

**TEACHING KATE
TEACHING KIDS ABOUT THE ENVIRONMENT**

LIFE IN THE SOIL

Grade Level: 9-12

Time Required: 4 class periods

SC Science Standards

This lesson plan was correlated with only the grade level specified unless otherwise noted.

Grades 9-12:

I. B. 1, 2, 9, 10

I. C. 3

I. C. 3. b (if organisms are classified)

Note: Meets these core standards for 7th: III. A. 2. b

Purpose

Students will observe the layers of litter, duff and soil in a forest. They will isolate and identify soil macroorganisms. Students will grow and observe microorganisms found in the soil. Students will compare organic matter to soil and describe how the process of decomposition contributes to the formation of soil. They will determine the relationship of the amount of organic matter in soil to the number of organisms living in it.

Skills

Analyzing, classifying, estimation, evaluation, graphing, identifying, interpretation, measuring, observing.

Concepts

Identification of the different layers of soil, formation of soil, how the amount of organic matter in the soil affects the number of macroorganisms and microorganisms which can be supported by that soil.

Materials Needed

Alcohol	Beaker (400 ml)
Cheesecloth	Drying Oven
Funnel	Graph Paper
Hand-held Rake	Inoculating Loop
Lamp (with 25-watt bulb)	Nutrient Agar
Petri Dishes	Plastic Bags
Ring Clamp	Ring Stand
Ruler	Soil Auger
Worksheets	Stereo Microscope

Definition of Terms

<u>Decomposition</u>	Breakdown of complex organic substances into simpler ones.
<u>Duff</u>	Litter that has begun to decompose.
<u>Humus</u>	Organic material derived from partial decay of plant and animal matter.
<u>Litter</u>	Dead plant and animal material found on the surface of the soil which has not yet begun to decompose.
<u>Macroorganisms</u>	Organisms large enough to be seen with the naked eye.
<u>Macropores</u>	Spaces in the soil structure cause by the movement of burrowing animals and by the decay of roots.
<u>Microorganisms</u>	Organisms which are too small to be seen with the naked eye.
<u>Micropores</u>	Spaces in the soil between the particles of the soil.
<u>Mineralization</u>	Conversion into mineral or inorganic form.
<u>Soil</u>	A mixture of minerals, organic matter, water and air which has a definite structure and composition.
<u>Topsoil</u>	The dark, upper mineral layer of the soil.

Before the Session

Select wooded areas where students will be able to separate the organic layer from the soil. Mark enough circular areas of 20 cm² for each group of students. Be sure these are randomly selected. Nutrient agar plates and funnel and ring stand apparatus need to be set up before Day 2.

Background Information

All living things are composed of organic material. As these organisms grow, they use organic and inorganic materials from their environment; upon their death, their organic matter is recycled to the soil. The breakdown of organic material is accomplished by decomposition and mineralization.

Microorganisms, such as bacteria and some fungi, aid in the process of decomposition. Macroorganisms, which include worms and many Arthropods, consume organic matter and leave partially decomposed products in their wastes. Some loosen the soil allowing oxygen to enter and speed up the process of decomposition.

Soil is a fairly stable environment in the number of nutrients and its temperature. The activity of organisms in the soil can increase pore space by physically moving the soil particles. This movement increases the rate of decomposition and therefore adds humus to the soil. Humus improves the soil by improving aeration and water and nutrient retention capacity. Aeration increases as pore spaces increase. A soil excellent for plant growth is composed of equal amounts of solid particles and pore spaces. The availability of soil nutrients and water as well as the pore spaces help determine the amount of vegetation that can be produced on a given site.

Suggested Lesson Plan

Day 1

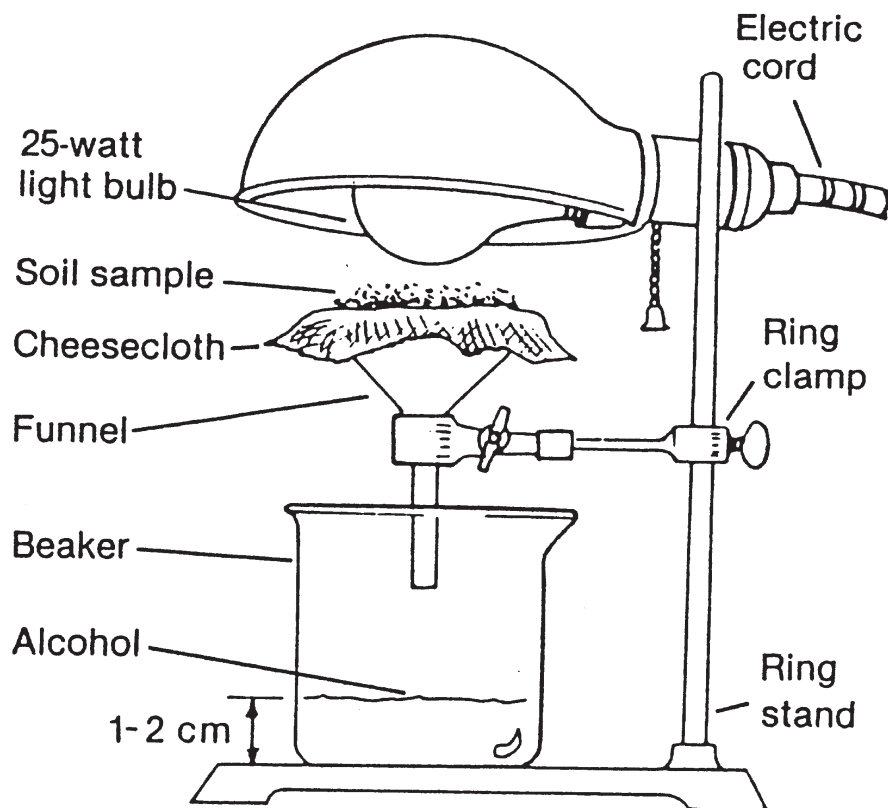
1. Introduce students to organic matter and soil. Discuss the components of these layers and what makes up a fertile soil; be sure to include how the components are useful to vegetation.
2. Take students to a wooded site and tell them to choose an area to work. Using hand-held rakes, they should carefully observe the layers of litter, duff and soil. Caution students to work slowly and carefully recording their results. Use Worksheet 1, "Identification of Layers."

Day 2

1. Students will work at the prepared 20 cm² area circles. Using a ruler, measure height of the organic layer and record.

2. Using auger get a sample of soil; measure height of the sample and record. Put sample in a plastic bag and return to the laboratory.
3. Set aside two small portions of sample. Examine remaining sample removing coarse litter and noticeable organisms such as worms, sow bugs and insect larvae. Record on Worksheet 2.
4. Line a funnel with cheesecloth and add large soil sample. Position ring clamp holding the funnel under the lamp so that the bulb is approximately 30 cm above the soil level. (See diagram).

Diagram of Funnel Apparatus



5. Leave apparatus set up for 24 hours. The heat and light from the lamp will force the organisms to move downward away from the heat and light. Eventually, the organisms will fall from the funnel into the alcohol which will kill and preserve the organisms.

6. Take first small sample and dry in the oven.
7. Use the other small sample to make a soil suspension in water. Streak onto a nutrient agar plate. Place in a warm dark location.

Day 3

1. Obtain dried soil sample and weigh. Record weight. Saturate sample with 3% hydrogen peroxide and allow to sit.
2. Remove organisms from beaker by pouring the alcohol through a filter. View these organisms through a stereomicroscope and identify them using reference materials. Record data.
3. View Petri dishes and count the number of colonies present. Record information on the Worksheet. If no colonies have started to grow, students may want to observe for a few more days.
4. Place small soil sample saturated with 3% hydrogen peroxide back in the oven to dry.

Day 4

1. Remove small sample from oven and reweigh. Record. Compute the percentage of organic material.
2. Discuss with students the results of their findings. Make sure that the calculations have been done correctly. Graph class data of number of organisms found versus amount of organic matter.

Note

Soil composition usually consists of approximately 5% (range can be 1-12+%, depending on soil) of organic matter.

Application

Earthworms are excellent aerators of soil. They tunnel through the soil ingesting it as they move. They incorporate organic material from the soil and leave their wastes in tube-like forms called castings. Their tunnels loosen the soil and become air pockets for plant roots.

The earth's atmosphere is abundant in nitrogen, and plants need nitrogen in order to grow. The problem is that plants cannot use the gaseous nitrogen. Bacteria in the soil "fix" the nitrogen so that it is made useful for plants. This process is called nitrogen fixation.

Extension

Classification of organisms can be incorporated with this unit. Students could even draw the different macroorganisms they find.

Resources Available

Biology. 1989. T. M. Brittain and G. Courts. Prentice-Hall, Englewood, New Jersey.

Project Learning Tree. 1993. American Forest Foundation, Washington, D. C.

Elements of Ecology. 1992. R. L. Smith. Harper-Collins Publishers, New York, N. Y.

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ORGANISMS IN THE SOIL

WORKSHEET 1 — IDENTIFICATION OF LAYERS

Name:

Date:

Group:

I. Table

Layer	Thickness	Description

II. Questions

A. What kinds of materials make up litter? _____

B. What kinds of materials make up duff? _____

C. What materials make up soil? _____

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ORGANISMS IN THE SOIL

WORKSHEET 1- IDENTIFICATION OF LAYERS
TEACHER'S GUIDE

Name:

Date:

Group:

I. Table

Layer	Thickness	Description
Litter	Answers will vary	Answers will vary, but should include color, texture and compactness
Duff	Answers will vary	Answers will vary, but should include color, texture and compactness
Soil	Answers will vary	Answers will vary, but should include color, texture and compactness

II. Questions

A. What kinds of materials make up litter?

Answers will vary — pine straw, leaves, dead animal, insects, twigs, etc.

B. What kinds of materials make up duff?

Answers will vary — should include the above but in an advanced stage of decomposition.

C. What materials make up soil?

Organic material, minerals, and possibly sand, silt, and/or clay

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ORGANISMS IN THE SOIL

WORKSHEET 2

Name:

Date:

Group:

I. Organisms Present

Name of Macroorganism	Number Present

II. Results of Agar Streaks

Organism	Number Present

III. Percentage of Organic Material

A. Height of organic layer _____

B. Height of sample _____

C. Organic material present _____

$$\frac{\text{Height of organic material}}{\text{Height of sample}} \times 100$$

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ORGANISMS IN THE SOIL

WORKSHEET 2 — CONTINUED

Name:

Date:

Group:

D. Original weight of dried sample _____

E. Weight of sample after treatment _____

F. Organic material present _____

$$\frac{\text{Weight of } D - \text{Weight of } E}{\text{Weight of } D} \times 100$$

G. Total percentage of organic material _____

IV. Questions

A. Using your results, explain whether soil organisms form an ecosystem or not.

B. Legumes contain nitrogen fixing bacteria in root nodules. Of what value are these bacteria to the soil and the legumes?

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ORGANISMS IN THE SOIL

WORKSHEET 2
TEACHER'S GUIDE

Name:

Date:

Group:

I. Organisms Present

Name of Macroorganism	Number Present
Answers will vary, mainly worms and arthropods	

II. Results of Agar Streaks

Organism	Number Present
Answers will vary, count separate colonies of bacteria and fungi	

III. Percentage of Organic Material

A. Height of organic layer _____

B. Height of sample _____

C. Organic material present _____

$$\frac{\text{Height of organic material}}{\text{Height of sample}} \times 100$$

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ORGANISMS IN THE SOIL

WORKSHEET 2
TEACHER'S GUIDE — CONTINUED

Name:

Date:

Group:

D. Original weight of dried sample _____

E. Weight of sample after treatment _____

F. Organic material present _____

$$\frac{\text{Weight of } D - \text{Weight of } E}{\text{Weight of } D} \times 100$$

G. Total percentage of organic material _____

IV. Questions

A. Using your results, explain whether soil organisms form an ecosystem or not.

Answers will vary — but should include food chain.

B. Legumes contain nitrogen fixing bacteria in root nodules. Of what value are these bacteria to the soil and the legumes?

The bacteria add nitrogen to the soil. The increased nitrogen enables the plants to make their necessary proteins.