TEACHING KATE
TEACHING KIDS ABOUT THE ENVIRONMENT

Soil Organisms

Grade Level: 9 - 10 **Time Required: Five 50-minute class periods.**

SC Science Standards

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

I. A. 2.
I. B. 2, 9
II. D. 3. b
II. D. 4. b

Also applies to the following standards:
Grade 7:
III. A. 2. a-b

Purpose

Students will collect soil samples from various sites with different conditions. They will isolate the macroorganisms from these soil samples and will classify them using a dichotomous key. Students will compare how differing soil conditions affect the number and variety of organisms in the soil and will illustrate and analyze trends using techniques of graphing of variables and controls.

Skills

Analyzing, classifying, comparing, evaluating, graphing, identifying, interpreting, measuring, observing.

Concepts

Identifying characteristics of soil organisms, effect on soil fauna of changes in microclimate, determinants of soil microclimate.

Materials Needed

rubbing alcohol
cheesecloth
funnels
lamps (25 watt bulb)
petri dishes
ring clamps
rulers
forceps
graph paper
worksheets
beakers (250 mL)
thermometers
plastic bags
ring stands
magnifying glass
stereo microscope
dichotomous keys

Definition of Terms

Annelid	Any organisms of the phylum Annelida that have segmented, worm-like bodies.
Arthropod	Any organisms of the phylum Arthropoda that have jointed limbs and body, usually a chitinous shell.
Berlezie funnel	Apparatus for collecting macroorganisms from a matrix by applying heat and light to one side of the sample and driving them through and down into a funnel where they fall into a killing solution.
Decomposition	The breakdown of complex organic substances into simpler ones.
Insect	Any organism of the class Insecta of the phylum Arthropoda with a well defined head, thorax, and abdomen, three pairs of legs, and typically one or two pairs of wings.
Larvae	Independent, immature stage in animal development following emergence from the egg.
Litter	Dead plant and animal material found on the surface of the soil which has not yet begun to decompose.
Macroorganisms	Organisms large enough to be seen with the unaided eye.
Nematode	Any organism of the phylum Nematoda characterized by an unsegmented, worm-like body.

Soil	A mixture of minerals, organic matter, water, and air which has a definite structure and composition.

Before the Session

Obtain the materials in the materials list and have available for the students to set up their funnel apparatus. Ensure that there are enough outlets available and that there is enough counter space available where the setups will not be disturbed. Check the electrical capacity of lab tables where apparatus will be left set up to ensure there is sufficient amperage available. Select 4 sites on the school campus with different soil conditions. Mark areas large enough that each group will be able to take a sample from a 25 cm^2 area within the designated site. Ensure that the entire site has uniform soil conditions of moisture, vegetation, light, exposure, etc.

Background Information:

Virtually all life on Earth depends on the soil, either directly or indirectly. The soil of an area determines the plant life in that area and thus determines the animal life of that area. In turn, the organisms of an area help to determine the characteristics of the soil. This may be in the form of larger animals disrupting the soil or leaving organic rich droppings. On a smaller scale, but perhaps more importantly, the fauna living in the soil help to determine the soil characteristics and the species of organisms present which are, in part, determined by the environmental factors of the area. These environmental factors may include the amount of rainfall on and humidity of a soil, the temperature of the soil, the amount and type of vegetation growing in the soil, amount of sunlight striking the soil, and many other factors, some biotic and some abiotic.

"Soil is not just an abiotic environment of plants. It is teeming with life – billions of minute animals, bacteria, and fungi. The interaction of the abiotic and biotic make soil a living system." (Smith, 1990). The higher soil organisms consume fresh material and leave this material in a more broken down form as their excretions in the soil. They also mechanically mix the soil by their activity of burrowing, etc. It is the biotic character (variety and density) of the minute organisms in relation to the abiotic factors that this investigation is designed to explore. In any given area, the abiotic and biotic factors can differ markedly over a relatively short distance. The soil moisture may be too high in an area overall, yet in a small square meter area the soil may be raised enough to support plants that would drown in the surrounding soil. In this same vein, the microorganisms that help to determine the nature of the soil by their activity are also affected by these microclimates. As has been noted, these microclimates can occur in close proximity to each other. In a given area, such as a suburban lot, field, woodland, etc., there may be any number of these microclimates, each with its own number and variety of organisms. The area near the base of a tree, near the foundation of a house, on the slope of a ditch, in the middle of a grassy lawn, on the edge of a grassy lawn, all could have different microclimates.

Suggested Lesson Plan

Day 1

In the Classroom:

1. Introduce the topic of soils. Discuss the components of soils and how these change from place to place to create microclimates. Briefly discuss the organisms that may be found in soil.

In the Field:

2. Move the students to Sampling Site #1 and have each student write a description of the characteristics of the site to include amount of plant cover, temperature, time since last rain (or watering), amount of sunlight the site receives, and any other characteristic they feel is important.

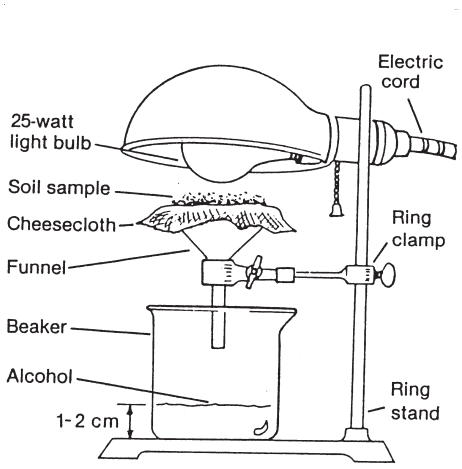
3. Divide the class into groups of two or three and have each group use a ruler to mark off a 25 cm^2 sampling area within the designated site.

4. Have each group collect a sample of the soil from their marked off area by first removing any large pieces of undecomposed plant material, rocks, etc., then removing the soil (including organic material) to a depth of 2 cm. and placing it in the plastic bag.

Back in the Lab:

5. Have each group set up a Berlezie Funnel in accordance with the diagram below.

Diagram of Funnel Apparatus



6. Have them place their soil sample in the funnel and leave the apparatus set up for 24 hours (until next class). The heat and light from the lamp will force the organisms to move downward away from the heat and light and they will fall through the funnel into the killing solution below the funnel.

Day 2

In the Field:

1. Move the students to Sampling Site #2 and have each group collect another sample of soil by repeating steps 2 - 4 of Day 1.

Back in the Lab:

2. Have them remove the soil sample and the beaker of killing solution from the previous day's sample (Site #1) from the apparatus.

3. Have each group place a fresh beaker of solution and the new soil sample (Site #2) in the apparatus and let stand under the light for 24 hours.

4. Hand out copies of the "Simple Dichotomous Key for Soil Organisms" and discuss its use. Have the students use the key and identify and count the organisms from the Site 1 sample and record on the Data Sheet table for their individual group.

5. Have the groups report their results to the rest of the class and compute and record the class average for Site 1 data.

Day 3

In the Field:

1. Move the students to Sampling Site #3 and have each group collect another sample of soil by repeating steps 2 - 4 of Day 1.

Back in the Lab:

2. Have them remove the soil sample and the beaker of killing solution from the previous day's sample (Site #2) from the apparatus.

3. Have each group place a fresh beaker of solution and the new soil sample (Site #3) in the apparatus and let stand under the light for 24 hours.

4. Have each group use the dichotomous key and identify and count the organisms from the Site 2 sample and record on the Data sheet table for their individual group.

5. Have the groups report their results to the rest of the class and compute and record the class average for Site 2 data.

Day 4

In the Field:

1. Move the students to Sampling Site #4 and have each group collect another sample of soil by repeating steps 2 - 4 of Day 1.

Back in the Lab:

2. Have them remove the soil sample and the beaker of killing solution from the previous day's sample (Site #3) from the apparatus.

3. Have each group place a fresh beaker of solution and the new soil sample (Site #4) in the apparatus and let stand under the light for 24 hours.

4. Have each group use the dichotomous key and identify and count the organisms from the Site 3 sample and record on the Data sheet table for their individual group.

5. Have the groups report their results to the rest of the class and compute and record the class average for Site 3 data.

Day 5

In the Lab:

1. Have each group remove the soil sample and the beaker of killing solution from yesterday's sample (Site #4) from the apparatus.

2. Have each group use the dichotomous key and identify and count the organisms from the Site 4 sample and record on the Data sheet table for their individual group.

3. Have the groups report their results to the rest of the class and compute and record the class average for Site 4 data.

4. Have the students Graph both their individual group data and the class average data and include this graph with their data sheets. Have them try using different kinds of graphs, possibly including bar, straight line, different scales, etc.

Application

The variety and number of organisms in a soil can act as a barometer of the overall health of a soil. Many parameters can change markedly in a small area. Also, man can change these parameters markedly in a short period of time and thus impact the soil organisms and at the same time soil health. Some examples of this would be fertilizing a field for a crop, irrigating a crop, watering your lawn, fertilizing your flowers with an organic instead of inorganic fertilizer, compacting the soil by running equipment over it, etc. All these will change the parameters of the soil including the organisms in the soil and can be investigated through the organisms in the soil to indicate soil health.

Extension

- Students could change the parameters of a study site and investigate how that changes the soil organisms by increasing the watering of a moist soil, a dry soil, etc.
- Students could draw the organisms found in the soil.
- Students could vary a different parameter, such as time of day, time after a rain, changing the vegetation layer on a given site, etc.
- Students could explore how different fertilizers, organic and inorganic, affect the number and variety of organisms.

Resources Available

Biology: Principles and Explorations. 1996. Johnson, G.B. and Raven, P.H. Holt, Rinehart, and Winston, Inc. Orlando, Fl.

Project Learning Tree. 1993. American Forest Foundation, Washington, DC

Ecology and Field Biology (Fourth edition). 1990. Smith, R. L Harper Collins, New York, NY

Teaching Kids About the Environment Lesson Plans. Coalition for Natural Resource Education. 1995.

Prepared by: Kevin Jones

Soil 0rganisms
Worksheet

Name:

Date:

Group Number:

Description of Site and Soil:

Site 1:

Litter

Duff

Soil

Vegetation

Moisture

Soil and Air Temperature

Date and Estimated Amount of Last Rainfall (or watering)

Other

Site 2:

Litter

Duff

Soil

Vegetation

Moisture

Soil and Air Temperature

Date and Estimated Amount of Last Rainfall (or watering)

Other

Site 3:

Litter

Duff

Soil

Vegetation

Moisture

Soil and Air Temperature

Date and Estimated Amount of Last Rainfall (or watering)

Other

Site 4:

Litter

Duff

Soil

Vegetation

Moisture

Soil and Air Temperature

Date and Estimated Amount of Last Rainfall (or watering)

Other

Organisms Present (Group):

Type of Macroorganism	Site 1	Site 2	Site 3	Site 4
Nematodes				
Annelids				
Insects				
Insect Larvae				
Other Arthropods				
Other Organisms				
Total Organisms				

Organisms Present (Class Average):

Type of Macroorganism	Site 1	Site 2	Site 3	Site 4
Nematodes				
Annelids				
Insects				
Insect Larvae				
Other Arthropods				
Other Organisms				
Total Organisms				

Soil Organisms
Worksheet

Conclusions:

1. What is the relationship between the soils and the number of organisms present? (list each characteristic and compare and contrast the number of organisms in each sample.)

2. Is there any difference between your results and the class results? Why or why not? How can these differences be minimized?

3. What does the number of organisms in a soil sample tell you about that soil? How can this information be useful?

4. How did using different graphs affect the 'look' of the information analyzed? Which technique works best to analyze the trends of soil organism with soil characteristic? Explain.

Simple Dichotomous key
For Soil Organisms

1a. Body worm-like	2
1b. Body not worm like	5
2a. No segments present	Nematode
2b. Segments	3
3a. Body soft	4
3b. Body not soft, head or legs present	Other
4a. No legs or head present	Annelid
4b. Head or small legs present	Insect larvae
5a. Body in three sections and 6 legs present	Insect
5b. Body in 2 or more than 3 sections and more than 6 legs present	Other Arthropods