COOPERATIVE EXTENSION SERVICE • THE UNIVERSITY OF MARYLAND

SOILS
UP FROM THE SOIL
ORIGIN AND IMPORTANCE OF SOIL

4-H 315

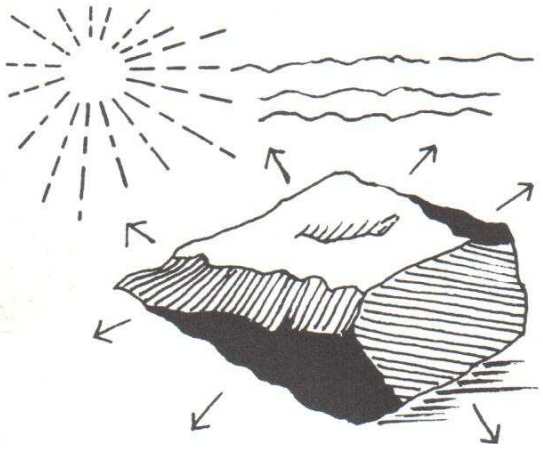
Soil is one of the most important natural resources that we possess. Even though it is commonplace, it has not been adequately studied by most people. Most of us must learn something of the soil's origin and properties if we want the soil to continue to do the best job of growing plants for food and fiber.

Soil has three important functions in plant growth:

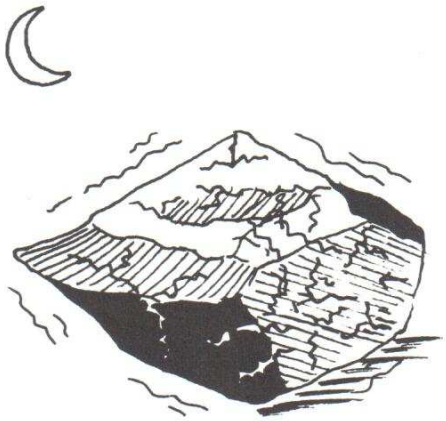
1. It is a vast reservoir of minerals which supply the nutrients needed by plants for growth.
2. It provides a storage place for much of the water that plants use.
3. It provides mechanical support for plants; it holds them in place.

Where did the soil come from? Many millions of years ago, the earth was a mass of hot molten rock and gases. As the earth cooled, the rocks and minerals were crystallized. Some of the hot gases cooled to form our atmosphere and others condensed to form water. Millions of years of heating and cooling, wetting, drying, and the forces of wind and water gradually have changed the rocks into a thin layer of soil on the surface of the earth's crust.

These are some of the weathering forces which are continually acting upon rocks and minerals to form the soil.



Rocks expand when heated by the sun during the day.



Rocks will contract or shrink as they cool during the night. Alternate expansion and contraction eventually causes rocks to crack.

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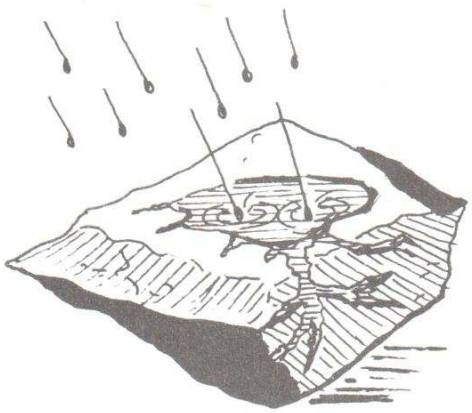
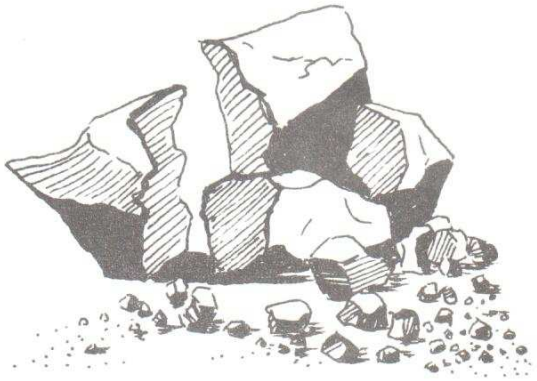
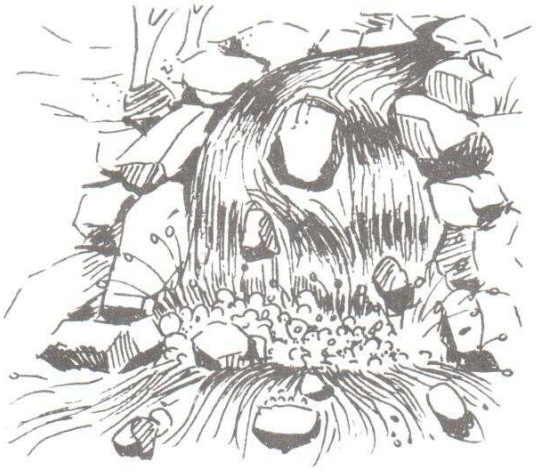


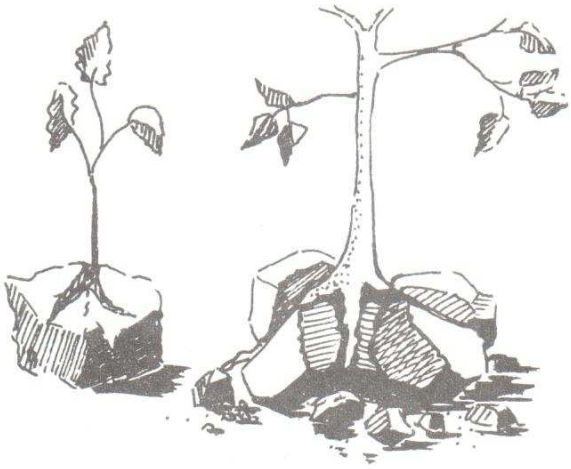
Water accumulates in cracks and freezes.



Expansion of ice in the cracks breaks rocks apart. Alternate freezing and thawing breaks rocks into smaller and smaller pieces.



The force of flowing water in streams grinds and breaks rocks into fine particles.



Plants growing in cracks of rocks cause the rocks to split into smaller pieces. As roots grow larger in the cracks, the pieces of rock are forced apart.

Wind and rain combine the forces of moving air and water to "weather" rocks into particles small enough to be called soil.

Water dissolves some of the rocky material from the ground surface and deposits it in a crystalline form in the subsoil. Some clays are formed in this manner.

As time passes, the weathering processes (physical, chemical and biological) continue to reduce the size of rock and mineral particles until soil is formed. These soil particles vary considerably in size, and can be classified into three groups--sand, silt and clay.

The coarseness or fineness of soil particles is called "texture". The manner in which soil particles are held together in groups is known as "structure". These properties will be studied in later lessons.

Experiment

Some of the physical weathering processes which ultimately result in soil formation can be demonstrated with a few simple treatments.

1. *Grinding or abrasion.* Find the fairly soft stones, such as limestone or sandstone. (If you cannot find natural stone, a couple of bricks or pieces of concrete will do.) Rub them together briskly and notice the fine particles which are formed. Also, notice the relatively long period of time required to form just a few particles.

2. *Heating and cooling.* Heat a piece of limestone over a flame or on a hot plate. Be extremely careful not to burn yourself. Drop the rock quickly into a pan of water with a pair of tongs. The rock should break or crack as it contracts (shrinks) after expanding from heat. (An adult should be present to help with this.)

3. *Freezing and thawing.* Fill a small discarded paper milk carton with water. Cap tightly and place outdoors (if winter) or in the freezer. As the water freezes, notice what happens. The ice expands and either pushes the lid off or swells the sides. The same force is at work when water freezes in the cracks in rocks.

The following experiments will demonstrate some chemical and biological forces involved with weathering.

1. *Chemical.* Obtain some vinegar from a grocery store. Vinegar contains a dilute concentration of acetic acid. The acetic acid can be used to demonstrate how acids in general react to weather certain minerals.

   Obtain some finely ground high calcium or high magnesium limestone. Cover the bottom of a small dish or a jar lid with vinegar. Add a pinch of limestone. What happens? Does it fizz? The formation of bubbles is caused by a chemical reaction between the dilute acid in the vinegar and the limestone. Carbon dioxide, a gas, is evolved which escapes into the atmosphere. This chemical reaction is expressed as follows:

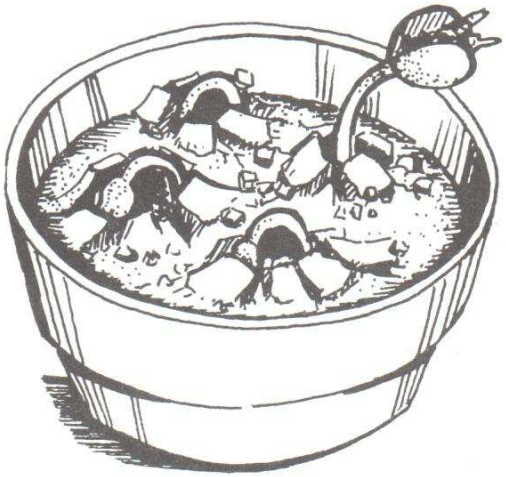
$$CaCo_3 + 2CH_3COOH \longrightarrow Ca(CH_3COO)_2 + H_2O + CO_2 \uparrow$$

or

Limestone + Dilute acetic acid (Vinegar) → Calcium acetate (a salt) + water + carbon dioxide (a gas)

   Other acids would have a similar effect on limestone.

2. *Biological.* Plant five or six bean seeds in a pot or can. Use a soil with a fairly high clay content from a cultivated field or garden, or use subsoil. Do not use soil from a lawn or pasture. Add enough water to the pot so that the soil around the seed becomes completely moist. Set aside and wait for the seedlings to sprout. As the plants come up, notice how the surface crust is broken into smaller pieces. This same process occurs when plants grow through cracks in rocks. The rocks are split up and broken by the growing plants.



SEEDLINGS BREAKING THROUGH SOIL

Summary

Write a brief paragraph describing each experiment that you have just performed. Be sure to include the purpose, your observations and any conclusions you can draw from your work.

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