N	A	L	R	O	O	T	N	A	M	E	A	O
S	O	I	L	F	E	R	T	I	L	I	T	Y	I	N	E	O
O	C	R	O	P	Y	I	E	L	D	U	S	I	L	T	R	T
O	R	G	A	N	I	C	M	A	T	T	E	R	O	S	R	T
O	S	L	F	R	D	C	C	A	E	O	U	L	U	G	I	H

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Topic 10: Soils and Climate Change

Glossary

ice age temperature geological radiation greenhouse effect

atmosphere fossil fuels carbon dioxide ecosystems

hydrology scarcity

S	C	A	R	C	I	T	Y	F	T	E	T	A	I	O	N
U	S	N	C	A	E	G	L	C	E	S	D	O	O	S	Y
S	R	E	F	R	E	E	F	F	Y	Y	T	E	S	C	B
S	M	O	G	B	L	O	G	O	Y	M	O	H	O	T	E
R	M	T	R	O	L	L	I	S	O	E	R	T	I	E	A
G	R	E	E	N	H	O	U	S	E	E	F	F	E	C	T
Y	A	M	S	D	Y	G	G	I	T	C	E	Y	C	O	M
Y	D	P	I	I	D	I	R	L	E	Y	A	E	I	S	O
R	I	E	M	O	R	C	A	F	L	R	S	A	L	Y	S
F	A	R	I	X	O	A	A	U	O	E	Y	A	D	S	P
S	T	A	H	I	L	L	A	E	S	L	T	T	L	T	H
G	I	T	M	D	O	R	E	L	I	C	E	A	G	E	E
O	O	U	U	E	G	O	E	S	I	R	R	E	L	M	R
R	N	R	R	T	Y	E	R	H	H	P	G	M	L	S	E
S	I	E	F	F	H	E	S	R	R	I	Y	E	I	O	L
U	G	E	C	S	A	R	O	E	I	C	O	D	I	C	O

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Topic 12: Soils of Britain

Glossary

Temperate temperature vegetation deforestation pesticides

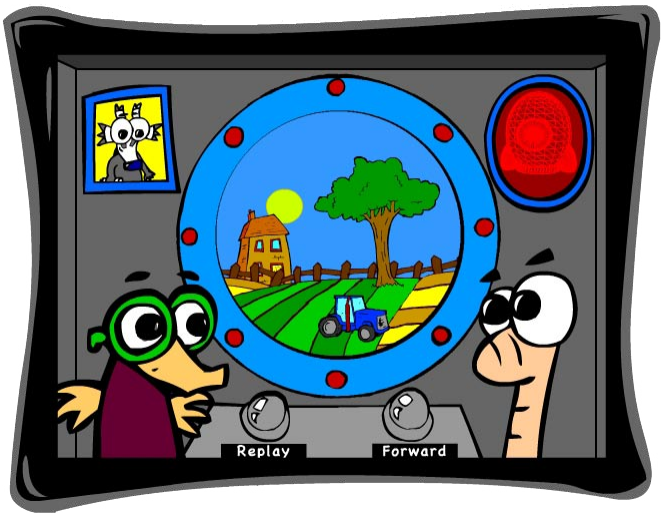
Mechanisation ice ages glacier weathering

Farming agriculture

S	U	M	M	E	O	E	A	E	W	C	C	E	R
V	E	G	E	T	A	T	I	O	N	H	R	I	R
G	L	A	C	I	E	R	N	A	W	E	D	I	O
S	S	A	H	D	A	A	T	T	C	L	E	W	T
R	E	E	A	T	E	E	A	E	R	U	R	E	N
M	T	R	N	A	E	E	R	A	E	T	E	A	G
U	E	E	I	C	E	A	G	E	S	E	R	T	M
E	P	E	S	T	I	C	I	D	E	S	O	H	S
G	M	E	A	T	E	M	P	E	R	A	T	E	S
S	I	L	T	E	M	P	E	R	A	T	U	R	E
A	G	R	I	C	U	L	T	U	R	E	S	I	F
D	E	F	O	R	E	S	T	A	T	I	O	N	E
L	E	A	N	R	L	F	A	R	M	I	N	G	I
N	R	O	L	V	A	O	F	H	T	C	A	E	T

Topic 1: What is Soil?

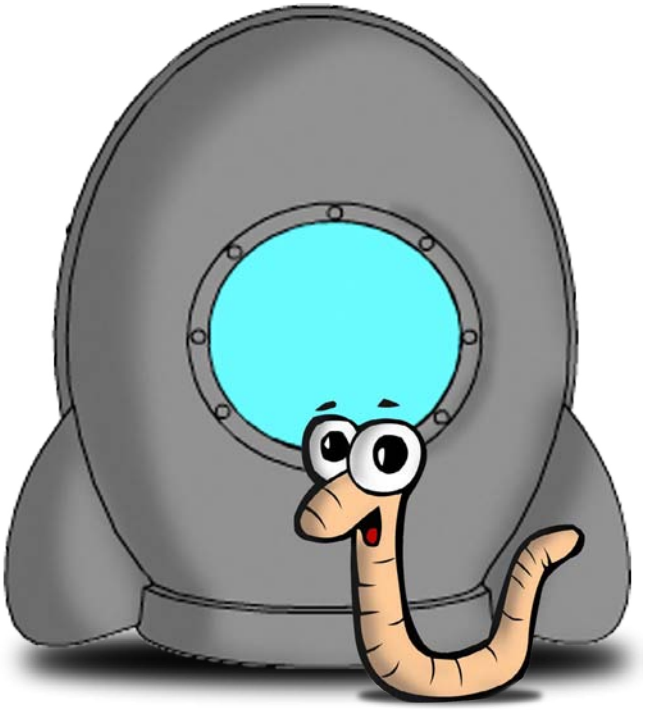
Soils and the Farm The soil contains the water and nutrients needed to grow plants. Without these nothing would grow. This is true whether the plants are wild or cultivated. Each year farmers cultivate their soils, plant seeds, fertilise the soil and harvest the crops that grow. Farmer's cultivate their soils in order to grow food. This food is used to feed the world's population.



Soils and the Town All the buildings, roads and railways and other parts of the infrastructure in a town are built on or in the soil. Unfortunately when towns are built, the soils within them cannot be used for other important uses, such as growing farmers' crops. Each year we lose a lot of our soils to buildings. In fact the amount of soil lost each year to buildings covers the equivalent area to that of the fairly large town.

Soils and the Garden Soils are extremely important to gardeners because they enable their flowers and vegetables to be grown. Like the farmers, the gardeners needs to look after their soils, keeping them well drained and fertile. If the gardeners look after their soils they can grow beautiful flowers, large onions or beans, and provide the family with healthy vegetables.

Soils in the Woodland Soils play a very important part in our woodlands. They provide anchorage, water and nutrients for the plants that grow in our woodland.Soils have a responsibility for anchoring even our largest trees and stopping them falling over in the winds. Soils provide the water and nutrients for the plants and whether they are acid or not will influence the type of plants that will grow in a particular spot.



Additional Points ? www.soil-net.com

Together with air and water, soil is one of the major natural resources that make the world the wonderful place it is.

Soils form a thin skin over the surface of the earth. Although generally about 1 metre thick, in areas such as the tropics it may be several metres thick, and in the cold arctic areas only a few centimetres thick.

Soils mean different things to people: To the farmer and the gardener, it is what things grow in; to the builder, it is what he needs to put his buildings on; but to the mother whose child is covered in dirt, it is mud.

Fantastic Facts Wow! www.soil-net.com

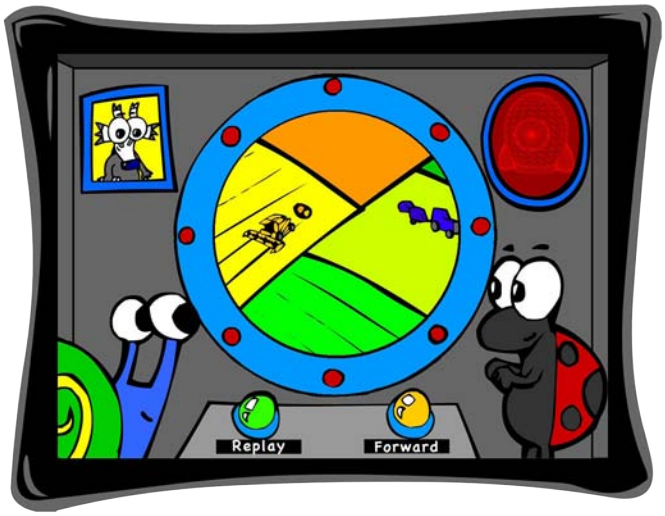
Soils are the home to millions of organisms which live beneath our feet.

Soils are composed mainly of particles of rock of various sizes. At the top of the soil is usually a darker organic-rich layer which contain many of the nutrients. Soils also store the water for use by plants and animals.

Soils are now under increasing pressure as world population increases rapidly. It is important that we recognise the importance of soils and ensured they are preserved for this and future generations.

Topic 2: Why Does Soil Matter?

Introduction Soil is extremely important as it supports several vital functions allowing life on earth as we know it to develop and prosper. There are many reasons why soils matter, why we should appreciate soils and why we need to look after them. Let's try and learn about them and have fun doing so.



Soils and Farming Farming the soil to produce crops has gone on for as long as man has been on the earth. We rely on the farmers of today to till the soil, plant seeds and then to harvest the crop that grows. This annual sequence of events is the source of most of the world's food. In the more developed parts of the world, farming the soil has become very intensive, using fertilisers, more mechanisation and chemicals to control pests, so as to produce higher yields of crops and keep pace with a rapidly growing population.

Soils and Forestry Soils, together with climate, play a major part in producing the world's forests. These forests are the source of timber and fuel for mankind and home to a wide range of plants and animals. The wide range of soils and climate across the world leads to a wide range of trees needed to meet the needs of the world population. It is an amazing to think that the soils in the hot moist climates of the tropics are able to sustain such a dense, luxuriant forest and maintain its growth year after year.

Why not? ? www.soil-net.com

When next you visit a farm ask the farmer about his soils and how they are used to produce crops, which eventually become our food.

When next you are in a woodland, think about the soil and how it helps all the trees to grow.

Why not? ? www.soil-net.com

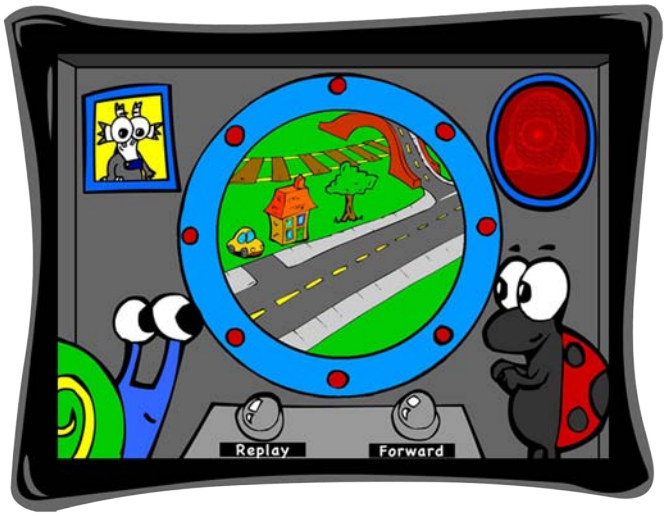
Soils and the Countryside

Soils play a major part, together with climate, in the wide range of flowering plants that occur in the world. The nature of the soil at any point in the landscape is important in determining what will grow and where it will grow. Thus we have plants that love chalky soils and those that do not; we have plants, such as heather, that like the wet, acid soils of the uplands, and we even have flowering plants in which the colour of the flower depends on the soil in which it grows.

When next you are out walking in the countryside look at the vegetation and appreciate that soil is one of the major reasons for it.

Soil as Foundations for Buildings

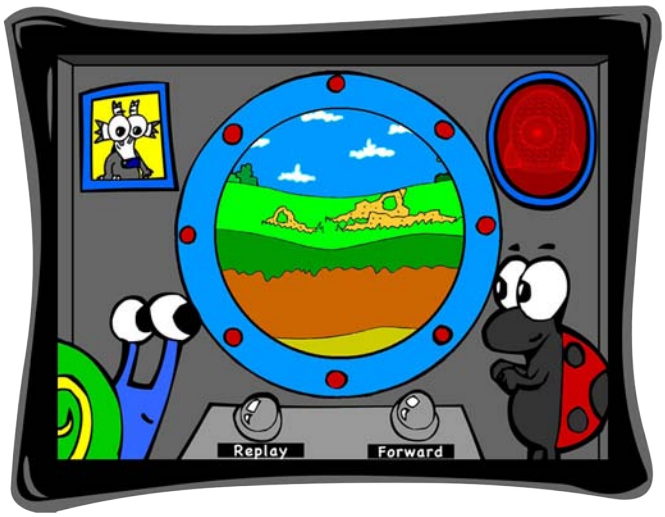
All our towns and cities over the years have been constructed on or in the soil. The nature of the soil plays an important part in ensuring the stability of all these buildings. Some soils can be a problem to build on. For example, some clay soils swell when wet but shrink when dry. This change can cause a problem for some buildings. Increasingly dry summers have caused a problem for the structures of some buildings because of this. It is important to realise that when we build on soils they are unlikely ever to be used for other purposes, such as farming, ever again.



Think when next you enter the town that much of this was once farmland. We must ensure we do not use up too much of our precious soil for building so that one day we cannot produce enough crops.

Soil and our Water Supply

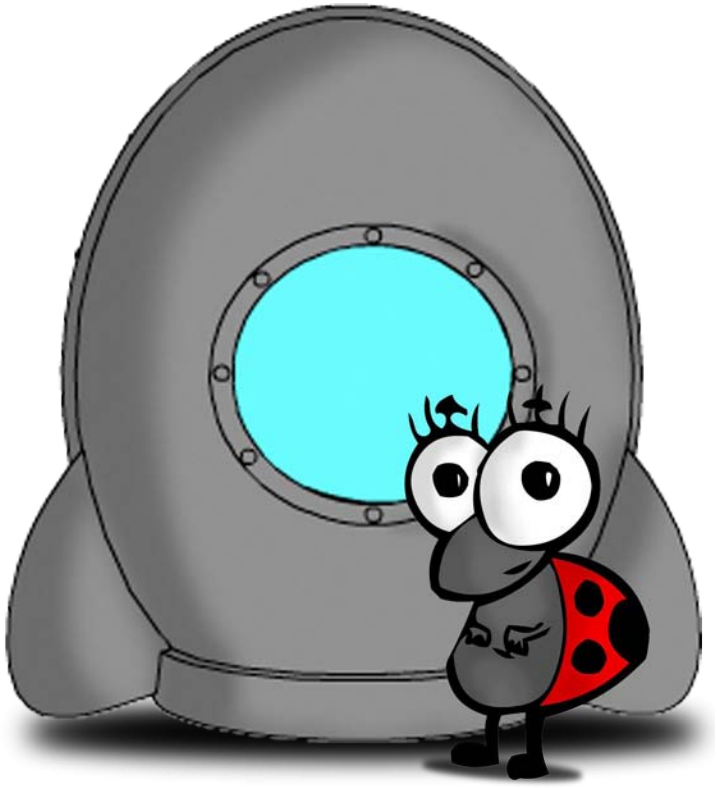
Soils help to regulate the flow of water from the moment that rainwater reaches the soil surface. Some will flow over the surface, some will enter the soil and be retained and some will flow almost straight through to the aquifers below. Much of the water reaching the soil will be retained in the soil where it can be used by the plants that grow in the soil and by the organisms that live in the soil. Soils can also act as a filter, helping to clean up the water before it flows through to the lakes and rivers.



Soils as a Preserver of Our History

Over many centuries the soil has acted to preserve historical objects within it. By digging into the soil it is sometimes possible to unearth remains of previous generations. Much information can be obtained on how previous generations lived by excavating the soil. Thus many of the Roman remains in our museums today have come from excavating the soil. Analysis of the soils in which the archaeological remains occur can also tell us much about the diet of the people, the crops they grew and the vegetation that occurred in that period.

It is estimated that there will be billions of organisms in just a teaspoonful of good soil!



We must not forget that the soil is very important as a home to millions of organisms that play a vital part in the use that can be made of soil.

Soils also play an important part in modifying pollutants that enter the soil. Thanks to the many organisms, the soil is able to 'clean up' many pollutants that are spilled on its surface.

There is currently much concern that the climate appears to be changing. The soil stores huge amounts of carbon in its organic matter. How this stock of carbon is managed can greatly affect the rate of climate change.

It is important to realise that soils that are built upon are lost to other uses for ever. Currently, the spread of towns and cities swallows up about 5,000 hectares each year, the equivalent of a new city the size of Norwich.

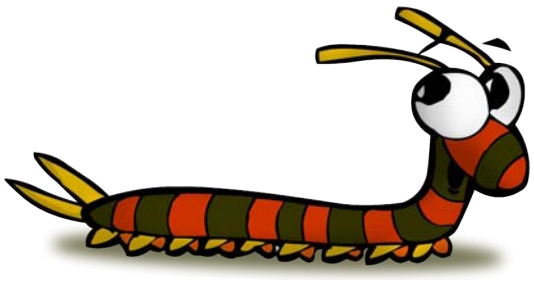
Topic 3: How Do Soils Form?

Introduction Soils form an almost complete skin over the earth, broken only by oceans and other water bodies and by mountains that have yet to develop a soil cover. When you walk in your garden or through the fields and woods there is always this magical carpet, the soil, beneath your feet.

Soil Parent Material Just as we all have parents, so soils also have 'parents', or rather parent materials, from which they form. For most soils the parent material is either solid rock or sediments. The last Ice Age (more than 10,000 years ago) left sediments in many parts of the world from which many soils have formed. Parent material is the main factor responsible for the texture of the soil (i.e. whether the soil is sandy, silty or clayey) and is also important in determining whether the soil is acid or basic, and whether it is rich in nutrients. When you are out and about look out for the different types of rock and imagine what types of soil will form from them.

Climate Climate is a very important soil forming factor. As climate changes across the world so does the soil type. Temperature, rainfall, snow and ice all influence the way the parent rocks and sediments are converted into soils. They play a large part in breaking down the rocks to form soil. They affect the rate at which chemical, physical and biological processes combine to develop soil in a particular place. Rainfall influences the distribution and amounts of nutrients in the soil, and hence their availability to plants.

When you go on your holidays to a different climate look at the soils there and see how they are different to the ones back home.



Organisms, including Vegetation and Fauna

Vegetation and soil animals are important in several aspects of soil formation including organic matter production, release of nutrients to support plant life, and in the development of soil structure. Soils under grassland tend to develop fairly thick top organic rich horizons whereas in those under forest the organic matter layer is usually thinner. Plant cover acts to stabilise soils during their development and helps to prevent erosion of the soil.

Remember there is a very close relationship between the soil and the vegetation that grows on it. The two work together very well to produce our native flora.

Landscape

The way that the landscape is developed has a strong influence on the thickness of soils and how well they are developed. On steep slopes, such as hillsides, the soils are often very thin because the soil tends to be washed down the slopes by the rain. In flat positions, such as plains and valley floors, the soils tend to be thicker. Here, they do not tend to be washed away like the hillslope soils but instead tend to receive sediments washed downslope from above them.

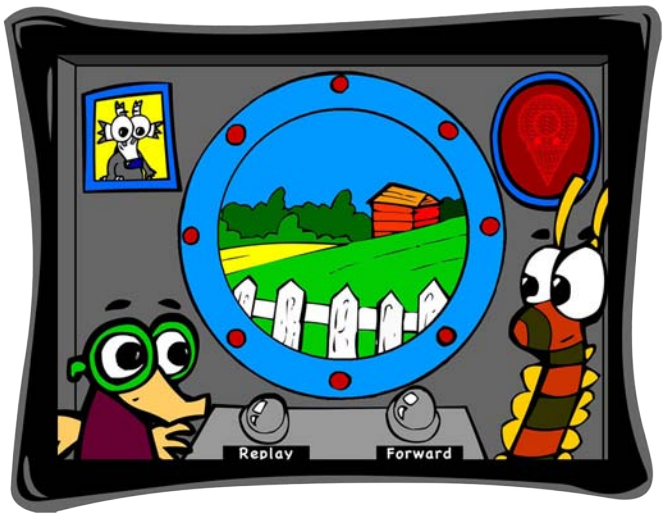
When next you are in the hills look at the steep slopes and imagine how the soil can be washed down the slopes. Also when you are on flat land realise that the soils beneath your feet are probably quite deep.

Time

Soils need a lot of time to develop. It takes hundreds of years for just a centimetre of soil to form from hard solid rock but perhaps only a few decades to develop a few centimetres of soil in soft sediments. Soil formation first began many millions of years ago and there are some world soils that are over a million years old. We need to look after our soils well because they are very precious and new ones can take along time to form.

When you are out in the countryside and come across boulders and other pieces of rock, you can say to them ‘one day soils may come and form from you’.

Topic 3: How Do Soils Form?



The Influence of Human Beings on Soils

Farming soils to produce crops has had a big influence on soils. The upper parts of the soil, in particular, will have been disturbed by cultivation and organic remains mixed in with the mineral soil. Humans have also increased the fertility levels of many soils by adding fertiliser. In some parts of the world, soils have been farmed badly and soil erosion has resulted, decreasing the potential of the soils.

Soil formation is a complex process brought about by the interaction of these various soil forming processes.

There are several thousand different types of soil in the world as a result of the different interactions of the soil forming processes across the world.

In the last 100 years human beings have had a bigger and bigger effect on soils and in many parts of the world have modified soils greatly.

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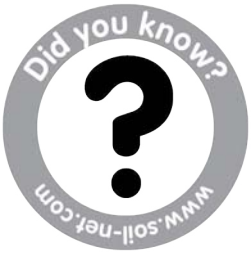
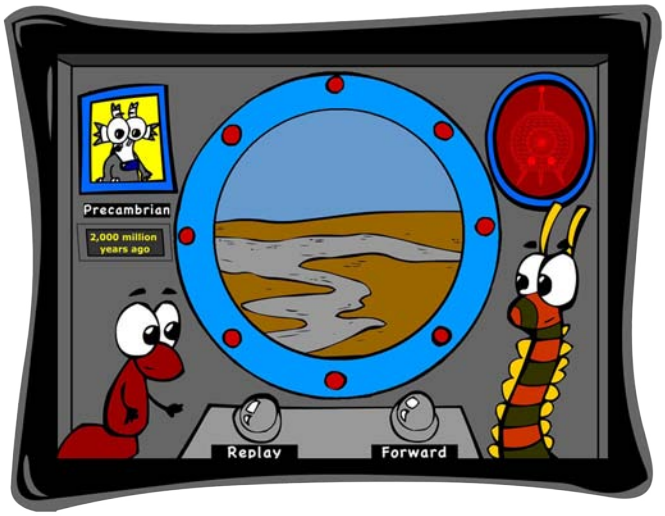


People who use the soil should do so carefully and ensure that they maintain the soils for use by future generations.

Topic 4: The Beginnings of Soil

Introduction Soil formation has been going on for billions of years but geological times have often been turbulent times so there have been periods of great disruption to this soil formation. Think, for instance, of the great mountain building periods, the huge earthquakes that occur and the movements that have occurred to the earth's crust. Such events will have disrupted soil formation and in many cases soil formation will have needed to begin again. Let us look in on some of these geological periods and trace soil formation back in time.



2,000,000,000 years ago This is called the Pre-Cambrian period and is the earliest geological period. It is, of course, difficult to be sure what was happening so long ago but scientific research suggests soil formation began in this period. Compared to today, soil forming factors were very different so long ago. For example, there was no vegetation and few organisms to help to create the soil. It is thought that these earliest soils formed in an atmosphere with little or no oxygen and consisted of greenish clays.

400,000,000 years ago This is called the Devonian period. By this time land plants were becoming established and these required soils in which to grow. There was more oxygen in the atmosphere in this period and the soils were redder and browner, like some of our soils today. Various organisms developed and for the first time soil organisms began to play a part in soil development.

354,000,000 to 250,000,000 years ago

Carboniferous times, which were 354 to 290 millions years ago, were characterised by forests and swamps but there were major changes in the vegetation as the sub-tropical climate developed. The most striking soils from this era were the peat soils which eventually became buried and converted into coal. The Permian period dating from 295 to 250 million years ago also experienced a wide range of climate. Towards the end, conditions became hot and dry and desert soils developed widely.

180,000,000 years ago

This was the Jurassic period, now well known for its dinosaurs, living in the subtropical conditions that were a bit like parts of Africa are today. By this time there was quite a wide range of animals, including soil organisms. The soils of this era would have resembled the subtropical soils of today, quite deep and reddish under the warm conditions that prevailed and capable of sustaining luxuriant pines and ferns.

Fantastic Facts Wow! www.soil-net.com

Over this long, long time period from 2000 million years to just 2 million years ago think of the many changes that have taken place including the beginning of animals and plants, but remember also that soils started to form and this allowed the ancestors of the various plants and animals we see today to develop.

The Ice Age, beginning 2 million years ago

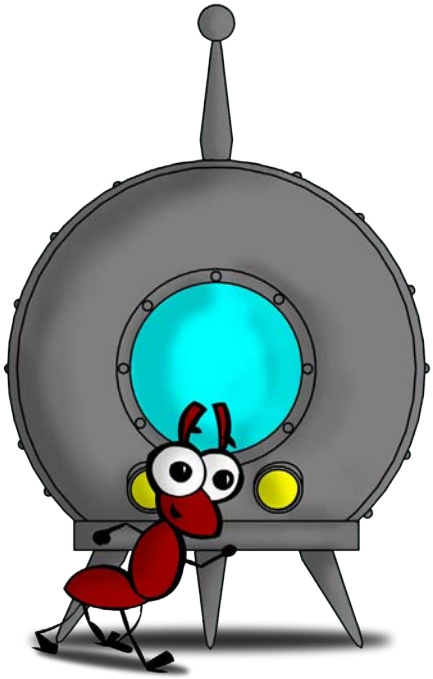
Many parts of the world have been affected by at least one major Ice Age, resulting in the landscape being covered by ice. In some parts of the world there have been as many as four periods in the last 2 million years when the temperature has fallen and the land has become covered by an ice sheet. In these conditions pretty well all previous soils are scoured from the landscape and soil formation has to begin again. When the ice melted it left behind large deposits of mixed sediments. It is in this material that many of today's soils have been formed.

Why not? ? www.soil-net.com

Get your teacher to tell you about the Ice Age. This is a good example of how nature can control and change many situations.

Just as there is a lot of news currently about climate change, and the fact that temperatures are rising, the Ice Age is an example of what happens when the climate cools so much that ice sheets form across the landscape and nothing will grow. This would have had a devastating effect on plants and animals because there was no soil to support them any longer over some very large areas.

Soils of Today Although soil formation began 2000 million years ago, virtually all world soils are less than 1 million years old. The oldest soils are probably those found on some of the old landscapes of Africa. Most world soils are quite young and date back less than 10,000 years when the last ice sheets melted. Soils continue to form every day and even today somewhere there will be a new soil, perhaps on an exposed rock, beginning to form.



Additional Points ? www.soil-net.com

Each geological period has been marked by some degree of soil formation which has been able to support a characteristic flora and fauna for that period. Nature has a great deal of resilience. However, this resilience becomes increasingly tested as the human population increases, and perhaps as the climate begins to change again.

There are some landscapes of the world, particularly the desert landscapes, which are changing even as you read this note. Here the wind is the force which is regularly remoulding the landscape. Think how difficult it is here for the soils to stabilise when the wind is regularly changing the shape of the landscape.

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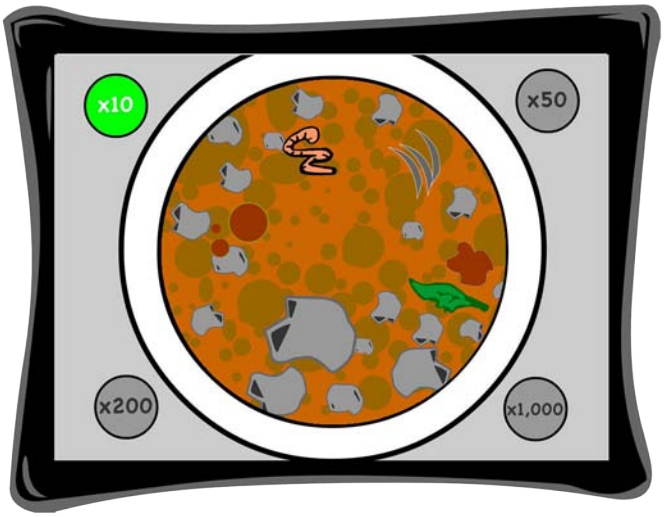
The birth of soils has a long and complicated history but because soils need a long time to form and we need them for this and future generations we must be sure to look after them and protect them.

Topic 4: The Beginnings of Soil

Topic 5: Soils Under the Microscope

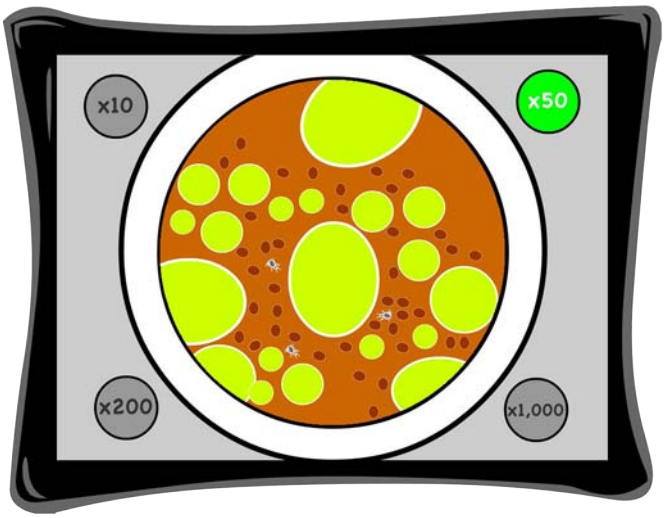
Introduction Most soils are derived from some form of rock or sediment and therefore most of what soils are composed of is mineral as opposed to organic because rocks are composed dominantly of mineral matter. The main exception to this is the peat soils which are formed of organic matter in different stages of decomposition. The particles that make up soils come in a wide variety of shapes and sizes. Because most particles that make up the soil are very small, some form of magnification is important for looking at these particles in detail.

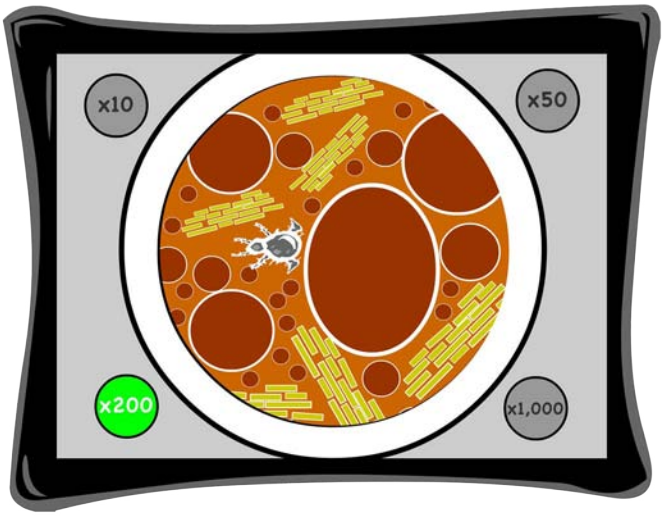


10x Magnification At this magnification it is possible to see the small rock fragments and larger mineral particles such as those of sand size. These are an important constituent of sandy soils. Also at this magnification it will be possible to see fragments of organic matter. Some of this will still have the structure of the plant from which it came visible but if it is very decomposed it will just appear as a blackish mass without any structure. The third important component of soils is the pores (holes) formed when these mineral and organic matter parts link together. The pores are very important because they allow water into and through the soil, air into the soil and provide places where the small organisms can live. When you look through a magnifying glass or microscope at a sample of soil look out for the sand grains, the pieces of plant material and, of course, you may well spot some of the amazing creatures that live in the soil.

50x Magnification At this magnification you are likely to be able to see some of the small soil creatures that spend their whole life moving about the soil and see some of the small pores in which they live. In addition to the sand-sized grains (greater than 0.05 mm in size) that you can see at smaller magnification, silt-sized mineral grains (0.002 to 0.05 mm in size) will also be more visible.

There will be many of these in the silty soils. At this magnification also you can have a closer look at the structure of some of the plant material that has yet to decompose. See if you can pick out the cells (small compartments) in some of the plant remains and other parts of the decaying plant. As you increase the magnification at which you look at the soil so you will be able to pick out many more details about the things that make up the soil, like the structure of the plants, the movement of the organisms, the different types of mineral grain.

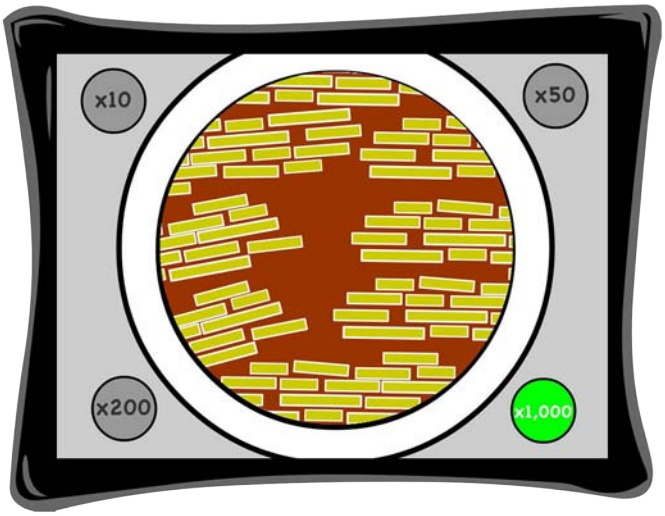




200x Magnification At this magnification you will be able to pick out virtually all the things that make up the soil and how they work together to create such an important material to support life. At this magnification you will begin to pick up bundles of clay particles. These are the smallest of the mineral particles but they do an important job, together with organic matter, in binding soil particles together.

You should also be able to see some of the smaller pores which are so important in storing the water that is held in the soils ready for uptake by the growing plants. The higher the magnification at which you look at the soil, the more unusual looking things you will see, such as some of the very tiny creatures and the roots of plants that are looking for nutrients and water.

1000x Magnification Now you will be able to see all of the mineral particles and how they are held together to form soil. You can even see some of the tiny clay particles. At this magnification you may see some mycorrhizae. This is a type of fungus which attaches itself to plant roots and helps to pass nutrients from the soil to the plant root. You may also see other types of fungi and also bacteria. The bacteria tend to be very tiny and may be difficult to spot but they play such an important part in helping to maintain good healthy soils. At high magnifications it takes more experience to unravel and identify the many parts of the soil but you should be able to identify some of the mineral grains, roots and plant fragments. Do try to see the soil at this magnification.



The microscope is a vital instrument in identifying the different minerals in a soil and thus helping to identify the rocks and sediments from which the soil is derived.

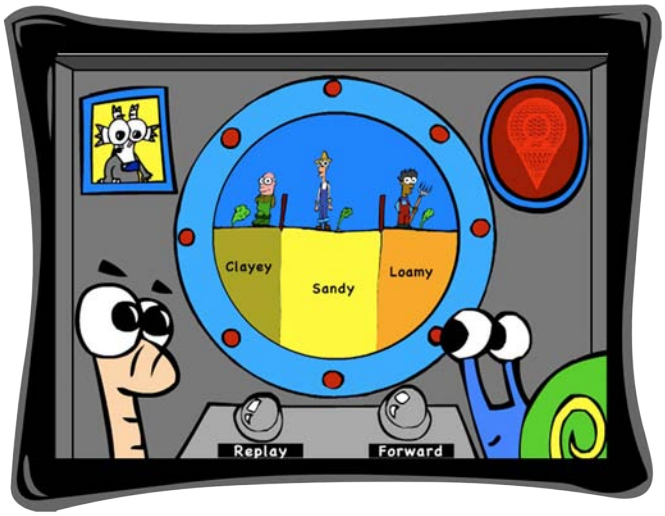
Similarly, it is an essential tool for studying the breakdown of plant fragments in the soil and their transfer into organic matter from which nutrients can be extracted and recycled.

The microscope is an important tool in studying the make up of soils. It is particularly useful in the study of soil organisms and in unravelling the role these play in the soil.

It is also important in understanding the interaction between the various parts of soil that make the soil what it is. These include mineral grains, plant fragments, organic matter, pores, water and the numerous living organisms.

Topic 6: Properties of Soil

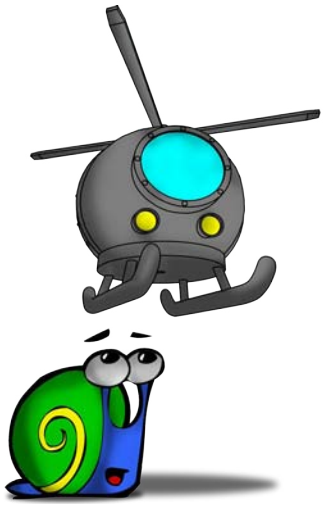
Introduction Soils have many different properties, including texture, structure or architecture, waterholding capacity and pH (whether the soils are acid or alkaline). These properties combine to make soils useful for a wide range of purposes. Soil properties govern what type of plants grow in a soil or what particular crops grow in a region. Here are some of the main soil properties that are important.



Texture When you take some moist soil in your hand and rub it between your fingers, you will feel the texture of the soil. In particular, you will be able to detect whether the soil feels rough or coarse, in which case it is probably a sandy soil, or whether it feels smooth which is the feel of a clayey soil. The amounts of sand, silt, clay and organic matter in a particular soil play a large part in the way that it behaves, how it can be managed and what it can be used to grow. Sandy soils are easy to cultivate but tend to hold little water and may be droughty, whereas clay soils are more difficult to cultivate, hold a lot of water and can become waterlogged, especially in winter.

With the agreement of your parents, why not take some of your garden soil, make sure it is moist and then rub it between your fingers. You can then experience the feel or texture of the soil and perhaps tell your parents whether it is sandy, clayey, or, something in between, loamy.

Soil Structure Just as houses and buildings have a structure or architecture, so also does the soil. The particles of sand and clay that make up the soil rarely occur as separate particles but are more or less loosely combined into aggregates. The type of structure in soil depends to a large extent on the texture and the amount of organic matter in the soil and the way the land is managed. The aggregates that make up the structure may be as small as a few millimetres, such as granules and crumbs, or as large as several centimetres, such columns and prisms. The granular or crumb structure is the one favoured by farmers and gardeners as it makes a better bed for the seeds they plant.



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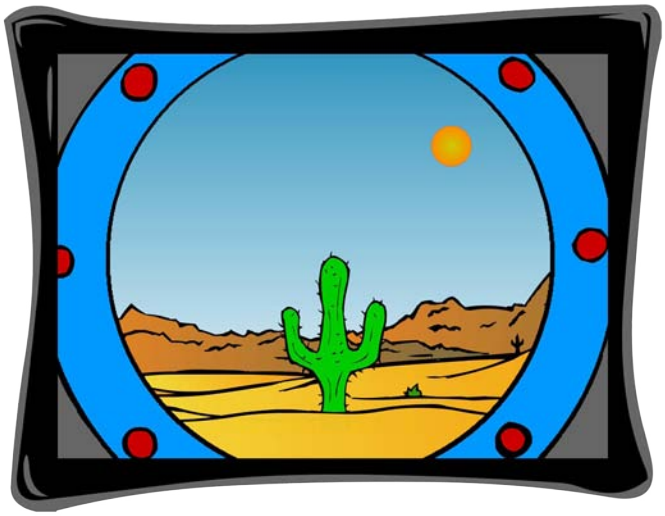
Unfortunately nature does not always provides soils with the best structure for growing things and farmers around the world have to make do with the soils that they have on their farm or modify their properties to suit the crops to be grown.

Waterholding Capacity All soils have the ability to hold water in their pores and on the surfaces of mineral grains and structural aggregates. This ability varies from soil to soil and relates closely to the texture of the soil. Sandy soils, while easy to cultivate, often suffer from the fact that they cannot hold onto much water and have a poor waterholding capacity. They are often known as thirsty soils. Clay soils by contrast have lots of small pores in which they can store water. This means that they always have some water for the plants that grow in them and thus have a good waterholding capacity.



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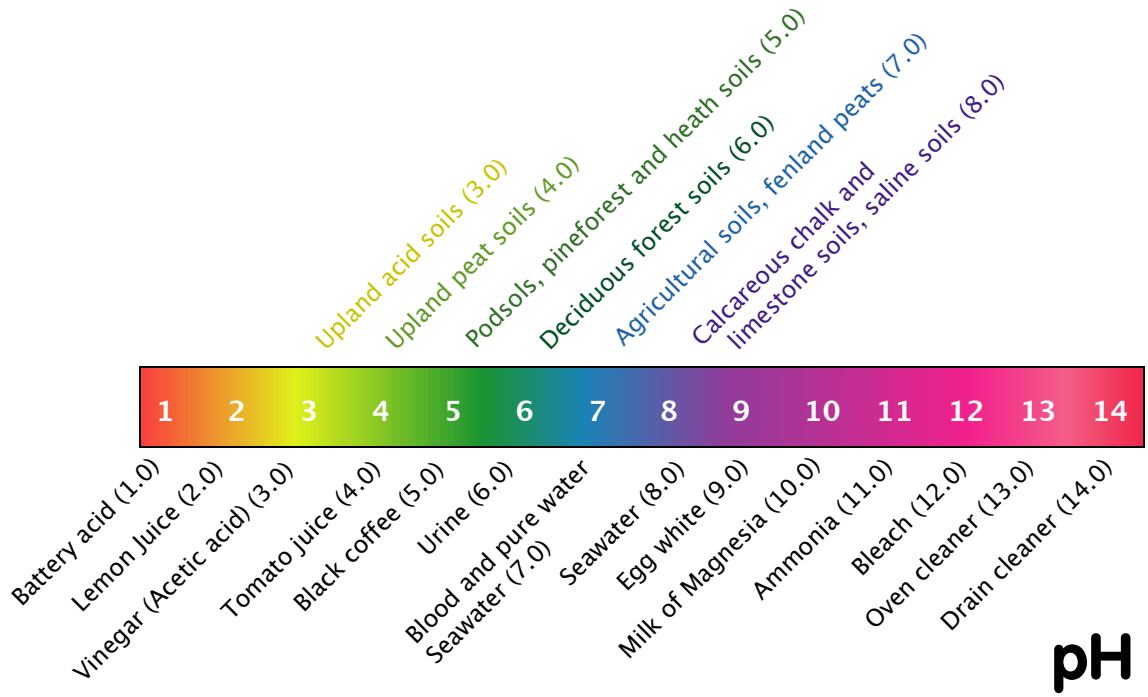
Think of the sponge in your bath and how that can hold water. Well the soil is a bit like a sponge. When it rains the soil will absorb a lot of the rainwater, like a sponge does bathwater.

Acidity and Alkalinity The term pH is used to indicate the level of acidity or alkalinity of a soil. It is important to try to understand pH because it helps you decide what is the best plant or crop for a particular soil. The range of pH values in soils is usually between 3 and 8 though most world soils are between 5.5 and 7.5. Below pH 7 the soils are termed acid and above pH 7 alkaline. The pH of the soil is important in determining the type of vegetation that will grow in the soil and the type of organisms that will live there. For example some types of earthworm prefer acid conditions (low pH) while others prefer more alkaline conditions (higher pH).

Many gardeners and farmers buy a meter with which to measure pH. They can then be sure that the soil is at the right pH for the crops they wish to grow. It will also help them to decide whether that should add fertiliser to the soil. Do you know the pH of your home garden soil or the school garden soil?



pH Scale

Organic matter plays an important part in most topsoil properties, particularly structure and waterholding capacity. This is why gardeners are keen to add compost and farmers to add manure.

Also where there is organic matter, there will also be numerous organisms helping to convert it back to nutrients and these organisms help to create a crumb or granular structure, ideal for cultivation.

Partly because of the organic matter there and also the organisms, topsoil structures tend to be much smaller than subsoil structures. Subsoil structures, such as are found below about 20 cm of the surface, tend to be coarser and the structural blocks can be several centimetres in size.

Soil water is held in the pores in the soil with different degrees of strength. In sandy soils most of the water is not held very strongly and therefore they can be droughty, whereas in clay soils, because they have many very small pores, it is held much more strongly and water is retained for longer.

Topic 7: Why and How Soils Differ

Introduction There are many different soils both within a country and worldwide. For example, there are over 700 soils in the UK and many thousands worldwide. The reason that there are so many is that the main things that influence soil formation vary greatly across the world. Take, for example, climate. The rainfall varies from just a few millimetres in the desert areas of the world to several thousand millimetres in the tropics. The rocks of the earth are also very variable from one country to another and these differences mean that soils will also be different. Let us look at soil formation in some of the main climatic zones of the world.

Soils and the Tropical Rainforest

The soils of the rainforest are generally deep because the hot temperatures help to break down (weather) the rocks and the high rainfall tends to leach (remove nutrients) from considerable depths of the soil. The soils tend to be reddish because the high temperatures tend to convert the iron in soil (the mineral largely responsible for soil colour) into haematite which is the reddish form of iron. Although the trees of the rainforest penetrate deeply, most of the organic matter in the soil is as a shallow layer at and near the surface of the soil. This organic rich layer is amazing in that it recycles nutrients and maintains the dense tropical rainforest.

When next you see pictures of the jungle, think about the soils that do such a good job in maintaining this wonderful growth of vegetation and all the wondrous life that resides in the tropical rainforest.

Desert Soils Desert soils are very different to the tropical rainforest soils. They contain very little organic matter partly because there is very little vegetation and partly because any organic matter is quickly broken down by the hot sun. The desert soils lack the dark surface organic horizon of most other world soils. There is also usually a big shortage of water in desert soils to support plants. There is very little rainfall so the soil does not receive much water to hold for any plants. Many desert soils are also unstable, with high winds blowing the soils about, so that they do not have time to develop and mature.

Have a look at pictures of deserts. You will see that very little grows there, mainly because of the climate.

Tundra Soils These are characteristic of areas like the higher northern latitudes where cold temperatures and frozen conditions for much of the year slow down the rates of soil formation. Thus tundra soils are generally shallow, poorly developed soils which include layers that are frozen for long periods of the year. Because they are covered by snow and ice for much of the year, plant growth is confined to just a few weeks a year. The soils may support scattered shrubs, grasses and lichens during the brief summer. The remains of the vegetation are slow to break down in these cold conditions so the soil can contain much organic matter, much of it largely undecomposed.

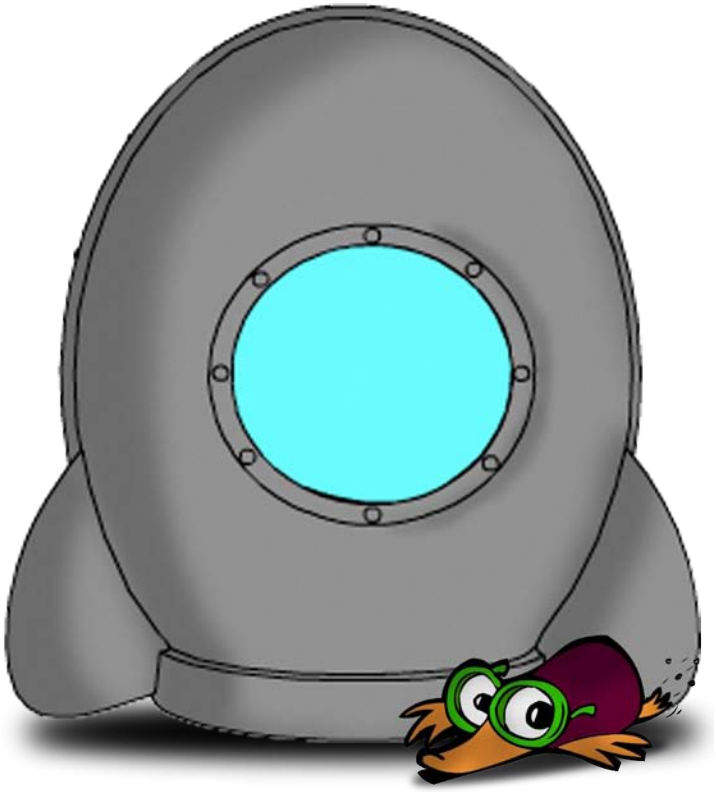
Think of these poor tundra soils trying to form in these icy conditions and think of the poor reindeer that come from these regions, trying to get enough to eat from the sparse vegetation.

Brown Soils of Temperate Regions

In some ways the brown soils of temperate regions are ideal soils because they are not affected so much by the extremes of climate that desert, tropical and tundra soils are. It is the brown soils that play an important part in feeding the world population. The temperate soils are characterised by sufficient, but not excessive, amounts of rainfall and temperature and a vegetation which is adapted to these moderate conditions. The characteristic soil profile will have a dark upper horizon, a more or less distinctive B horizon and a C horizon with contact with the underlying rock. Many of the soils will be around a metre deep.

Did you know? www.soil-net.com

These are just some of the main soils in the world but there are many others. Farmers have learned to make the most of their local soils, even poor soils, in the drive to produce food for themselves and for the rest of the world.



Additional Points www.soil-net.com

It is important to be able to identify and name the different types of soil (just as we name different trees and flowers). For this reason there have been several attempts made to develop soil classifications.

Some classification systems have been developed for single countries, others for the whole world. They tend to use quite complex names and currently are of most benefit to specialist soil scientists. There is a need for popular classification of soil to be developed as well as the more detailed complex one.

Soils are being used for growing all sorts of crops around the world, for example soils of wine regions for growing grapes, soils with olive trees, paddy soils for rice production. We must not forget that soils also sustain a wonderful range of trees and flowers around the world.

Topic 8: Soils as a Living Being

Introduction The soil is an ecosystem in which millions, even billions, of living creatures live and interact. Rather little is known about this huge population because for the most part they are underground and out of sight. The soil ecosystem has been declared by some scientists to be the last great biotic frontier that we need to discover. One thing we do know is that there can be more organisms in a teaspoonful of good soil than there are people in the entire planet earth -that is more than 6 billion. Wow ! There is a very wide range of organisms in the soil, ranging from protozoa which require the strongest of microscopes to detect them, up to large burrowing animals like badgers and rabbits which can readily be seen with the naked eye.

The Larger Fauna (greater than 2mm in size)

The macrofauna include a wide size range from badgers, on the one hand, down the tiny creatures such as ants. This group of creatures that depend on the soil include rabbits, badgers and gophers, which spend part of their life in the soil, and slugs, moles, earthworms, ants, millipedes, which spend most of their life in the soil. The burrowing animals such as earthworms, ants, millipedes create their own living space by burrowing into the soil.

These larger fauna play an important part in creating soil structure and helping with soil drainage. Think of the earthworm that burrows through the soil, creating channels, eating some soil as it burrows and then defecating the soil in the form of small granules.

The Medium Sized Fauna (Meso-tauna) (0.1 to 2mm)

Now we are beginning to think about some of the much smaller soil organisms. These include arthropods; collembola; and enchytraeids. Please excuse the complicated names but this is what they are called.

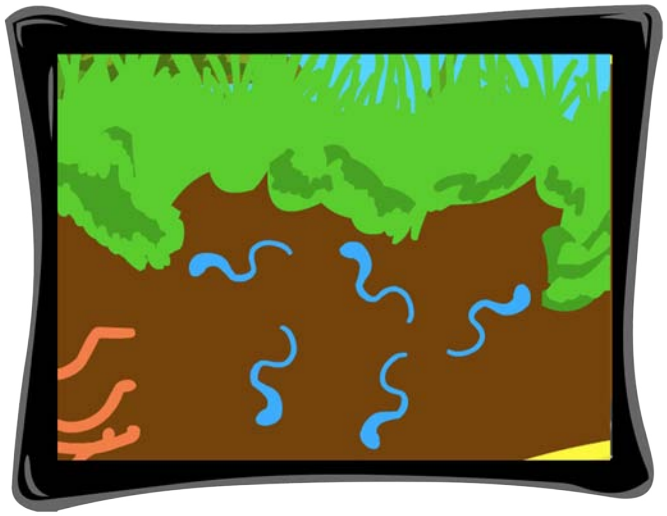
More than 200,000 arthropods have been recorded in a square metre of soil that has been under grassland for many years. Some mesofauna feed on the even smaller organisms like bacteria, fungi and algae, others scavenge dead organic matter usually after it has been partly broken down. They thus contribute to the recycling of the nutrients that are in organic matter.

Did you know? www.soil-net.com

You will need a microscope or strong magnifying glass to see some of these creatures. They are below our feet in the soil in huge numbers, working away as we walk over the surface of a lawn, field or woodland.

The Microfauna and Microflora (less than 0.1mm in size).

Now we are talking about the really, really tiny creatures that live in the soil. These play the final role of converting plant debris back into plant nutrients and in making the nutrients and water available to the plant again. Microfauna that are small enough to be in this category include nematodes which depend on a thin film of water around soil particles for their movement and protozoa which are variable in shape and which eat bacteria for much of their food. There are three main microflora in soils: bacteria, fungi and viruses. These play a major part in breaking down plant debris so that the nutrients in it can be reused. There are many different species of each of these, for example there can be as many as 20,000 species of bacteria in just one gram of soil.



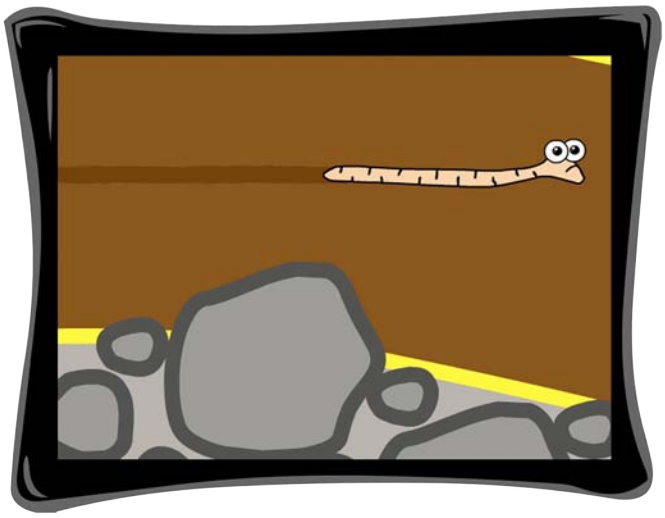
The soil is teeming with these small creatures but thank goodness they are there so that they can make the soil water and nutrients available to the growing plants. Say 'hurrah' for the microflora and microfauna when you re next walking on the soil in your garden.

Fantastic Facts Wow! www.soil-net.com

Other Important Points It is these living creatures that create the living soil and enable it to do marvellous things like grow crops and beautiful flowers.

Such a wide range of creatures thrive in the soil because the soil is a source of such a wide range of foods for them and a wide range of habitats that suit their style of living.

Earthworms are one of the best known of the larger creatures in soils. They are not pests like some animals, but instead do a lot of good things like begin the decomposition of plant fragments, create a good soil structure and their burrows help the soil to drain well. There are several thousand species of earthworm worldwide.



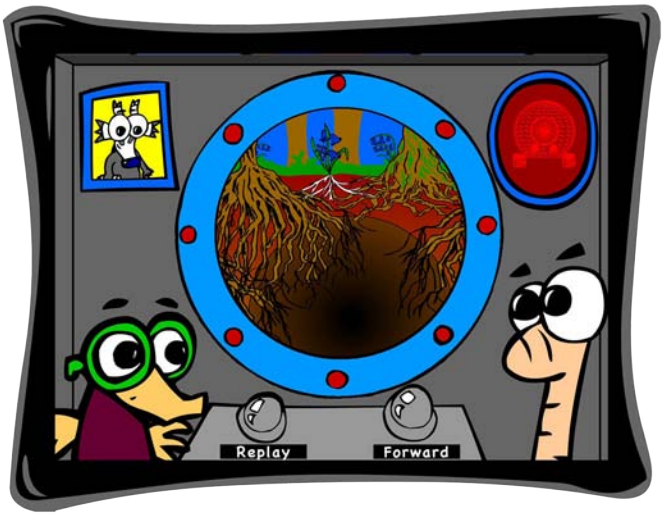
There may be billions of bacteria in just a gram of soil. They take part in many of the important transformations in soil including weathering of rocks and minerals, breakdown of organic matter and many aspects of nutrient cycling.

Fungi in soils come in the form of filaments, spores and globules. They are extremely important in the link between soils and plant production. Many thousands of species have been identified and it is thought that there are several thousand more awaiting discovery
We live in dangerous times when we are using soil more intensively than ever without a full understanding of the soil ecosystem. We need to develop a fuller understanding of this biotic community.

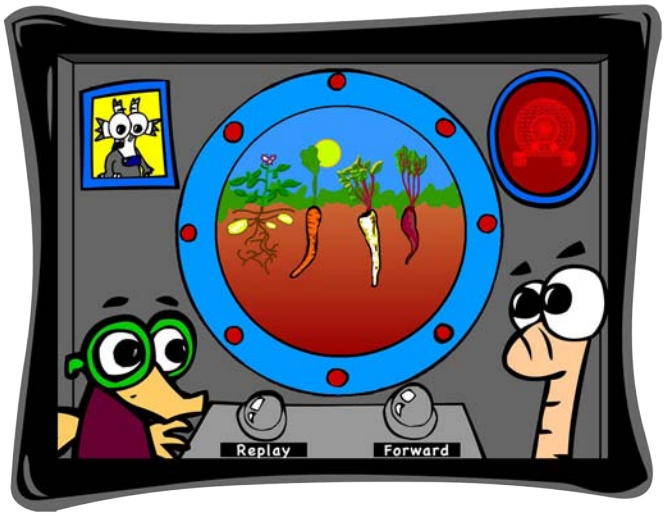
Topic 9: Soil, Plants and Food Production

Introduction Virtually all plants need soils in which to grow. Soils do three major things which enable a plant to grow. They provide support for the plant roots which in turn supports the above ground growth of the plant and generally stops the plants from blowing over in the wind. They provide the water for plants which enters the plant system through the roots within the soil. Finally they supply most of the nutrients needed by plants to grow.

Just imagine a large oak tree, for example, that has grown to over 15 metres height and has a very large trunk. The soil has provided the nutrients and water to enable it to reach this size and holds onto the roots to stop the tree blowing over. What a very important part the soil plays in supporting and maintaining our wide range of plants and ultimately our food supply.



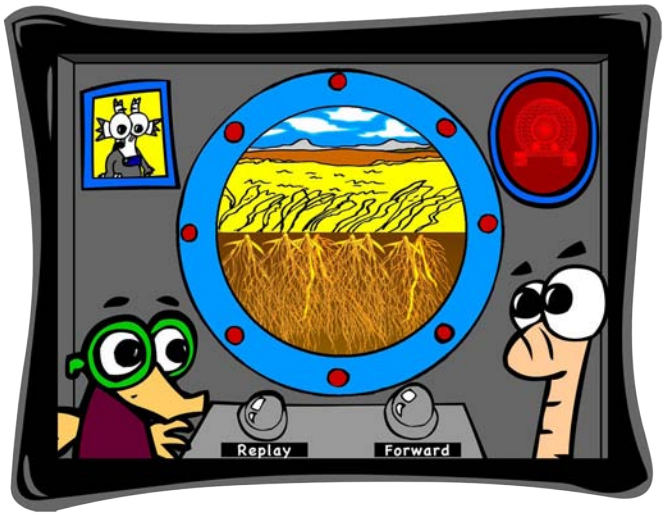
Soils and the Woodland In the woodlands, soil supports several layers of plant li:fe, from the tallest trees to the flowers, ferns and mosses that make up the undergrowth. It may come as a surprise to learn the root systems for a particular plant below ground can cover a larger area than the plant above ground, even if the plant is a large tree. The roots of some plants, known as taproots, can go deep down into the soil, even to many metres, Some other plants keep their roots near the surface but have many branches through which they prospect the soil. When next you are in a woodland see if you can find some of the roots of plants, or see the roots of trees that may have fallen over.



Soils and the Garden Growing vegetables and flowers year after year in the garden depends on the soil being maintained in good condition. Good gardeners look after their soil and ensure that there are enough nutrients and water in it and that it has a good structure to allow plant roots to move through it. Because vegetables are grown year after year in the same soil, it is necessary to add fertiliser to make sure the soil has enough nutrients to allow good quality vegetables to be grown.

Why not ask your parents, or someone who likes gardening, to take you to look at garden soils and let them tell you about the wonderful things soils can do.

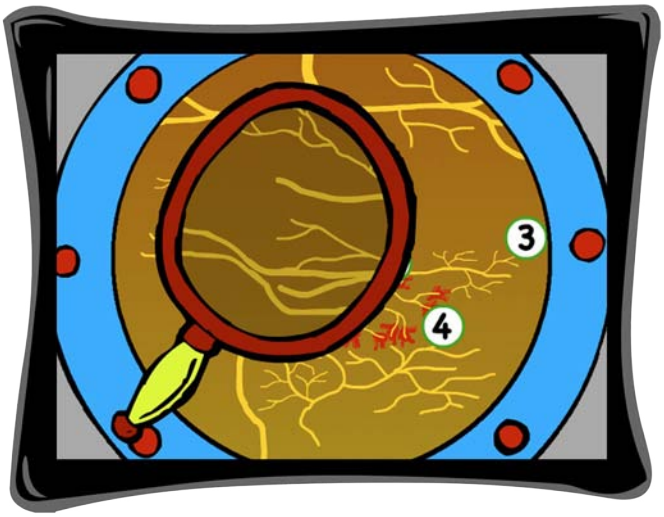
Soils and the Farm Like the gardener, the farmer has to look after the farm soils very carefully and ensure that they are well supplied with water and nutrients for the crops to grow year after year.Soils contain some eighteen essential nutrients that will be needed by the crops that are being grown. Farmers use fertilisers and farmyard manure to maintain the right levels of nutrients in the soil. To ensure good yields of crops there needs to be enough water in the soil. In countries where there is plenty of rainfall this is not a problem but in drier climates it is necessary to top up the soil water by irrigation.



When next you have a farm visit be sure to ask the farmer to tell you about the farm soils and what they can grow.

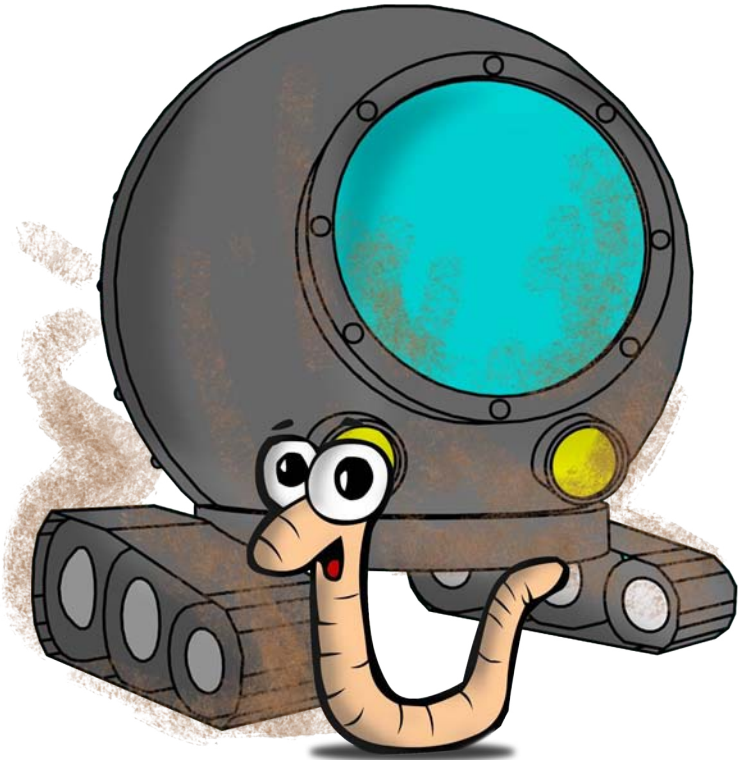
Plants Under the Microscope

The rooting structure of plants is extremely important in ensuring the health of plants. In some soils the total length of roots below a plant can run to several kilometres as they prospect the soil for water and nutrients. Most plants have not only their roots but the roots themselves have many root hairs. It is the important responsibility of these root hairs to prospect for food and water for the plant. Mycorrhiza is an important fungus that occurs in soils. It plays an important part in the transfer of nutrients from the soil to the plant via the roots.



Why not? www.soil-net.com

Wherever possible have a look at soil under the microscope or with a magnifying glass and examine plant roots.



Additional Points www.soil-net.com

Most plant roots occur in the upper half metre of the soil. This is where most of the nutrients are held. The organic matter, which comes from the decay of plant material and soil organisms in the top layer of the soil, is the source of many nutrients which are cycled time and time again to maintain the fertility of the soil. Other nutrients are inherited from the rocks and sediments on which the soil forms. These are then prospected for by the deeper roots of the plants. Some nutrients, termed macronutrients, are needed in very large quantities while others, the micronutrients, are need in much smaller quantities. All are important in creating a fertile soil. It is part of the magic of soils that even in natural and semi-natural situations, e.g. woodland, soils can continue to support plant life year after year.

Soils are cultivated worldwide to produce food for the fast growing world population. There is an important responsibility to look after our soils so that they can continue to do this for future generations.

Topic 12: Soils of England and Wales

Introduction Although you may think there are just one or two types of soil in Britain you would be wrong. Britain has over 700 different types of soil which is a lot considering its small size compared to many countries. The reason for this is that it has a wide range of rock types and quite a varied climate. There are examples of rocks in Britain from all the geological periods going back two billion years. As we have seen conditions in which the rocks formed throughout time varied greatly, from hot sub-tropical through to the frozen barren wastes of the Ice Age, and this variety of rocks and sediments has become the parent material of the soils of Britain. The annual rainfall, a major factor in soil formation, varies from as little as 250 mm in southeast England to over 2000 mm in northwest Britain and the mountains of Wales. This diversity of rocks and climate is the main reason why there are over 700 different types of soils here. Other factors such as vegetation, landscape, time and the influence of man have also influenced soil formation.

Soil Classification

(i) Just as we have classified plants and animals and given them names, so we have classified soils. The classification of soils is much more recent and the names given to soils are not as well known.

(ii) There are several levels to the classification of British soils. There are just 10 major groups of soils in Britain but at the most detailed level which is used when making detailed maps of soils throughout the country there are over 700 types of soil.

(iii) Here, we shall just introduce you to some of the10 main types of soil. This will give you some idea of the difference between the soils of Britain

Brown Earths

(i) The brown earth is one of the most widespread soils in Britain and is the 'type' soil for the temperate world climatic zone in which Britain lies.

(ii) The soils are characterised by a dark brown surface layer called the A horizon which contains most of the organic matter. Below this is a brown layer called the B horizon, and further down is the parent material which may be rock or sediment.

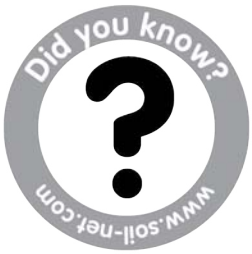
(iii) The brown soils are generally quite deep, well drained, fertile soils, good for farming, and most of British agricultural production depends on these soils.

Gley Soils

(i) These are the most widespread soils in Britain. A typical feature of the soils is the mottled appearance of their B horizon. This is due to the fact that the soils are periodically waterlogged and suffer from lack of oxygen, which changes the form of iron in some parts of soil. Hence the mottled appearance.

(ii) There are two main types of gley soils: the surface water gley in which, because of their mainly clayey texture and limited large pores, rain and snow melt are held up in the upper layers of the soil causing waterlogging.

(iii) The other main type of gley soil is the ground water gley. These are poorly drained soils like the surface water gley soils above but differ from them in that the wetness is due to a high water table, which rises to near the soil surface in the winter time. This cause waterlogging and a lack of aeration. These soils occur on the floodplains of rivers.



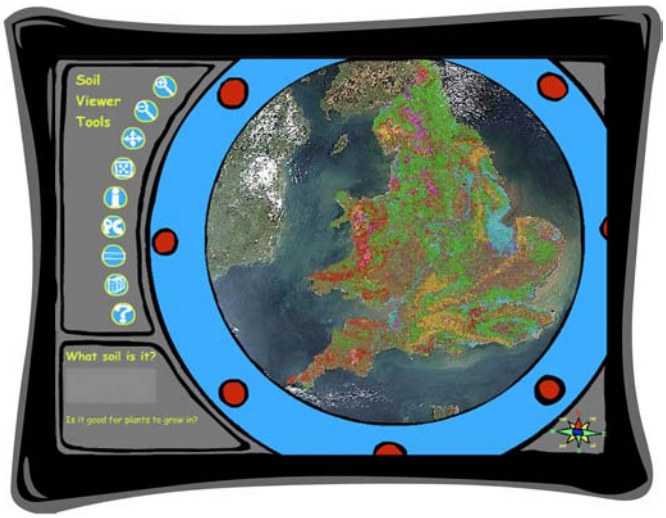
A gley soil is one that is periodically waterlogged during the year, mainly in winter and spring when there is the wettest weather, and this sets up chemical processes which give the soils a mottled appearance. Both types of soil can be productive agricultural soils but they need to be drained artificially to remove surplus water.

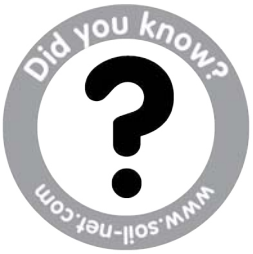
Podzols

(i) The word is of Russian origin and is used to describe the whitish upper layer in the soils from which soil constituents have been leached and redeposited further down in the soil. This soil type is typical of those formed in the colder, northerly regions that stretch from northern Britain across Scandinavia to Russia.

(ii) The soils are among the most acid soils in Britain. They are strongly leached soils and devoid of many nutrients particularly in the upper layers of the soil. Their B horizons have layers of humus, iron and sometimes aluminium washed down from the upper parts of the soils.

(iii) In Britain there are two main types: (a) the humus-iron podzol typical of the more lowland heaths and coniferous forests and (b) the peaty gleyed podzol with a thick topsoil of peat, which is typical of many upland areas of Britain.





(Like the brown earths the podzols occur in a zone across North America and Europe. They are more acid and impoverished than most brown soils and low in nutrients. When next you are in a coniferous forest or on a heathland, look to see if you can find these soils).

Organic Soils

(i) These are unique soils in that most of the soil profile is composed of organic matter rather that mineral matter and have been formed of the breakdown of plants rather than rocks.

(ii) There are two main types in Britain which are put to very different uses. The lowland Fen soils are extremely fertile and are much sought after for agricultural and horticultural purposes.

(iii) The other main type is the upland organic soils which have formed as a result of waterlogging under the high rainfall climate. They are generally acid soils and this combined with the wet upland climates means that they are not used for growing crops. Heather, sedges and mosses are the main vegetation.

When next you are walking in the uplands, like those in Wales and Scotland, you should have no difficulty in finding the peaty soils.

Other Soils of Britain

(i) There are several other main soil types in Britain. These include the salt marsh soils and the dune soils that are formed around our coastal edge. These tend to be immature soils because they are changing regularly as the tide comes in or the wind blows the sands from around the sand dunes.

(ii) Shallow soils are a feature of steep slopes that we find on our hill and valley sides. It this position there is constant, usually gradual, movement of materials downslope so the soils are usually shallow, with just topsoil lying on rock. The two main examples are the rendzina on chalk or limestone and the ranker on more acid rocks like those in Wales and Scotland.

(iii) The remaining two soils we need to know about in this summary of the soils of Britain are the pelosol and manmade soils. Pelosols are heavy clay soil formed on clay sediments which allow rather better drainage than that in gley soils. Humans have had a strong influence on some soils through their industrial and agricultural uses and in a few instances have strongly modified the original natural soils as to require to be classified separately.

(When next you go to the seaside look out for dune soils and even salt marsh soils. Be careful with the latter though because the tide comes rapidly in.)

Soils of England and Wales

Fantastic Facts!

These are immature soils that form on dunes around the coast of Britain.

www.soil-net.com

Did You Know?

They are poorly developed soils because the dunes on which they form are regularly moving due to strong coastal winds.

www.soil-net.com

Fantastic Facts!

They have a thin, weakly organic, layer overlying sand deposits.

www.soil-net.com

Sand Dune

Soil-net.com

Soils of England and Wales

Fantastic Facts!
Brown earths are quite deep, fertile soils.
www.soil-net.com

Did You Know?
Brown earths are one of the most widespread soils of Britain.
www.soil-net.com

Fantastic Facts!
Brown earths are mostly not too acidic and not too alkaline.
www.soil-net.com

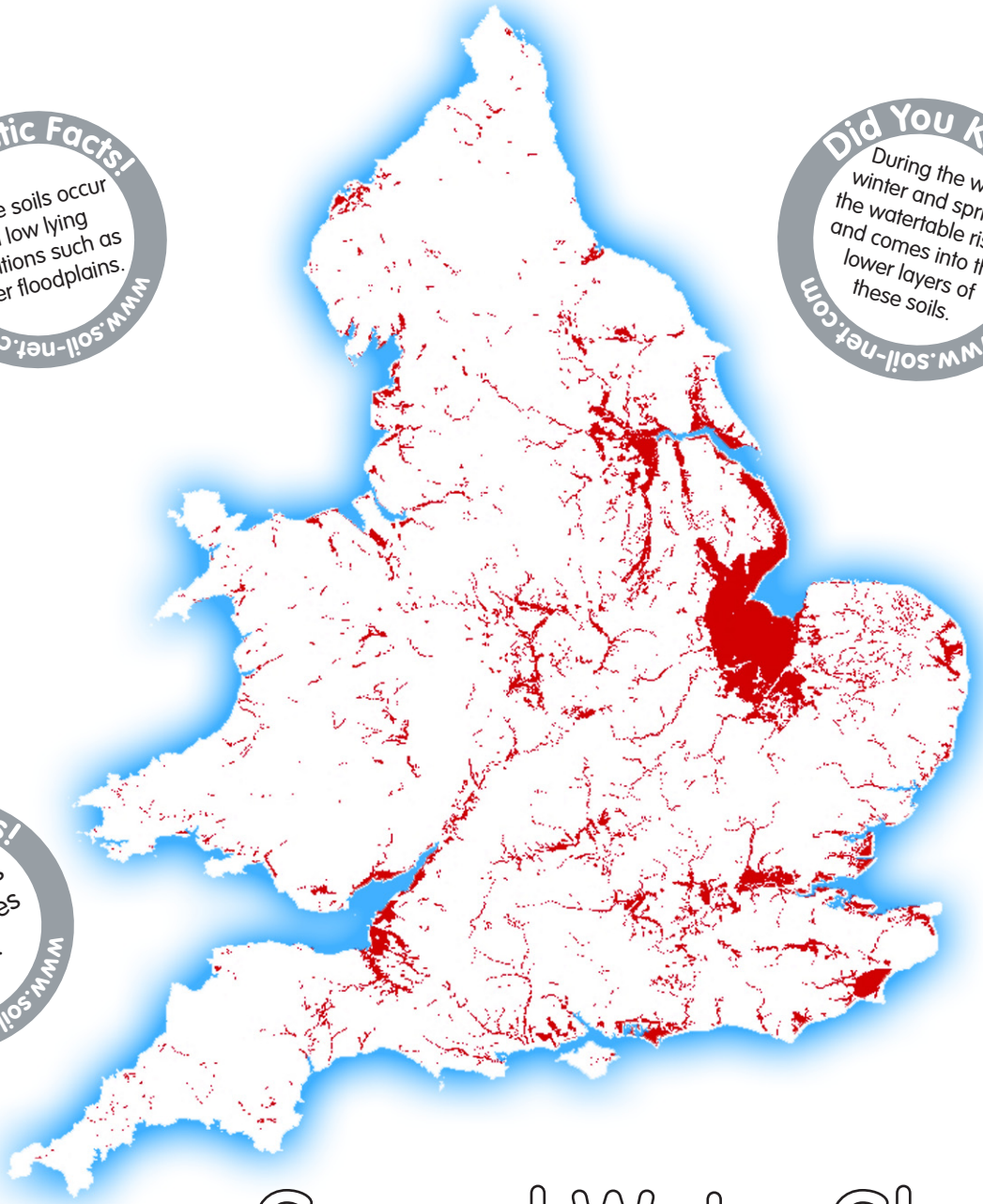
Brown Soils

Soil-net.com

Soils of England and Wales

Fantastic Facts!
These soils occur in low lying positions such as river floodplains.
www.soil-net.com

Did You Know?
During the wet winter and spring the watertable rises and comes into the lower layers of these soils.
www.soil-net.com



Fantastic Facts!
The water fills the pores and excludes the air.
www.soil-net.com

Ground Water Gleys

Soil-net.com

Soils of England and Wales

Fantastic Facts!

There are a whole variety of manmade soils because industry and mining have mixed up soils and created others.

www.soil-net.com

Did You Know?

They differ from the more natural soils by lacking clearly defined, naturally formed, horizons.

www.soil-net.com

Fantastic Facts!

These soils need to be used with care as some may be polluted.

www.soil-net.com

Man Made Soils

Soil-net.com

Soils of England and Wales

Organic Soils

Fantastic Facts!
Whereas most of our soils are mineral soils, organic soils are dominantly of organic matter.
www.soil-net.com

Did You Know?
The lowland varieties, often called Fen Soils, are the most fertile soils in Britain.
www.soil-net.com

Fantastic Facts!
The Fen soils grow wonderful crops of vegetables and cereals.
www.soil-net.com

Soil-net.com

Soils of England and Wales

Fantastic Facts!
These are clayey soils that are better drained than the gley soils.
www.soil-net.com

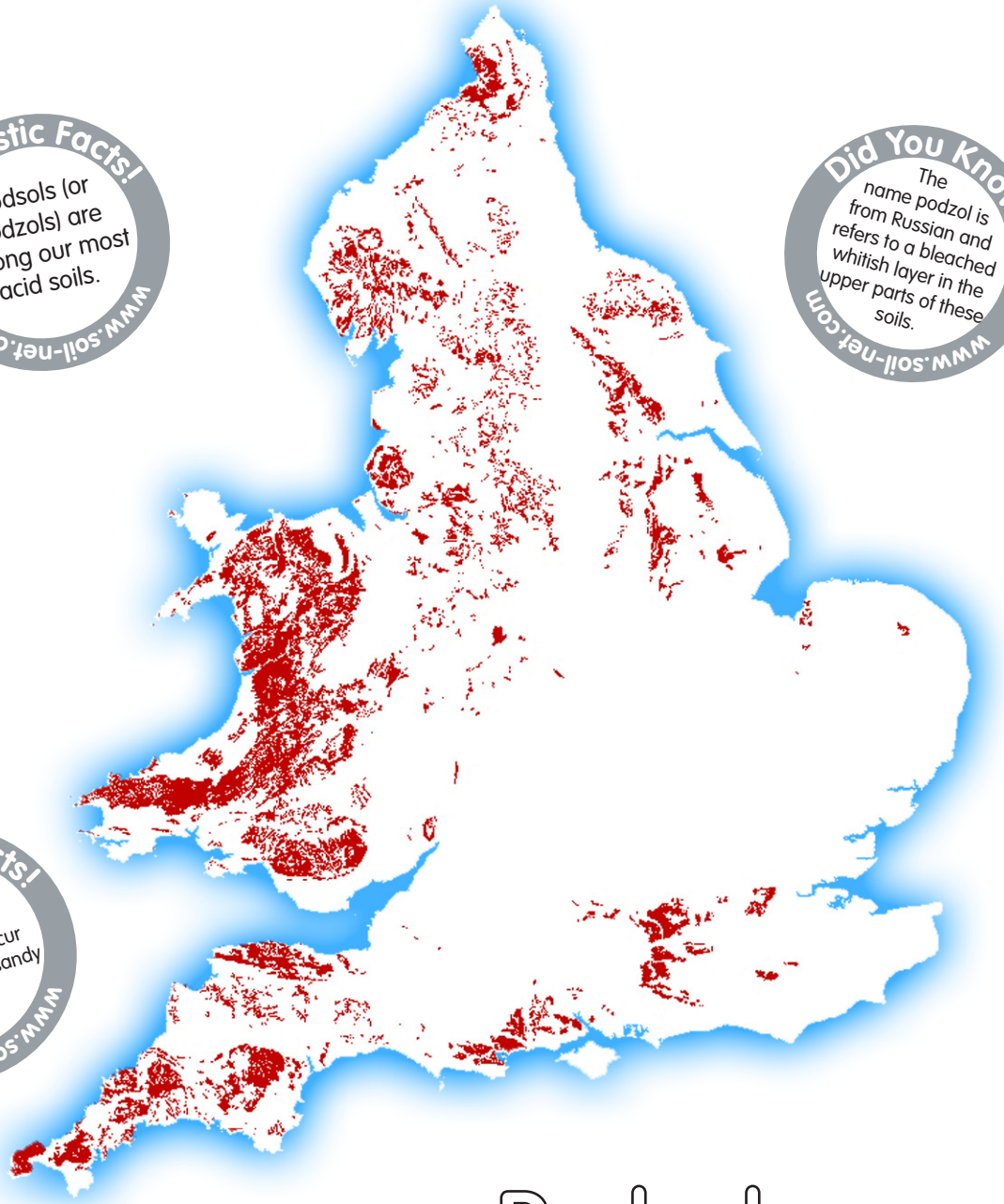
Did You Know?
They are good fertile soils and many are used for agriculture.
www.soil-net.com

Fantastic Facts!
They crack deeply as they dry out in summer which can be a problem when building on them.
www.soil-net.com

Pelosols

Soil-net.com

Soils of England and Wales



Fantastic Facts!
Podsols (or podzols) are among our most acid soils.
www.soil-net.com

Did You Know?
The name podzol is from Russian and refers to a bleached whitish layer in the upper parts of these soils.
www.soil-net.com

Fantastic Facts!
They are typical soils of colder regions and occur mainly on acid sandy deposits.
www.soil-net.com

Podzols

Soil-net.com

Soils of England and Wales

Fantastic Facts!

These are the acidic equivalent of rendzinas.

www.soil-net.com

Did You Know?

They form on acid rocks mainly in the uplands.

www.soil-net.com

Fantastic Facts!

Being acid they do not have a very varied flora.

www.soil-net.com

Ranker

Soil-net.com

Soils of England and Wales

Fantastic Facts!
These are shallow soils on chalk or limestone.
www.soil-net.com

Did You Know?
They develop on steep slopes and are immature soils because erosion of materials downhill means they are always underdeveloped.
www.soil-net.com

Fantastic Facts!
The A horizon is black or can be more greyish if mixed in with much chalk.
www.soil-net.com

Rendzina

Soil-net.com

Soils of England and Wales

Fantastic Facts!
These are coastal soils that are subject to inundation by seawater daily or at seasonal high tide.
www.soil-net.com

Did You Know?
Because they are regularly covered by seawater they are wet soils and experience the same gley processes as in true gley soils.
www.soil-net.com

Fantastic Facts!
They vary greatly in texture, from sandy to clayey, depending on what the sea deposits.
www.soil-net.com

Salt Marsh

Soil-net.com

Soils of England and Wales

Surface Water Gley

Fantastic Facts!
The term gley is used for soils that are temporarily waterlogged during the year.
www.soil-net.com

Did You Know?
The term 'surface water gley' is used to describe soils that have impeded drainage in the upper horizons so that winter rain has difficulty draining away.
www.soil-net.com

Fantastic Facts!
The soils have a dense layer below the surface which stops water moving through.
www.soil-net.com

Soil-net.com

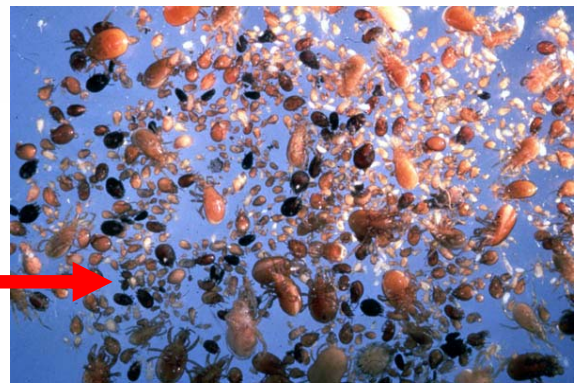
Soil Biodiversity

Soil-net.com

Soil biodiversity is amazing!

For example, in a 1 m by 1 m piece of garden soil you might find…

- 100 species of worms (earthworms, nematodes, enchytraeids)
- 100 species of mites and collembola
- hundreds, even thousands, of species of bacteria and fungi)



For every type of organism present, there will be many different species. The variety and numbers of creatures that live in the soil is mind-boggling!

For example, you can find all these different species of collembola…

Did you know…?

All animals that live in the soil have a job to do…

1. **Building soil structure**
2. **Nutrient cycling**
3. **Protecting plants against diseases and pests**

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Earthworms

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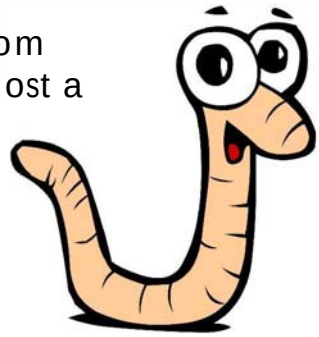
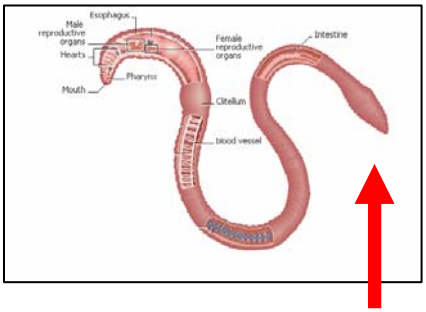
•Earthworms range in size from several millimetres up to almost a metre in length!

•There are 28 species of earthworm in the UK





An earthworms mouth is at the pointed end. Earthworms do not actually have any eyes, but can sense changes in light with their body

Earthworms eat plant remains and ingest soil organic matter in various stages of decomposition together with microorganisms associated with this material

Earthworms create tunnels by burrowing. These tunnels help improve soil structure which in turn helps plant growth by aerating the soil, and drainage of water

Earthworms are very helpful creatures to have in the soil!

Did you know…?

Worms fertilize the soil with their castings (poo), which contain the recycled nutrients from the food they eat

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Foundations

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Why don't trees fall over?

They stand so tall, they sway in high wind. So why don't they blow over...?!

It's all in the soil!!

Just like you can't build a house without foundations, a plant cannot stay upright without similar support.

So how does soil keep them upright?

- Soil provides an **anchorage** for trees and other plants that grow above ground.
- Roots grow down and through soil throughout the life of a plant – they are the plant's foundation!
- Without the possibility of a root network a plant couldn't grow tall and strong

Soil allows roots to grow through it

As plants grow up and out, the roots grow down and through. Different plants have different root systems – including "tap", "heart" and "flat" roots.

Soil surrounds roots and prevents them being pulled out of the ground.

One of the major roles of plant roots is to anchor the plant firmly in the soil, and prevent it being blown over.

Careful!!

This doesn't always happen. Some bigger trees can be unstable in bad weather.

Hungry Plants

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Where do plants go when they're hungry?

Nowhere. They can't move so the food comes to them...

It's all in the soil!!

Plants need nutrients just like humans do, the sun is not enough by itself. These nutrients are taken in from the soil by the roots of growing plants and carried through the roots into the growing plant above ground.

Where does plant food come from?

- Rock breakdown
- Rotting of organic matter (plants and animal bits)

In nature, nutrients are constantly recycling between soils and plants. Dead plants fall to the ground and are broken down to release nutrients, which then take part in the next cycle of growth.

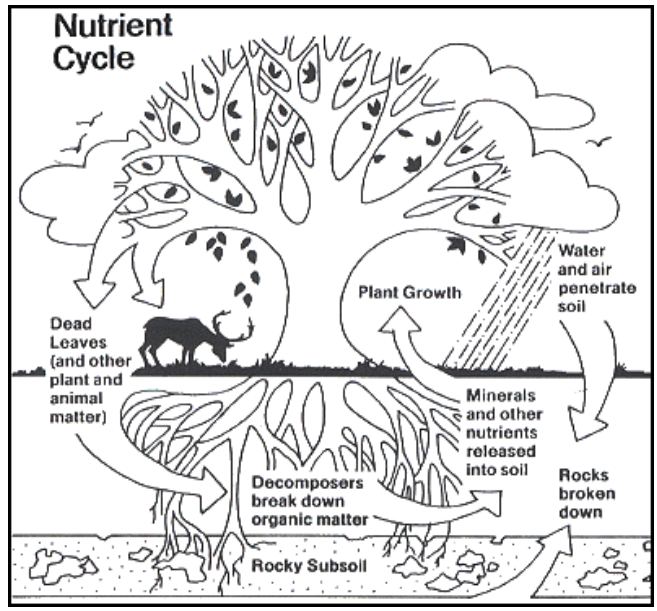
In agriculture, when the crop is harvested, most of the nutrients in the plants are also removed from the field and important recycling of nutrients is not possible. The farmer must therefore add extra nutrients to the soil.

What do plants like to eat?

There are 18 nutrients in soil that are important to plants. Like us, plants need a balanced diet and without all the nutrients they can't grow properly and may die.

Some lack **macro-nutrients** (including nitrogen, calcium, magnesium and potassium).

Some lack **micro-nutrients** (including iron, zinc, copper, and boron).



It's the "circle of life"!

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Soils that breathe

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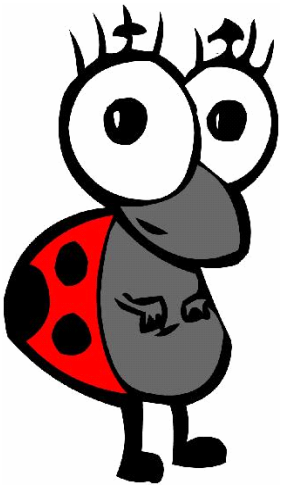
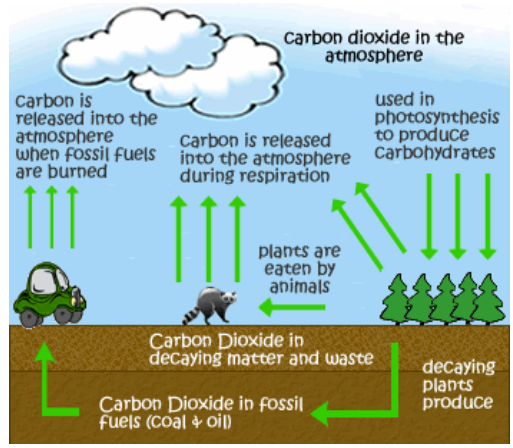
Organisms that live in soil breathe in oxygen and breathe out carbon dioxide and water vapour...



...just like us!

Soil plays a critical role in the carbon cycle...

World soils contain twice as much carbon than there is in the whole of the atmosphere and more than twice that in all the living vegetation in the world!



http://www.realtrees4kids.org/sixeight/cycles.htm

Did you know...?

The presence of carbon dioxide and water vapour can be demonstrated using the following 3 experiments...

Cobalt (II) chloride hydrate

Water vapour liberated by the soil organisms when in contact with Cobalt (II) chloride changes the colour from blue to pink

Lime water

Carbon dioxide liberated by the soil organisms when mixed with lime water forms a cloudy precipitate known as calcium carbonate

Copper (II) sulphate hydrate

Water vapour liberated by the soil organisms when in contact with Copper (II) sulphate changes the colour from white to blue

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What is soil made of?

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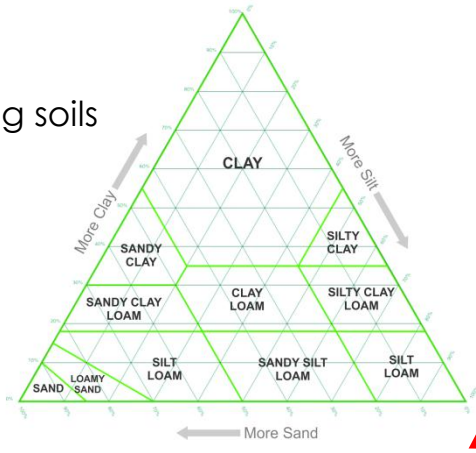
Soil is not just mud!

Sandy soils: These are light, generally free-draining soils but lose nutrients rapidly

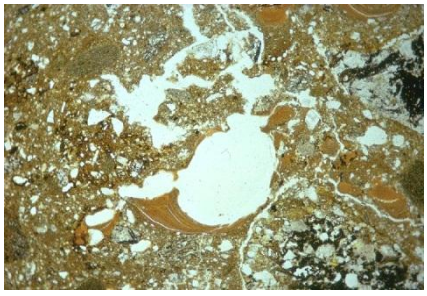
Clayey soils: These are heavy, difficult-to-work soils when wet. They hold on to both water and nutrients much more than sandy soils do

Silty soils:These tend to hold less water and nutrients than clay soils but more than sandy soils do



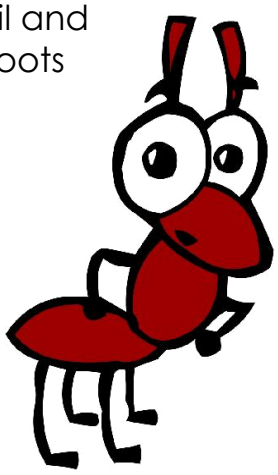
All mineral soils contain sand, silt and clay particles, but in varying proportions proportions. A **standard texture triangle** is used to decide the soil type based on the proportions of the three sizes of these mineral constituents

And there's more…!



Water: clings to soil particles and is taken up by plant roots

Air: fills gaps in soil and allows the plant roots and animals to 'breathe'



Organic matter: releases nutrients slowly as it rots and improves water holding capacity

Animals: including insects, bacteria and earthworms – these help to break down dead materials

Soil means different things to different people, but we all need to look after it!

Soil pH

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What is pH ?

- pH is a measure of the acidity or basicity of a solution
- pH depends on the activity of hydrogen ions
- The pH of soils is usually between 3.5 and 8.5

How is pH measured?

- pH can be determined using a litmus paper
- Litmus is a water-soluble dye extracted from certain lichens

Litmus (pH indicator)		
below pH		*above pH*
4.5	↔	**8.3**

Substance	pH
Hydrochloric Acid, 1M	0.1
Battery acid	0.5
Gastric acid	1.5 – 2.0
Lemon juice	2.4
Cola	2.5
Vinegar	2.9
Orange or apple juice	3.5
Beer	4.5
Acid Rain	<5.0
Coffee	5.0
Tea	5.5
Milk	6.5
Pure Water	7.0
Healthy human saliva	6.5 – 7.4
Blood	7.34 – 7.45
Sea water	8.0
Hand soap	9.0 – 10.0
Household ammonia	11.5
Bleach	12.5
Household lye	13.5
Caustic Soda	13.9

Did you know…?

The *Hydrangea macrophylla* works just like litmus paper as the soil pH determines the colour of the flowers. In **acidic** soils the flowers are blue…

but in **alkaline** soils, the flowers are pink!

Sources : Soil-Net.com/Wikipedia

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Thirsty Plants

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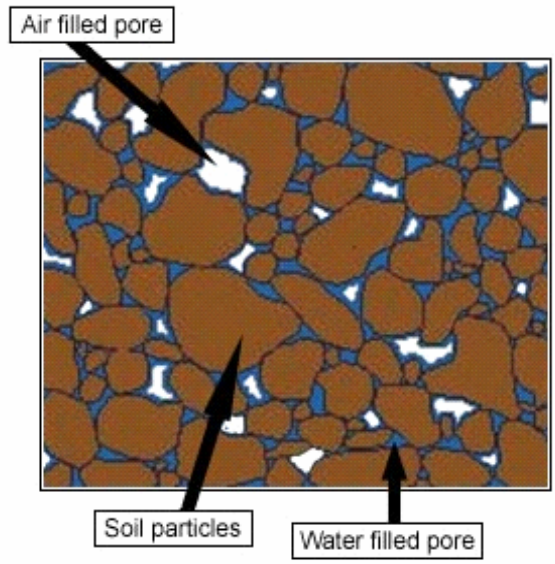
Where do plants go when they're thirsty?

Nowhere actually. They can't move so they need to be able to reach water from where they are.

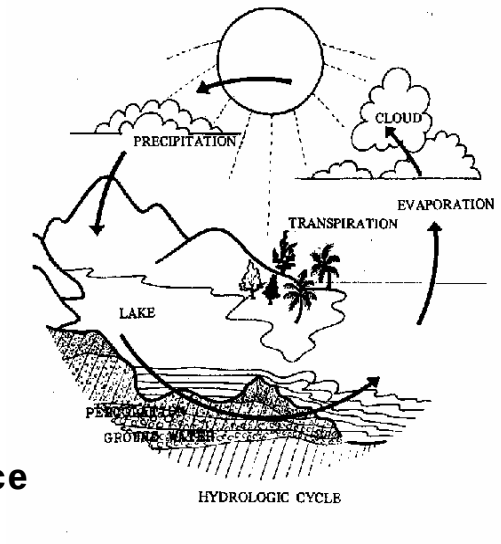
It's all in the soil!!

Water gets into soil from rain or snow. Plants produce roots that grow through soil as wide as possible so they can reach water even in dry weather.



How do the plants get the water?

Plant roots mainly take water in near the tips where there are lots of root hairs.



Soil can hold water like a sponge!

Water is held in soil in pores, with organic matter and around soil grains.

Different types of soil hold different amounts of water. Some hold too much, some hold too little, and some are just right (these are prized for gardening and food production)!

Getting the balance right

Too much water...

...requires **drainage**

Too little water...

...requires **irrigation**

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