Forest Soils

Nº. 7

PRIMARY

Science

LESSON SUMMARY

To investigate the structure and formation of soils.

FORESTS ONTARIO

Focus on Forests

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Activity Information

Estimated Duration: Two 45 minute periods

Materials: Magnifying glasses, microscopes, large glass jars, potting soil, sand, gravel, bean seeds, camera (optional).

Setting: Indoors/Outdoors

Key Vocabulary: Soil, horizon, humus, bedrock, organic, inorganic.

Teacher Background

The Soil Ecosystem

Soil particles, sand and bits of rocks act as host to a thriving community of organisms. Life within the soil varies in size from tiny bacteria to large burrowing mammals and massive tree roots. It is a community of living plants and animals and a set of non-living elements such as rock, air, temperature, water and mineral particles operating in 24-hour darkness.

Like other ecosystems such as a pond, a field, or a forest, the soil ecosystem is made up of two basic parts: the living and the non-living. All living things in the soil community (plants and animals) are influenced by each other and by the non-living elements such as temperature, moisture, and nutrients. Similarly, the environment is affected to an extent by living plants and animals. These interactions can become very complex, for everything is in some way connected to everything else.

The base of all soil lies in the rocks that make up our planet. As they weather and erode, tiny rock fragments such as grains of sand accumulate in sheltered areas. But soil is much more than a layer of dry lifeless sand. There are three other very important elements: organic matter, water, and air. Soils differ according to the proportions of these elements they contain.

Air Air makes up approximately 25% of the soil. It is important because it contains life-sustaining oxygen. The amount of air available depends on the amount of water in a particular soil, because both occupy the pore spaces between soil solids. Increasing the proportion of water (after a heavy rain for instance) will squeeze out the air in the pores. After the rain, downward percolation of water and evaporation from the surface layers will allow air to seep back into these spaces.

Water Water also constitutes about 25% of the soil and is also an extremely important part of the soil mix. It holds dissolved nutrients required by plant roots. Water moving down through pores in the soil is also responsible for percolation of dissolved substances from the upper layers of soil to the lower ones. This leaching process dissolves, removes and mixes the minerals available in the soil. Water and its passenger minerals can also travel upward from lower levels by capillary action. Evaporation from the soil surface draws water up through the pores.

Mineral Matter Mineral matter comprises about 45% of soil. Mineral matter refers to the inorganic portion of soil that is derived from the physical and chemical weathering of the original parent rock into regolith (weathered parent material), and subsequently, into soil. Consequently, the mineral composition and properties of the mineral matter such as pH and texture are reflective of the parent rock from which it was derived. For example, the calcitic and dolomitic bedrock in much of southern Ontario has created the alkaline soils that often occur in the area.

Organic Material The remaining 5% of the soil consists of organic material composed of dead plants and animals, fungi, molds, bacteria and the by-products of their decay. Most organic materials enter the soil at its surface (fallen leaves, dead branches, animal droppings). Bacteria, fungi and animals living in the soil decompose these materials and obtain their food and energy requirements from them, and finally return smaller pieces of organic matter back to the soil environment.

The Soil Profile The best way to study soil is to dig a pit. Exposing the vertical walls in the pit will clearly display the different 'layers' of soil called a soil profile. The layers are different in colour, texture, thickness and chemical properties. Generally soil profiles will have at least three distinct layers or horizons. On top of the profile, a loose-packed layer of dark-coloured humus is often found. The humus is made up of decomposed plant and animal material.

Sample Soil Profile

A Horizon The top horizon in the profile is called the 'A' horizon and is commonly known as topsoil. The most active layer, it is undergoing the fastest chemical and physical changes and has the greatest amount of plant and animal activity. It is generally black to dark brown because of its humus content.

B Horizon The second zone or 'B' horizon is mineral soil which accumulates organic compounds that filter down from 'A' horizon above. Organic compounds are converted into inorganic compounds by decomposers. It often has a distinctive brownish colour and a definite chunky structure.

C Horizon The third zone or 'C' horizon is composed of more or less weathered rock, the parent material for the mineral or sandy part of the soil.

ACTIVITY

Step 1 If possible, take the students to a site where an excavation is going on. Observe the layering in the soil. Draw sketches or take pictures.

Step 2 Alternatively, in an appropriate spot, dig a soil pit to a depth of 50cm and observe the profile. Collect some material from near the top and the bottom of the pit and place in separate jars. NOTE: Digging soil pits can be very destructive to the environment. The students should not be allowed to attempt this.

Step 3 From the observations, ask the students to describe the soil. Introduce the term 'horizon'. On a chalkboard or experience chart paper, draw a diagram of a soil profile as shown in the Teacher Backgound section.

Step 4 Develop an understanding of the materials found in each horizon. Explain the difference between organic and inorganic materials. Use magnifying glasses or microscopes to study the soil samples collected from the pit.

Step 5 Discuss how soil develops under a forest canopy. Where would the organic matter come from? (Answer – From the decay of the fallen leaves and branches.) Where would the inorganic material come from? (Answer – From the breakdown of bedrock or sand and clay washed into the area.)

Extension

Create a model of a soil profile in a glass jar. Place a layer of gravel in the bottom (the C horizon). Next, mix a small amount of dry potting soil with dry sand and pour the bean seeds in the jar so that they are up against the glass.Water sparingly so that you do not drown the seeds. Cover the jar with black paper. Place in sunlight and allow it to grow for two weeks. At the end of that time remove the paper to observe the root structure. Where are the roots growing? Do the roots grow down into the C horizon?