

Unit E: Basic Principles of Soil Science

Lesson 1: Determining the Nature of Soil

Student Learning Objectives: Instruction in this lesson should result in students achieving the following objectives:

1. Explain how the resources soil provides help in supporting life.
2. Explain the contents of soil.
3. Describe the biological nature of soil.
4. Describe the four ways plants use soil.
5. Describe some agricultural uses of soil.
6. Describe some nonagricultural uses of soil.

Recommended Teaching Time: 3 hours

Recommended Resources: The following resources may be useful in teaching this lesson:

- A PowerPoint has also been developed for use with this lesson plan

List of Equipment, Tools, Supplies, and Facilities:

Writing surface
PowerPoint Projector
PowerPoint Slides
Transparency Masters
Sample of soil
Copies of Student Lab Sheet
Magnifying glasses
Plastic or metal sieves

Terms: The following terms are presented in this lesson (shown in bold italics and on PowerPoint Slide 2):

- Capillary water
- Gravitational water
- Hygroscopic water
- Infiltration
- Leaching
- Mineral matter
- Organic matter
- Percolation
- Permeable
- Pore spaces
- Soil aeration

Interest Approach: Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Have students bring in soil samples or provide them with samples. Set the samples before the students and ask what is contained in each sample. Are all the samples going to be the same? Will they look the same and have similar properties? Using a writing surface, record student responses. Ask students to focus on the specific contents that are in the samples. After a consensus is reached, identify the specific objectives and possible problems for this lesson.

Summary of Content and Teaching Strategies

Objective 1: Explain how the resources soil provides help in supporting life.

(PowerPoint Slide 3)

I. Soil is a layer on the earth's crust that provides a combination of resources.

These resources allow the growth of plants and animals. These resources include:

- A. Oxygen—needed for adequate root growth.
- B. Temperature—soil absorbs heat from the sun. It also loses heat to the atmosphere. This allows satisfactory temperatures for plant growth and seed germination.

(PowerPoint Slide 4)

- C. Water—utilized for growth of plants.
- D. Carbon—utilized in the form of organic matter in the soil.
- E. Nutrients—provided as minerals. They are broken down as nitrogen and recycled through decaying material in the soil.

****Ask students to identify soil resources that may be helpful in supporting life. Use PowerPoint Slide 5 to discuss the practical importance of soil.**

Objective 2: Explain the contents of soil.

(PowerPoint Slide 6)

II. Soil is composed of four primary components. They are mineral matter, organic matter, air, and water.

(PowerPoint Slide 7)

In addition, there are numerous living organisms in the soil, such as bacteria, insect larvae, earthworms, and fungi. Soils may vary from one area to another, but most will contain these basic components.

- A. Solid portions (50% of soil volume) represent the space occupied by mineral and organic matter.

(PowerPoint Slide 8)

- 1. **Mineral matter**, which accounts for about 45% of the soil, is partially decomposed rock material.

(PowerPoint Slide 9)

It is the sand, silt, and clay that is found in the soil. These vary in amount depending on the type of soil. The amounts of sand, silt, and clay also determine the soil's ability to hold water and provide nutrients.

(PowerPoint Slide 10)

2. **Organic matter**, which accounts for about 5% of the soil, is partially decomposed plant and animal matter. Most organic matter is from plant leaves, roots, and stems. Organic matter gives soil its dark color. Organic matter contributes to the soil's fertility as well as improved aeration and water holding capacity.
- B. **Pore spaces** (50% of soil volume) represent the space occupied by air and water.

(PowerPoint Slide 11)

1. Air, which accounts for about 25% of the soil, is part of the pore space in the soil. When soils are wet the amount of air will be less. When soils are dry the amount of air will be more. There is a constant fluctuation in the amount of air and water found in the soil.

(PowerPoint Slide 12)

2. Water, which accounts for about 25% of the soil, is also part of the pore space in the soil.

(PowerPoint Slide 13)

When it rains water will enter the soil or flow off of the soil's surface. The process of water soaking into the soil is known as **infiltration**. Once water is in the soil, movement downward is known as **percolation**. A quality soil allows both kinds of water movement and is said to be **permeable**. Water in the soil may be one of three types:

(PowerPoint Slide 14)

- a. **Gravitational water**—water that drains through the pore spaces in the soil as a result of gravity. Gravitational water flows quickly through soil that has large pores and slowly through soil with small pores. As water moves through the soil, it carries dissolved minerals, chemicals, and salts. This movement of water is referred to as **leaching**.

(PowerPoint Slide 15)

- b. **Capillary water**—water that is held between the particles of soil against the forces of gravity. It may move upward or sideways by capillary action. Clay soils hold more capillary water since they have more pore spaces.

(PowerPoint Slide 16)

- c. **Hygroscopic water**—water that forms a thin film around individual soil particles. This water is unavailable to plants.

****Bring in a sample of soil and use LS: E1-1 for students to identify the soil components that are present. Students may overlook the air and water in**

the sample. Explain the importance of these as it relates to plants being able to grow. Use TM: E1-1 or PowerPoint Slide 17 to show the relative percentages of the components in the soil.

Objective 3: Describe the biological nature of soil.

(PowerPoint Slide 18)

III. Abundant life can be found in soil.

A. Forms of life in soil include:

1. Earthworms
2. Insects
3. Bacteria
4. Fungi
5. Other organisms

(PowerPoint Slide 19)

B. Bacteria and fungi have an important role in the soil. They break down organic matter and release nutrients.

(PowerPoint Slide 20)

C. Earthworms, ants, crawfish, moles, and other organisms improve the soil *tilth*, the ease at which soil can be worked. These organisms create openings in the soil as they tunnel. This enhances drainage and improves air exchange.

****You can take students outdoors. Dig a hole in the soil, throwing the soil dug onto the surface so students can break it apart searching for signs of life. Ask students to identify the life they observe. Discuss the importance of these organisms in improving the soil.**

Objective 4: Describe the four ways plants use soil.

(PowerPoint Slide 21)

IV. Plants depend on soil to provide four basic needs.

- A. Anchorage—soil acts to provide a firm support as roots grow throughout the soil.**
- B. Water—soil provides nearly all of the water used by plants. Water is absorbed through the plants' roots.**

(PowerPoint Slide 22)

C. Oxygen—nearly all living organisms need oxygen. Plants release oxygen during photosynthesis but consume oxygen during respiration.

(PowerPoint Slide 23)

Plant parts above the ground have an ample supply of oxygen; however, those below the ground (roots) have less oxygen available. This increases the need for good ***soil aeration***, the exchange of soil and atmospheric air in order to maintain adequate oxygen for plant roots.

(PowerPoint Slide 24)

D. Nutrients—of the 16 nutrients considered to be essential for plant growth, 13 are obtained from the soil. Root hairs absorb the nutrients dissolved in soil water.

****Use PowerPoint Slide 25 as a review slide. Ask the students to list the four basic needs of soil for plants. When they restate the four you just covered, show this slide. Have them repeat these in order, aloud as a class. Do this until everyone is together.**

Objective 5: Describe some agricultural uses of soil.

(PowerPoint Slide 26)

V. Agriculture depends on soil to grow food, fiber, and ornamental plants for human societies. Various uses include:

(PowerPoint Slide 27)

A. Cropland—this is land on which soil is worked and crops are planted, cared for, and harvested. Most cropland is devoted to annual crops, such as corn, soybeans, cotton, vegetables, etc.

(PowerPoint Slide 28)

- B. Grazing land—this is land used for grazing cattle and sheep. It is often planted to perennial forage.
- C. Forest—this is land used for growing trees which are later harvested for building materials, paper, etc.

(PowerPoint Slide 29)

D. Water structures—ponds and other reservoirs are constructed out of soil.

****Lead a class discussion on the various agricultural uses of soil. Ask students to identify specific local uses of soil and expand discussion to include local, regional, and country differences.**

Objective 6: Describe some nonagricultural uses of soil.

(PowerPoint Slide 30)

VI. Humans require soil for many other uses besides growing plants. Such uses include:

(PowerPoint Slide 31)

- A. Recreation—recreational activities include playgrounds, sports fields, jogging paths, golf courses, parks, campgrounds, and many others.
- B. Foundations—buildings depend on a solid soil base upon which to be built to remain structurally sound.

(PowerPoint Slide 32)

C. Waste disposal—soil is often used for the treatment of human sanitary wastes. Soil filters some of the material, while microorganisms break down organic portions into less dangerous compounds.

(PowerPoint Slide 33)

- D. Building materials—homes and other structures are occasionally built underground, into hillsides, or even with soil piled over them. Earth-sheltered buildings help in lowering heating and cooling costs.

Review/Summary: Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. Questions on PowerPoint Slide 34 can also be used.

Application: Application can involve the following student activity using the attached lab sheet: Soils: What Are They?—Observational Exercise—LS: C6–1A

Evaluation: Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activity. A sample written test is attached.

Answers to Sample Test:

Part One: Matching

1=c, 2=g, 3=h, 4=a, 5=b, 6=d, 7=f, 8=e

Part Two: Completion

1. Students may list any two of the following: cropland, grazing land, forest, and water structures.
2. wastes
3. Answers will vary but may include: playgrounds, sports fields, jogging paths, golf courses, parks, or campgrounds.

Part Three: Short Answer

1. Answers will vary but may include: earthworms, insects, bacteria, or fungi.
2. Students may list any three of the following: anchorage, water, oxygen, and nutrients.
3. a. 45%
b. organic matter
c. 25%
d. air
4. Use Objective 4 as a guide for scoring.

Sample Test

Name _____

Test

Unit E Lesson 1: Determining the Nature of Soil

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

- | | | |
|-------------------|----------------------|--------------------|
| a. permeable | d. infiltration | g. percolation |
| b. tilth | e. leaching | h. capillary water |
| c. organic matter | f. hygroscopic water | |

- _____ 1. Partially decayed plant and animal matter.
- _____ 2. The downward movement of water through the soil.
- _____ 3. Water that is held against the forces of gravity and may move sideways or upward.
- _____ 4. A quality of soil that allows the movement of water and air.
- _____ 5. The ease with which soil can be worked.
- _____ 6. The process of water soaking into the soil.
- _____ 7. A thin film of water around individual soil particles.
- _____ 8. The process of carrying away dissolved minerals in water.

Part Two: Completion

Instructions. Provide the word or words to complete the following statements.

1. Two agricultural uses of soil include _____ and _____.
2. Soil is often used for the treatment of human sanitary _____.
3. Two examples of recreational uses of soil include _____ and _____.

Part Three: Short Answer

Instructions. Use the space provided to answer the following questions.

1. List three examples of biological life might be found in soil.

a.

b.

c.

2. What are three needs that plants depend on soil for?

a.

b.

c.

3. Soil is composed of the following components:

a. ____% mineral matter

b. 5% _____

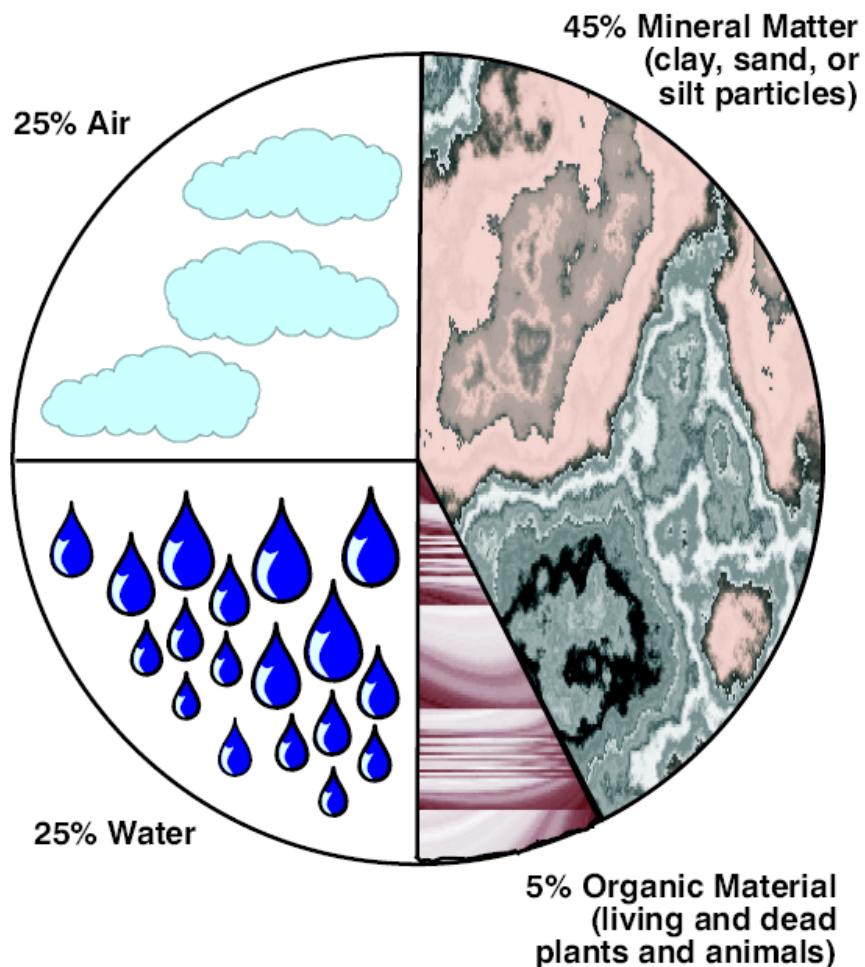
c. ____% water

d. 25% _____

4. Why is soil important in supporting life?

TM: E1-1

COMPOSITION OF AVERAGE SOIL



Lab Sheet

Soils: What Are They?—Observational Exercise

Purpose:

Observe soil samples to determine similarities and differences in their composition.

Materials:

Soil samples
Magnifying glass

Procedure:

1. Obtain a soil sample which contains enough of the top 5 centimeters of soil to fill half of a liter of a jar.
2. Observe the soil carefully and answer the questions below.
3. Trade samples with your lab partner. Examine the new sample, and answer the same questions again for it. How does this sample differ from the other one?

Questions:

1. Describe the location where the sample was collected.

2. Describe the color of the soil sample.

3. What does the soil sample smell like?

4. What does the soil sample feel like?

5. Does the soil sample contain any plants or animals? Describe them.

6. Use a magnifying glass to determine the structure of the soil. What structures are present? Draw a picture of each.

7. Using the magnifying glass, describe the organic matter.

8. Does the amount of water that a soil can hold change? Why?

9. Air and water make up about half of the soil sample. Where is the air and water found?