

Unit A: Principles of Soil

Lesson 3: Horizons of Soil

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

1. Explain a soil profile
2. Explain how soils within the profile change over time
3. Distinguish between major soil horizons in a profile and place in proper order

Recommended Teaching Time: 3 Hours

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

- A PowerPoint has been provided

List of Equipment, Tools, Supplies, and Facilities:

Writing Surface
PowerPoint Projector
PowerPoint Slides
Transparency Masters
Shovels
Meter stick
Pocket Knives
Water
10- large clear plastic bottles with lids
Soil Samples
Rocks

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

- Additions
- Eluviation
- Illuviation
- Losses
- Soil Profile
- Solum
- Subsoil
- Substratum
- Topsoil
- Transformations
- Translocations

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 describe as a class the differences between the pictures of soil found on PowerPoint Slide 3. Afterwards, explain that these are example pictures of soil profiles. Explain that no two horizons are the same. There will be differences between two profiles that are relatively close to one another. They will vary greatly depending on where the soil is located, what kind of climate they are located in, and the history of the area or province they are located in.

(PowerPoint Slide 4)

Show picture of soil map of Afghanistan. Explain how these different soil regions will differ in soil types, thus making the soil profiles and horizons look different.

Summary of Content and Teaching Strategies

(PowerPoint Slide 5)

Objective 1: Explain a soil profile.

I. A **soil profile** is a vertical cross-section of the soil. When exposed, various layers of soil should be apparent.

A. Each layer of soil may be different from the rest in a physical or chemical way. The differences are developed from the interaction of such soil-forming factors as:

1. Parent material – the original source of most soils is rock – the solid, unweathered materials of the earth’s crust. Solid rock breaks into smaller particles, which are called the parent materials of soil.
2. Slope – the rise or fall of the land over a certain area.
3. Native vegetation – plants that naturally grow without human interaction
4. Weathering (time) – the breakdown of rock and other material due to freezing and thawing, and rainfall over time.
5. Climate – the average weather for a specific area over a large span of time.

B. A soil profile is usually studied to a depth of 3 to 5 feet.

***** Before reading the soil forming factors, have the students try to come up with what different factors could affect soil formation. As a review of this objective take the students outside and have them look at the soil and their surroundings. See if they can show or point out examples of all the soil forming factors discussed in this objective. Use some questions to push their thoughts in the right directions. One such question might be, “How might the mountains in our country affect soil formation?” Have them raise their hand and talk through their idea if they have one. While outside consider having the students use a shovel to dig a hole in the farm plot that could show the***

students the soil profile. If there is a building under construction that could provide them with a good cross-sectional view of the soil that would also help them understand the idea of a soil profile.

Objective 2: Explain how soils within the profile change over time.

(PowerPoint Slide 6)

II. Soils change over time in response to their environment. The environment is influenced by the soil-forming factors.

A. The causes of these changes can be classified into 4 processes:

(PowerPoint Slide 7)

1. **Additions.** Materials such as fallen leaves, wind-blown dust, or chemicals from air pollution that may be added to the soil.
2. **Losses.** Materials may be lost from the soil as a result of deep leaching or erosion from the surface.
3. **Translocations.** Materials may be moved within the soil. This can occur with deeper leaching into the soil or upward movement caused by evaporating water.

(PowerPoint Slide 8)

4. **Transformations.** Materials may be altered in the soil. Examples include organic matter decay, weathering of minerals to smaller particles, or chemical reactions.

B. Each of these processes occurs differently at various depths. As a soil ages, horizontal layers develop and changes result.

***** To help the students understand this objective divide the students into equal groups so that each group will have a large empty plastic bottle with a lid. Have the students fill the bottle 2/3 of the way full with small stones and the soil sample provided or obtained while outside when you review Objective 1. Add water to fill the rest of the bottle. Put the lid on top of the bottle tightly. Shake for 60 seconds and then set the bottle on a secure surface and watch the soil separate. Explain how adding these things together cause transformations and shaking the bottle up can be considered translocations. Have the students think what they will see as the soil and stones begin to settle in the bottle.***

Objective 3: Distinguish between the major horizons of a soil profile.

(PowerPoint Slide 9)

III. There are 3 primary soil horizons called master horizons. They are A, B, and C. These are part of a system for naming soil horizons in which each layer is identified by a code: O, A, E, B, C, and R. They will be discussed as follows:

(PowerPoint Slide 10)

A. "O" horizon. This is an organic layer made up of partially decayed plant and animal debris. It generally occurs in undisturbed soil such as in a forest.

B. "A" horizon. This is often referred to as **topsoil** and is the surface layer where organic matter accumulates. Over time, this layer loses clay, iron, and other

materials due to leaching. This is called **eluviation**. The A horizon provides the best environment for the growth of plant roots, microorganisms, and other life.

(PowerPoint Slide 11)

C. "B" horizon. This horizon is referred to as the **subsoil**. It is often called the "zone of accumulation" since chemicals leached from the A and E horizons accumulate here. This accumulation is called **illuviation**. The B horizon will have less organic matter and more clay than the A horizon. Together, the A, E, and B horizons are known as the **solum**. This is where most of the plant roots grow.

(PowerPoint Slide 12)

D. "C" horizon. This horizon is referred to as the **substratum or parent material**. It lacks the properties of the A and B horizons since it is influenced less by the soil forming processes. It is usually the parent material of the soil.

E. "R" horizon. This is the underlying bedrock, such as limestone, sandstone, or granite. It is found beneath the C horizon.

Use PowerPoint Slide 13 and TM: A3-1 to show horizons as you explain each horizon. Have the students draw the different primary layers of a soil profile in their notes. Take the students back outside to view the hole that may have been dug in the farm plot to compare the soil profile in their notes with the actual soil profile they see from the hole that was dug. Discuss the differences or similarities of their soil profile drawing and the actual soil profile they are seeing in the farm plot.

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 14 can also be used as review.

Application: Take students outside. Their task is to dig a pit deep enough that they can see a soil profile. Once they finish digging, have students identify where they think each horizon ends. Use the water to mist the front of the soil to help distinguish different colors of the horizons. Show them how to pick at it with their pocket knives. Explain why each horizon they see is the A, B, C horizons and so on.

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 test has been provided.

Answers to Sample Test:

Part One: Matching

1=d, 2=c, 3=a, 4=b, 5=e, 6=f

Part Two: Completion

1. transformation
2. topsoil
3. organic
4. R
5. A

Part Three: Short Answer

1. Use TM: E5-1 as a guide for scoring this sketch.
2. Materials in the soil may be lost as a result of leaching or erosion.
3. A Horizon—darker, contains microorganisms and will be relatively uniform in texture (probably medium or moderately fine).
C Horizon—lighter in color, contains parent material, which may be sandy and gravelly.

Sample Test

Name _____

Test

Unit A Lesson 3: Horizons of Soil

Part One: Matching

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

- | | | |
|------------------|---------------|----------------|
| a. soil profile | c. substratum | e. illuviation |
| b. translocation | d. solum | f. subsoil |

- _____ 1. Area where most plant roots grow.
- _____ 2. C horizon. Usually composed of the parent material of the soil and has had little soil forming activity.
- _____ 3. A vertical cross-section of the soil.
- _____ 4. Process of materials moving within the soil horizons.
- _____ 5. The accumulation of chemicals, clay, iron, and other materials in the B horizon.
- _____ 6. Often referred to the B horizon.

Part Two: Completion

Instructions. Complete the following statements.

1. As materials such as organic matter and minerals are altered in the soil, this process is called _____.

2. The A horizon is often referred to as _____.

3. The O horizon is often composed of an _____ layer made up of decayed plant and animal debris.

4. The _____ horizon is underlying bedrock, such as limestone, sandstone, or granite found underneath the C horizon.

5. The _____ horizon is the one best suited for growth of plant roots.

Part Three: Short Answer

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

1. Draw a soil profile and label each of the three major horizons.

2. Explain how “losses” might occur that will cause a change in the soil profile.

3. Explain how the A horizon is different from the C horizon in terms of color and content.

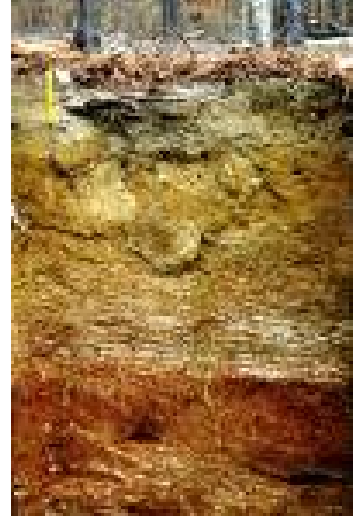
Pictures for Interest Approach



Soil Profile 1



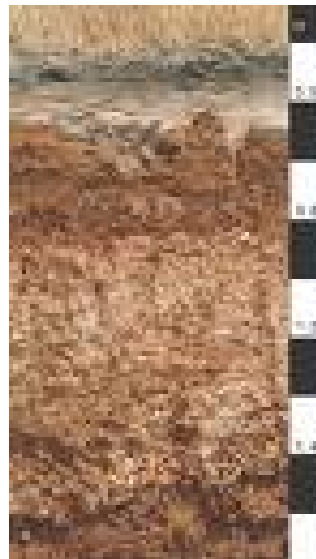
Soil Profile 2



Soil Profile 3



Soil Profile 4



Soil Profile 5



Soil Profile 6

TM: A3-1

PRIMARY LAYERS OF A SOIL PROFILE

