Enviroteach

An Environmental Education Resource for Teachers

Did you know that 2015 is International Year of Soils? What a great reason to include a focus on soils within your learning programmes!

(www.fao.org/soils-2015/en)

From the Editor

This issue of *Enviroteach* focuses on soils. It provides information on the importance of soil in our lives and the crucial role it plays in our ecosystems. It explains why it's so helpful to know the properties of our soil and provides some simple methods students can use to assess soil health. It outlines key threats to our precious soil resources and practical things people can do to protect and improve soil. It offers several fun and meaningful activities students can do to support their learning.

Environment Southland's education staff are available to assist with environmental learning at your school. Please contact us if you would like one of us to talk to your class, help run a field trip, or share information or teaching resources with you.

I hope you enjoy this issue. All the best for term two!

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environment SOUTHLAND
Te Taiao Tonga

Inside this issue

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Ecosystem services

Of all the planets in our solar system, only the earth has soil. Without soil, the earth would not have developed its incredible variety of plants, animals and ecosystems.

Soil provides many ecosystem services that are essential for life on our planet including:

- physical support for plants
- nutrients for plants
- processes of decomposition
- water storage and filtering
- soil processes which form an integral part of the water, carbon and nitrogen cycles
- an ecosystem for soil organisms

Soil is part of our lives

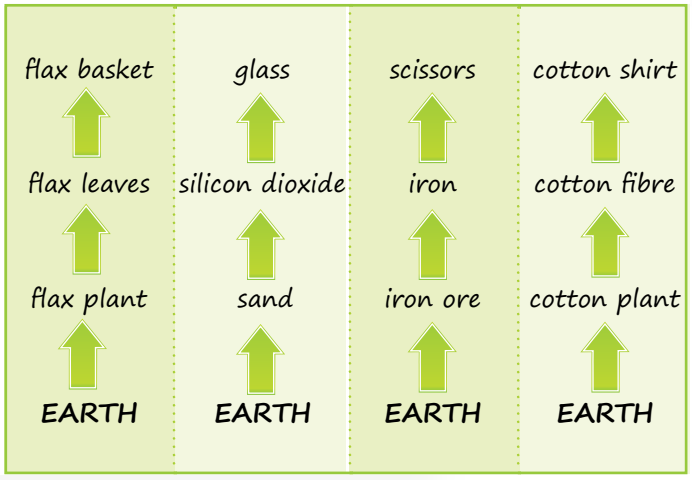
Human survival depends on soil too. No matter what we do, or where we live, each one of us will have something to do with soil every day. For example, our food crops and livestock rely on fertile soils to grow and thrive; many of the natural fibres we use for clothing, house furnishings and textiles come from plants that grow in soil; and the materials we require for building and infrastructure, such as timber, mud, sand and gravel, come from the earth.

ACTIVITY

Tracing the origin

In this activity, students trace a range of everyday items back to their original source, the earth. For example, eggs come from chickens, which eat grains from plants which grew in the earth. Challenge your students to try to think of anything that does NOT come from the earth.

Here are some more examples:



ACTIVITY

If the earth was an apple...

Did you know that less than one quarter of the earth's surface is soil-covered land? This activity demonstrates in a fun way how little of the earth's surface is available for producing all of the world's food crops.

1. Slice an apple into quarters. Set aside three of the quarters – they represent water on the earth's surface.
2. Cut the remaining quarter in half. Set aside one of the halves for uninhabited deserts, swamps and the Arctic and Antarctic areas.
3. Divide the remaining piece into quarters. Set aside three of the pieces for land that is too rocky, wet, hot or poor for crop production.
4. The remaining piece is 1/32 of the original apple. Peel this section. The peel represents the thin layer of soil that is available for producing all of the world's food crops.

(Adapted from: www.landlearn.net.au/print/apple_earth)

Soil life

Did you know that the diversity and abundance of life within the soil is greater than that above the ground? Scientists estimate that there are more individual living organisms in one tablespoon of soil than there are people on the earth!

Students can investigate microbes in the soil by building a Winogradsky column. Download instructions for this activity from www.sciencelearn.org.nz (search 'Growing soil microbes').

Soil properties

Soils are not uniform. They vary from region to region and often from paddock to paddock. All soils contain mineral particles, organic matter, water and air. The combinations of these determine the soil's properties, specifically its texture, colour, porosity, structure and chemistry. Farmers, land managers and scientists require a good understanding of soil properties in order to encourage productivity while preventing environmental impacts.

Soil texture

Texture is an easily recognisable soil property that can help people decide how to manage their soils. The soil's mineral component, which is made of tiny particles of rock, determines the texture of the soil. These particles are categorised according to their size as sand, silt, or clay. Most soils are a mixture of sand, silt, and clay. Soil texture is important because it affects the movement of water and nutrients in the root zone of plants. Clayey soils hold water and nutrients well, while sandy soils drain and dry out quickly. Farmers should make decisions about things like irrigation, tillage and what type of crop to plant based on the texture of their soil. With practise, anyone can learn to recognise different soil textures by feel. Sand feels gritty; silt feels smooth and slick; and clay feels sticky.

ACTIVITY

Soil composition

In this activity, students measure how much sand, silt and clay are present in a soil sample. Each group of students will need a soil sample, a ruler and a large jar with a tight-fitting lid. *Note: This activity will not work with potting soil because it is mostly organic matter. Remove rocks, roots and anything else that is clearly not soil from the samples and break up any large clumps before beginning.*

1. Place 2-4cm of soil in the jar, measure the level of the soil and record as "total soil".
2. Add water until the jar is ¾ full. Be sure the lid is tight.
3. Shake the jar vigorously until all the particles have been separated by the water. This takes about 2 minutes. Allow the soil to settle.
4. After 1 minute, measure the amount of soil on the bottom of the jar. Record this measurement and label as the "sand fraction".
5. Allow the sample to settle for 3-4 hours, then measure again and record the level. This second layer indicates the "silt fraction".
6. The remaining "clay fraction" may take as long as a week to settle depending on the composition of the sample. However, students can use the measurements they already have to determine the amount of clay in the soil. Clay measurement = total soil - (sand + silt).

   Organic matter will float to the surface of the water. Generally it is a small component that won't affect the measurements, but if there is a floating organic layer large enough to measure, subtract its measurement from the total soil before calculating the clay fraction and before moving on to calculate percentages.

Example:

	Measurement (cm)	Fraction	Percentage
Total soil	2	1.0	100%
Sand fraction	1	0.5	50%
Silt fraction	½	0.25	25%
Clay fraction	½	0.25	25%

Threats to soil

Many human activities have the potential to harm our soils. Throughout the world, land degradation threatens fertile land and the benefits that people derive from it.

It has been estimated that about twenty-four percent of the world's productive lands are already degraded. The consequences are alarming: food insecurity, poverty, reduced availability of clean water, and increased vulnerability of affected areas to climate change. Southland has just over three million hectares of land, twenty-three percent of which is intensively farmed and fifty-three percent that is legally protected. We need to manage our soils carefully to protect our productive lands.

Soil compaction

As farm tractors and field equipment become larger and heavier, there is a growing concern about soil compaction. Soil compaction occurs when soil particles are pressed together by a heavy weight, reducing the pore spaces between them. There are many causes of compaction, including increased use of heavy vehicles and equipment, livestock, minimal crop rotation and raindrop impact. Soil compaction reduces the soil pore volume, resulting in less space for water and air in the soil. This leads to reduced infiltration of water and air, and increased resistance to root penetration. This in turn can decrease the plant's ability to take up nutrients and water. Compaction can reduce crop yields by as much as fifty percent.

Non-compacted soil

Compacted soil

ACTIVITY

Water percolation

In this activity students compare how long it takes for water to percolate through compacted and normal soils. They will need two equal-sized aluminium cans with both ends removed, 2 x 250ml measuring cups containing water, a hammer, a wooden board and two stopwatches.

Place one can in an area of compacted soil, e.g. a footpath, and the other in an area where the soil is not compacted, e.g. the garden. Place the wooden board on top of the first can and use the hammer to tap the can about 2cm into the soil. Remove the board. Repeat with the second can. When both cans are in place, get two students to pour 250ml of water into each can at exactly the same time. Start the stopwatches. After a few minutes, check the cans. Is one draining faster than the other? How long does the water take to drain away completely? Ask students to record their results and explanations. Discuss how compaction of soil could affect its ability to perform all of its functions.

Other threats

Other threats to soils include:

- erosion – caused by activities such as overgrazing, deforestation and growing crops on sloping land
- contamination – e.g. by wastewater
- depletion of organic matter and nutrients – caused by activities like deforestation, burning, monocropping and draining of wetlands
- sealing – i.e. permanent covering of soil with urban infrastructure
- climate change - expected to cause changes to weather patterns around the world which will affect soils in all kinds of ways.

A soil's susceptibility to these threats depends on its parent material, its structure and the surrounding landscape.

River bank erosion

Slips often occur on hill country after heavy rain or prolonged wet weather. The risk is increased when land has been cleared of bush.

ACTIVITY

Threats to soils in your community

Are there areas in your school or community where you can observe some of these threats to soils?

1. Make a map of your school grounds or community and indicate where you observe these threats.
2. Talk to experts at your local city or district council, local government, or national government about ways soil can be more sustainably used and managed.

Soil health

Soil health is an assessment of how well soil is able to perform all of its functions. Indicators of soil health include physical, chemical and biological indicators.

Here are some simple activities students can do to learn about the properties of soil and soil health. These can be done either in the school grounds or on a field trip.

ACTIVITY

Visual soil assessment

Visual soil assessment involves digging up a 20 cm cube of soil, comparing the soil to sample photos and assigning a score (poor, moderate or good) for different indicators. The VSA Field Guide contains all the information necessary to carry out VSA (www.landcareresearch.co.nz/publications/books/visual-soil-assessment-field-guide). Contact Environment Southland if you would like one of our education officers to assist you and your class with a VSA. (Call 0800 76 88 45 or email education@es.govt.nz).

Alternatively, visit the Science Learning Hub to download instructions and handouts for a simplified VSA (http://sciencelearn.org.nz/Contexts/Soil-Farming-and-Science/Teaching-and-Learning-Approaches/Visual-soil-assessment).

ACTIVITY

Soil pH

Soil pH is a measure of how acidic or alkaline the soil is. Most vegetables grow best if the soil pH is between 6 and 7. Checking the pH level of your vegetable garden soil is a good idea. If the pH is lower than 6, you may need to add lime before planting.

For this activity you will need a 35ml plastic vial with a screw-on lid; an pH indicator strip with a colour chart; and water (preferably deionised – but tap water will suffice). Collect approximately 100g of topsoil from the garden or pasture. Air-dry the sample under shade for a week. Place the sample in a plastic bag and crush with a rolling pin. Remove any stones. Place a lid-full of your soil sample in the vial. Add 15ml of water. Screw the lid onto the vial. Shake to mix thoroughly. Leave to settle for 30 minutes. Shake again and allow the suspension to settle for 30 minutes. Dip the pH strip into the soil solution and leave for 1 or 2 minutes in the solution. Remove the strip from the solution and compare the colour against the colour chart. Record the pH.

ACTIVITY

Clover and nitrogen fixation

All living things need nitrogen to grow. Some plants have the ability to fix atmospheric nitrogen and convert it into nitrogen compounds that the plant can use to grow. Most plants with this ability are legumes. This group includes clover, lupin, kōwhai and broom. The nitrogen-fixing process is carried out by bacteria which live inside nodules on the roots of the plant. When the plant dies and decomposes, the nitrogen compounds fertilise the soil. This is an important part of our planet's nitrogen cycle. It has been estimated that approximately 1 million tonnes of nitrogen are fixed annually in the legume-based pastures of New Zealand.

In this activity, students collect clover plants and examine the colour inside the root nodules to determine whether they are fixing nitrogen. Visit the Science Learning Hub to download instructions (http://sciencelearn.org.nz/Contexts/Soil-Farming-and-Science/Teaching-and-Learning-Approaches/Clover-and-nitrogen-fixation).

What can you do?

There are many things you can do to protect and improve your soil.

For example:

Enrich the soil with compost

- The composting process encourages the growth of beneficial micro-organisms in the soil (mainly bacteria and fungi) which break down organic matter to create humus. Humus improves poor soil by increasing nutrient content and moisture retention.
- Compost helps to prevent soil erosion.
- Compost reduces or eliminates the need for irrigation and chemical fertilisers and promotes higher crop yields.
- Compost has the ability to clean up certain types of soil contaminants.
- If more people in Southland composted their organic materials instead of putting them in the rubbish bin, we would extend the life of our regional landfill, and reduce the production of methane and leachate.

Cover exposed soil with mulch

- This helps to retain moisture, suppress weeds and reduce temperature fluctuations in the soil.

Protect the soil from erosion

- Plant suitable groundcovers and shelter belts.
- Prevent or minimise soil erosion in hill country by planting trees on slopes.

The beautifully mulched garden at Garston School

Below – Shelterbelts help to reduce soil erosion.

Resources for teaching and learning about soil

Wednesday 17 June

Environmental Education Workshop for teachers

Do you enjoy environmental education? Would you like to know more about the resources, programmes and opportunities that are available to support environmental education in Southland?

Then come along to Environment Southland's workshop for primary school teachers on Wednesday 17 June.

To book your place phone (03) 211 5115 or email education@es.govt.nz.

Further details will be confirmed closer to the date.

Science Learning Hub

(http://sciencelearn.org.nz/Contexts/Soil-Farming-and-Science)

This website offers loads of free, quality assured teaching resources to support school science learning.

The Value of Soil video

(www.youtube.com/watch?v=403sT9CGRl0)

This is a five-minute animated video on the economics of land degradation. It is informative and entertaining, and presented in a very clear and interesting way.

This video is best suited to students who have already been introduced to concepts such as productivity, sustainability, soil degradation, non-renewable resources, ecosystem services, unsustainable land management practices and climate change).

It has been produced by the Economics of Land Degradation Initiative (http://www.eld-initiative.org/), a global initiative for sustainable land management.

Soils Challenge Badge

(http://yunga-youth.weebly.com/soils.html)

This booklet is packed with activities to help you learn about soil and how it is formed, the creatures that live in it, and just how important it is in our everyday lives. You will also discover how YOU can play a role in protecting soils for future generations.

This guide has been written to support International Year of Soils 2015, World Soil Day (5 December 2015), the World Day to Combat Desertification (17 June 2015), the United Nations Decade on Biodiversity (2011-2020), and the United Nations Decade for Deserts and the Fight Against Desertification (2012-2020).

The World Association of Girl Guides and Girl Scouts (WAGGGS) and the World Organisation of the Scout Movement (WOSM) endorse this educational badge framework for use by guides and scouts around the world, adapting it as necessary to their local needs and requirements.