What Makes Up Your Profile?

Soil Isn't a Dirty Word

Objectives

Students will be able to determine soil changes in relationship to depth.

Students will explain how soils are formed.

Materials

- overhead projector
- water
- clear plastic cup for each student
- different types of cereal
- 1/2 gallon of milk
- spoons
- sandstone or limestone
- river rock (rounded)
- 1 quart glass jar
- vinegar
- metal tongs
- ice water
- hot plate
- Soil Profile transparency
- Factors That Build Our Soil transparency

Time

Activity 1: 30 minutes
Activity 2: 30 minutes
Activity 3: 30 minutes

Getting Started

Gather materials, make necessary copies, and transparencies. Ask your students to bring in a ziploc bag of cereal, or purchase three to five different kinds of bagged bulk cereal. *Other food or nonfood items may be substituted for the cereals.* For Activity 3 you will need some sandstone. Sandstone is relatively easy to find, especially in Southern Utah. However, if you have difficulty finding sandstone, pieces of brick or concrete can be substituted.

Procedures

Activity 1 - What's Your Profile?

1. Draw a profile of one or of each student by asking them to stand, perpendicular, in front of an overhead projector. Trace their profile on the chalk board or on a piece of paper which you have taped to the screen. Explain to students that this is their profile. What do they think a "soil" profile would look like?
2. Begin with some opening questions: When you dig into the ground under the grass in your yard, you'll find soil. But what happens if you keep on digging? If you dug far enough, would you run out of soil? How far would you have to dig before you ran out? And what would you find there?
3. Using the soil profile transparency, and the background information, explain the differences in each layer of the soil profile. The video also shows many different soil profiles.

Discussion

1. Where do you think most soil life exists? Why?
2. Can a soil profile tell you how well plants might grow in that soil?

Activity 2 - Soil Profiles

1. Place the cereals brought in (or that you have purchased) on a table.
2. ***Students need to wash their hands***. They will be eating their creation. This is a good early morning activity.

3. Ask students to construct a soil profile complete with parent material, subsoil, and topsoil (based on what they have seen in the video and what you have explained from the background information, topsoils are usually darker and finer, etc.).
4. Students may want to crush the cereal to create their topsoil. Simply place the cereal in a bag or between two paper towels and they can crush it easily using their hands. Students could also mix cereals to get their desired colors and textures.
5. Allow each student to share their "profile." Then, milk acting as water, can be poured onto the cereal and students can see how pore space is taken up by the milk and how percolation occurs.
6. Pass out the spoons and *bon apetit!*

Discussion

1. Some layers in some soil profiles are difficult to see because the colors are very similar. What other ways could you determine where one layer begins and another ends? (By the amount of organic matter and rocks. (Chemical tests could also be used.)

Activity 3- Making Soil

1. Demonstrate how parent material can be broken into smaller pieces by rubbing two pieces of sandstone together over a white piece of paper. Particles of sand will fall off. (If you have enough sandstone for groups of students, they can conduct the activity on their own, with a little guidance).
2. Explain to students that you are using sandstone because it is easier to experiment with, other rocks need more force and time. Nature provides for these over time in the environment, but your school day will end in a few hours, not a few centuries.
3. Place the sandstone into some water, rub the stone with your finger. Particles come off. You could demonstrate how water running over the stone will also wash away mineral particles, but using your finger conserves water. Water erosion on rocks takes gallons of water and many years. Your school day will be over soon. Show a river rock, note the smoothness.
4. Heat a small piece of sandstone or limestone on a hot plate. You may want some safety glasses for this next part. ***Ask everyone else to stand back!*** Pick up the rock with metal tongs and quickly drop it into ice water. The rock should break or crack as it contracts after its expansion by heating. (To further demonstrate how rocks break down you could fill a small glass jar with water, cap it tightly, and the place it in a freezer. Be sure to put the jar in a bag so pieces of glass won't be all over the freezer.)
5. Put some small pieces of limestone or sandstone in a little vinegar. Heat the vinegar on a hot plate and notice how bubbles form on the pieces of stone. These bubbles are carbon dioxide gas caused chemically by the acid in the vinegar. If you continued this process for a long time the entire stone would gradually break down.

Discussion

1. How long does it take to make soil?
2. What factors help to make soil?
3. Is soil a renewable resource?
4. What kind of chemicals or acid might be in the soil to break down rocks?

Background

If you dug deep enough, you would hit solid rock. This is called bedrock. But before you got there you would have to dig through three or four different layers of soil (the profile). The layers are often referred to as horizons. The first horizon or layer is usually darker in color and contains most of the organic matter. Organic matter is the layer formed by plants and animals. In Utah, and the western U.S.A., in general, we have less organic matter and in many rocky places it may be nonexistent. In an area where there is more moisture and plant life you will find a deeper layers of organic matter. The first layer of soil is called ***topsoil***. The topsoil is where plants take root and grow. For good reason, this is where plants can absorb water, nutrients (minerals), and air (carbon dioxide).

Minerals come from rocks. Minerals have several different ways of getting into the soil. Sometimes they come from volcanic eruptions. Usually the minerals come from rocks that have broken apart. Water from rain flows into the cracks of rocks. When the water freezes, it expands and causes the cracks in the rocks to get bigger and little bits of the rock break off. Sometimes the roots of plants will grow into "soft" rock and cause them to break. Water and wind carry the tiny bits of rock along until they get trapped by the soil. You can see how weather and climate (physical forces) can play a big role in the development of soils. Chemistry also plays a role in developing soils. Many rocks are broken apart by lichens–tiny "crusty, coral-like" plants (green, orange, gray, etc.) that live on rocks. Lichens secrete an acid that dissolves some minerals. Also organic matter is acidic. When water and organic matter mix, they form a slightly acidic solution that breaks down rocks in the soil, like the vinegar in Activity 3. That is why soils in the eastern United States are more acidic than soils in the west. They contain more organic matter. Eastern topsoil are also generally deeper. Organic matter is good for plants, it keeps topsoil in its place, keeps soil particles together, retains soil moisture, and speeds up soil formation. It takes between 100 and 500 years for just 1-inch of topsoil to form depending on the type of rocks and climate.

In Utah, our topsoil depths range from 1-12 inches. However, topsoils can be several feet deep depending on their location. Because our topsoils are so shallow, farmers, ranchers and others who are charged with caring for the land, must use practices that conserve topsoils and hold them in their place. Soil is considered a ***nonrenewable*** resource because it takes them so long to form. Topsoil is the thin line or layer that sustains life.

If enough of the topsoil blows or washes away we are left with ***subsoil***. The subsoil is the layer below the topsoil. It is usually lighter in color and less productive than topsoil.

Minerals here are not in a form that are easy for plants to use. The subsoil is mostly made up of clay or sand and has very little organic material. Plants grow poorly in subsoil. That's why farmers must work hard to conserve their topsoil.

Between the subsoil and the ***bedrock*** is a layer of small rocks that have started to break off the bedrock. This layer is called the ***parent material*** of the soil. That is because most of what makes up the soil was once part of the rock.

Vocabulary

bedrock: a more or less solid rock, may be beneath the soil or at the surface (Zion National Park)

nonrenewable resources: limited natural resources that cannot be replaced.

parent material: layer in the soil that contains broken up pieces of bedrock.

subsoil: the layer of horizon of earth below the topsoil.

topsoil: fertile upper layer of soil which is rich in organic matter.

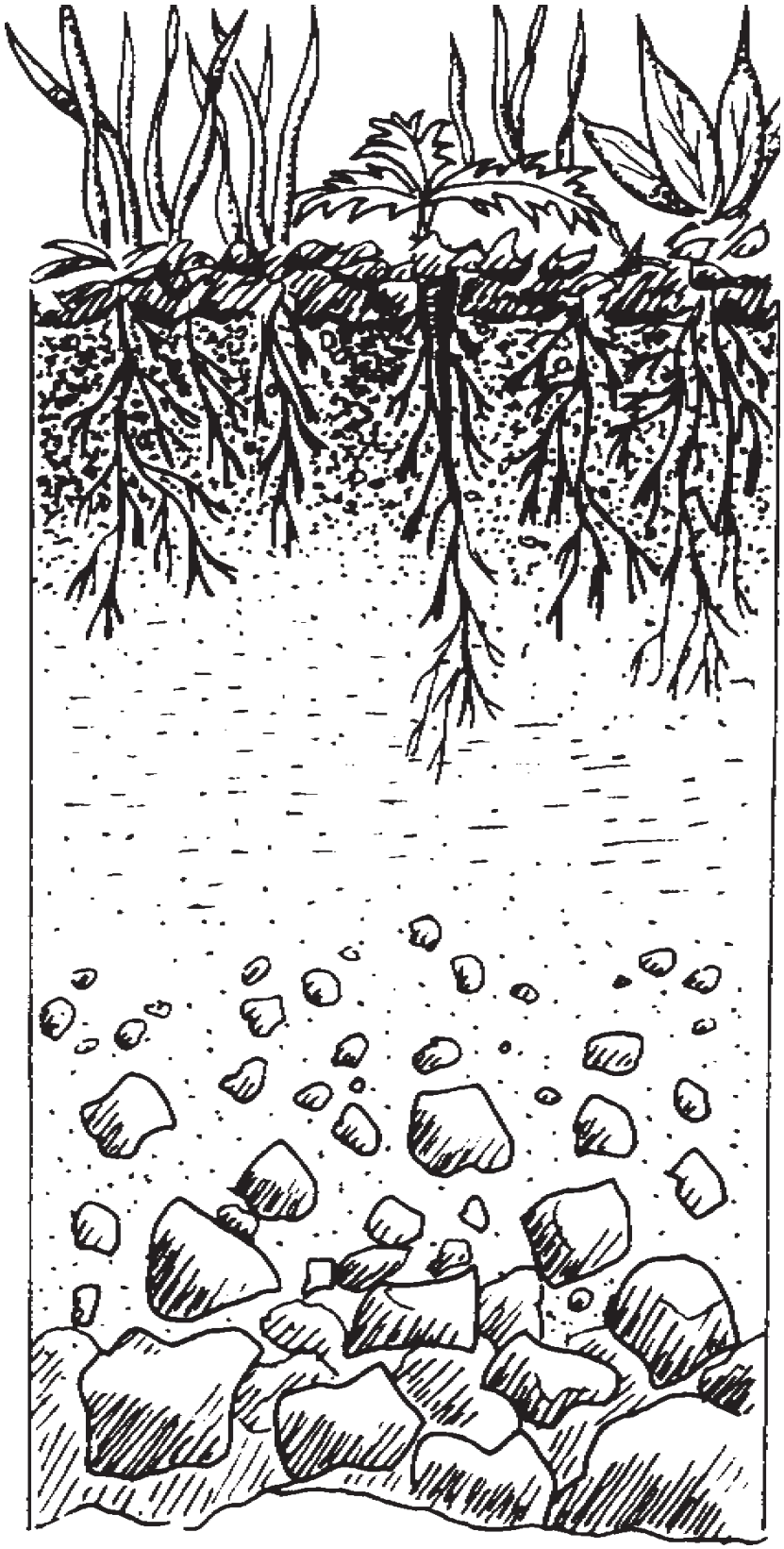
Soil Profile

Organic Matter

Topsoil

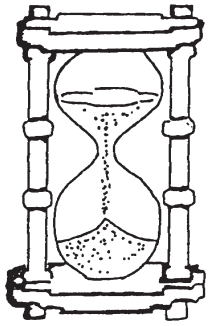
Subsoil

Bedrock

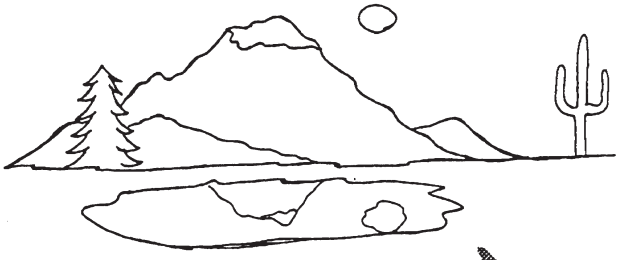


Factors That Build Our Soil

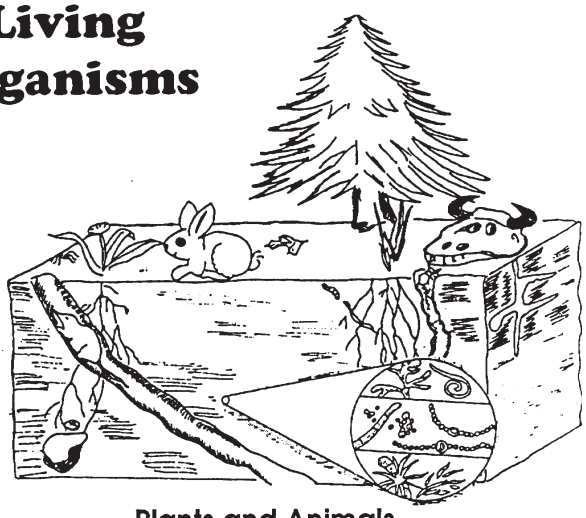
Time



Lay of the Land

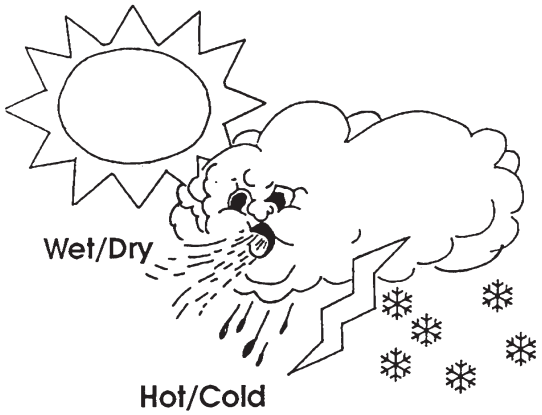


Living Organisms



Plants and Animals

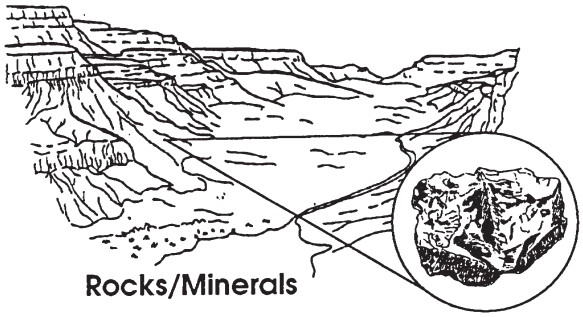
Climate



Wet/Dry

Hot/Cold

Parent Material



Rocks/Minerals