

Soil is Alive

DESCRIPTION: The student will identify and record information about the characteristics of organic matter found in a soil sample.

LEARNER OUTCOME: The students will be able to describe the relationship between the soil and the plant and animal life found there.

SUBJECTS: Biology, Life Science.

SKILLS: computation, description, discussion, listing, observation.

DURATION: one class period.

GROUP SIZE: small groups.

SETTING: indoors or outdoors.

"...Take just the top inch of soil, the world squirming right under my palms. In the top inch of forest soil, biologists found 'an average of 1,356 living creatures present in each square foot, including 865 mites, 265 springtails, 22 millipedes, 19 adult beetles and various numbers of 12 other forms...' Had an estimate also been made of microscopic population, it might have ranged up to two billion bacteria and many millions of fungi, protozoa and algae—in a mere teaspoonful of soil."

*Annie Dillard, Pilgrim at Tinker Creek,
(New York; Bantam Books, Inc., 1974).*

Materials:

- 1 soil sample for 2-3 students (each sample should fill a one gallon bucket)*
- 6 or more recloseable plastic bags or glass jars with lids for each team
- 1 large sheet of white paper for each team
- forceps for each student (optional)
- magnifying glass and/or microscope for each team
- Activity Sheet for each student
- poster paper for each student
- markers
- glue or stapler

*Soil samples can be brought from home by the students or by the teacher or obtained during an on-site field trip. Soil samples from the school site can be used. Try to obtain the samples from various locations—compacted areas, lawn, under trees, slopes, etc. Ideally, soil samples from a forest area, pastureland, badly eroded field, or soil that has been heavily influenced by chemical fertilizer could be used.

Measure off an area one-foot square and collect the soil to a depth of two or three inches. Soil samples can be examined indoors or outdoors, although if they are examined outdoors, you run the risk of small specimens blowing away. Soil samples can be transported in a heavy shopping bag or a plastic bucket to the classroom.

Teacher Background

The soil is the home of innumerable kinds of plant and animal life that range in size from those too small to be seen with a powerful microscope to large ones such as earthworms. These living organisms have a marked effect of the characteristics of the soil itself. At the same time, soil characteristics such as structure, soil air and water, pH, and how the land-operator manages the soil, all strongly affect the number of organisms in the soil.

Life that is too small to be seen without a microscope includes bacteria, protozoa, some fungi, and algae. Bacteria, one-celled, may be present to the extent of 1 to 4 billion per gram of soil. A gram of soil may contain from 8,000 to 1 million fungi, which includes molds. Soil algae may run as high as 100,000 per gram of soil under favorable conditions.

Animal life in the soil includes nematodes, and larger animals such as earthworms, ants, snails, spiders, mites, and various other worms and insects. It is only the larger animals and possibly some of the larger nematodes, that you will see in this study.

Earthworms are an important group of the larger animals. The earthworms in an acre of soil pass several tons of soil through their bodies each year and in so doing make certain nutrients available to plants. Burrows left by earthworms let water and air move more freely through the soil. Earthworms also bring soil from lower levels to the surface, thus mixing the soil. The number of earthworms may range from a few hundred to more than a million per acre.

Other animals such as rodents, ants, spiders, and insects spend all or part of their lives in the soil. The effect of these animals on the soil is beneficial for the most part. Because of their burrowing habits, a lot of soil mixing takes place. They improve soil aeration and drainage.

Soil-inhabiting plants and animals are also largely responsible for converting the nutrients in undecayed organic matter to inorganic forms that growing plants can use.

Activity

1. Divide the class into teams of two or three students. Each team should have a soil sample, activity sheets, white paper, forceps, magnifier, and plastic bags to collect data.

2. Ask the students to predict what they will find in their soil sample. Their predictions can be written on the Activity Sheet.

3. Then have the students estimate a teaspoonful of soil and set that amount aside. Read the quotation from the first page of this lesson to them. Ask if they wish to change their own predictions as to what they will find in their soil samples.

4. Describe to the students the important roles animal and plant life play in the soil. Information is found in the Teacher Background.

5. By this time, students will be eager to examine the soil samples in front of them. Students will sift through their soil samples and record on their Activity Sheet the evidence of plants and animals they observe.

(It is not necessary for students to know the scientific names of the organisms they find. A listing of the variety of life forms is what is important in this activity. But if students think they know a name of a plant or animal, be sure it is a name accepted by the whole class before using it to designate a plant or animal. Reference books could be made available to confirm names. The students may want to assign descriptive names, while understanding that the organisms have other names which are generally agreed on by the scientific community.)

6. After each team has completed their Activity Sheets and surveys, bring the teams together as a class and compare results.

7. Questions for discussion could include:

- What were your predictions for what you would find in the soil sample?
- What are some things you found?
- Did you find more or fewer animals than you thought you might?
- Which soil sample has the greatest amount of life?
- Under what conditions would you expect to find a different amount or types of animals or plants?
- What are some ways in which these things affect the soil?
- Does the amount of animal life appear to have any relation to the looseness of the soil?
- Do animal types vary with plant types?
- Does soil type appear to influence the types of plants and animals found? What evidence do you have to support your opinion?
- What other factors could influence the kind and amount of soil organisms in your soil sample?

Evaluation

Using the soil survey and Activity Sheet, have the student describe the relationships between the soil and the plant and animal life found in the soil sample area.

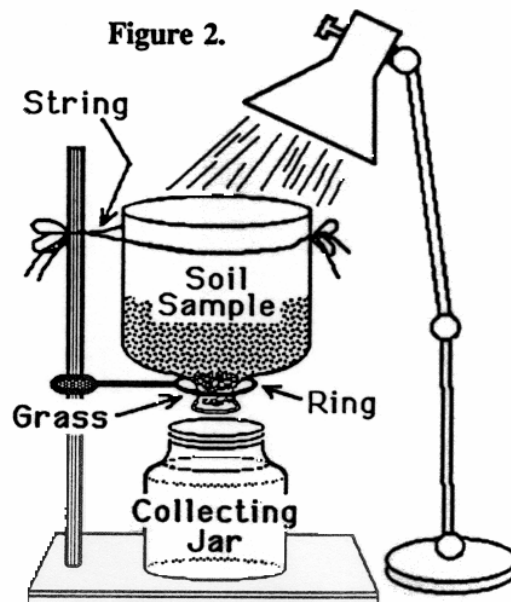
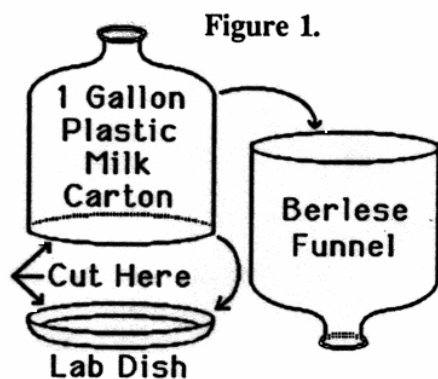
Have the student consider what would happen to the soil and plant and animal life if there was a flood, a drought, fertilizer was added, earthworms disappeared, or a new insect was introduced to the area.

Extended Activity

To take a sample of the microscopic animals in any soil, students can use a simple device called a Berlese Funnel. The construction and use are illustrated in figures 1 and 2. Samples should consist of soil taken down to a depth of about 7 inches. In principle, as the light source heats and dries the soil, the inhabitants are driven progressively deeper until they fall into the collecting jar which contains the alcohol. Placing a small bit of loose grass in the neck of the bottle helps prevent loose dirt from falling into the jar. But the grass must be loose enough to allow animals to crawl through. The alcohol will bleach the natural colors of the animals and most will appear white to tan in color.

Students can sort the preserved animals and count them. Students may also study the animals microscopically, drawing, describing and classifying with the aid of resource books. Teachers may want to prepare microscope slides for students to view and/or draw protozoa, nematodes, etc. and then have the students compare the slides or drawings with what the students have found in their soil samples.

Adapted from: *Soil - An Environmental Investigation*
by the National Wildlife Federation and
Minnesota Environmental Sciences
Foundation, Inc. 1972.



Activity Sheet A-1

Team Members' Names: _____

1. Before beginning, predict what you will find in the soil sample.

2. Place your soil on a sheet of white paper the size of an open newspaper.

3. Write a brief description of your soil sample. Include location (where the soil was taken from), color, moisture, and texture.

4. Now sift through the soil sample and record any evidence of plants and animals you observe by recording it on your animal and plant survey sheet. Your teacher will have a sample copy of one. You will need to enlarge the copy onto poster paper.

ANIMALS: As you carefully sort the soil, watch closely for small living things. Place the different kinds of animal life in separate bags or bottles. Count the animal life belonging to each of the following groups:

- 1) Worms (such as earthworms or night crawlers having no legs)
- 2) Grubs (any wormlike animal with legs)
- 3) Snails (snails without shells are called slugs)
- 4) Insects (any hard-shelled, soft-bodied, or winged [not all have wings] animal with three pairs of legs)
- 5) Spiders, mites, ticks (animals with four pairs of legs)
- 6) Animals with more than four pairs of legs (such as millipedes and centipedes)
- 7) Others (any animals not falling into one of the above groups)

PLANTS: The plant types can be sorted according to the different kinds of plants you find in your sample. Sample plants or leaves of each type can be drawn or pasted along with their count on the animal and plant survey sheet.

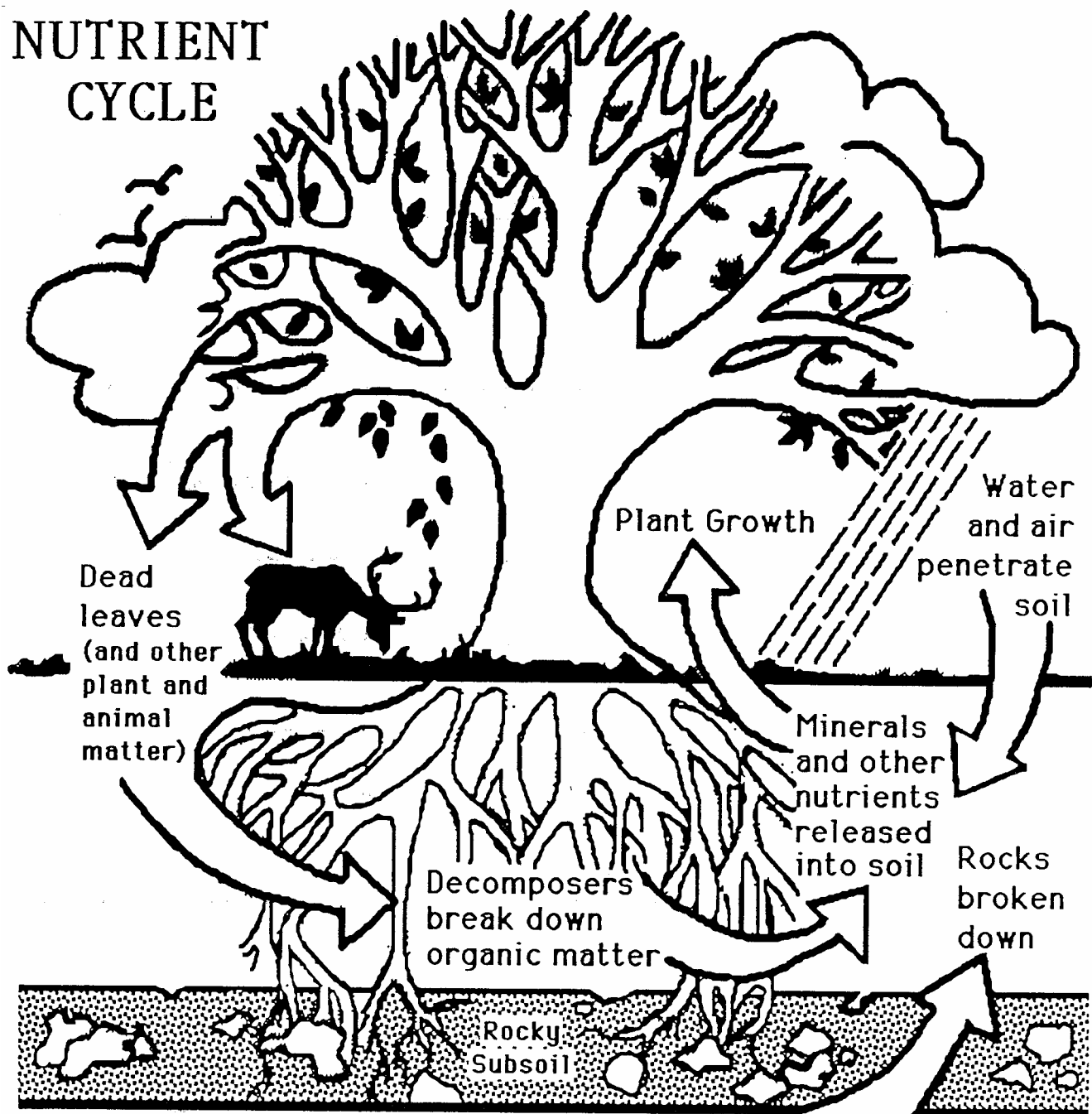
5. Now for a little math. Determine the total number of each type of animals per acre for your sample. (There are 43,562 square feet in an acre and your soil sample came from one square foot of soil.) Then compute the grand total of all the animals for one acre. What was your find?

6. As you now know, the soil beneath our feet is full of life. Many mammals such as moles, badgers, and ground squirrels use the soil to find food and shelter. Earthworms and many insects also live in the soil. As these animals burrow and tunnel, they mix the soil, allowing air and water to penetrate beneath the ground's surface. Plant roots stretch down through the soil where they absorb the air, water, and nutrients needed for growth.

In addition to these plants and animals, billions of microscopic organisms, such as algae, inhabit the soil. They, along with fungi, earthworms, and other soil creatures, play an important role in the decomposition of organic material. Decomposers help break down dead plant and animal tissue. Nutrients are returned to the soil, where they become available once again to plants.

Activity Sheet A-2

NUTRIENT CYCLE



7. On another sheet of paper, describe in your own words the cycle of nutrients found in a leaf.


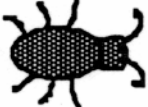

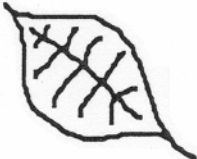
No matter how large the total number of visible animals you find in the soil, it is almost nothing compared to the number of microscopic plants and animals present in the soil.

Sample Copy
(Students will need to enlarge their survey on poster paper)

Plant and Animal Survey

Team Members _____

Location of Soil Sample _____

NAME, DESCRIPTION, OR SAMPLE	QUANTITY	POSSIBLE EFFECTS ON THE SOIL
<i>earthworm</i> 	5	<i>loosens soil</i>
	4	<i>aids decomposition</i>
 <i>grass</i>	1 <i>clump</i>	<i>holds water in</i>
 <i>leaf</i>	10	<i>nutrients for the soil</i>

Students can either draw, attach samples with glue, staple plastic bags with samples, or describe the plants and animals they have found.