

Lesson C1–3

Explaining a Soil Profile

Unit C. Basic Principles of Agricultural/Horticultural Science

Problem Area I. Using Basic Soil Science Principles

Lesson 3. Explaining a Soil Profile

New Mexico Content Standard:

Pathway Strand: Natural Resources and Environmental Systems

Standard: VII: Apply scientific principles to environmental services.

Benchmark: VII-B: Describe soil compositions and properties to demonstrate knowledge of soil science.

Performance Standard: 1. Describe soil geology. 2. Describe composition of soil. 3. Describe the biological properties of soil. 4. Identify the physical properties of soil. 5. Describe the chemical properties of soil. 6. Test soil samples to determine characteristics. 7. Explain classification of soil water. 8. Explain the relationship between soil classifications and land use.

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

1. Explain the soil profile.
2. Explain how soils within the profile change over time.
3. Distinguish between the major horizons of a soil profile.

List of Resources. The following resources may be useful in teaching this lesson:

Biondo, Ronald J. and Jasper S. Lee. *Introduction to Plant and Soil Science and Technology*, Second Edition. Danville, Illinois: Interstate Publishers, Inc., 2003. (Textbook and Activity Manual, Chapter 7)

Plaster, Edward J. *Soil Science & Management*. Albany, New York: Delmar Publishers, 1997. (Textbook and Lab Manual, Chapter 2)

Other Resources. The following resources will be useful to students and teachers:

Illinois Master Gardener. University of Illinois at Urbana-Champaign, Cooperative Extension Service.

Porter, Lynn, et al. *Environmental Science and Technology*, Second Edition. Danville, Illinois: Interstate Publishers, Inc., 2003. (Textbook and Activity Manual, Chapter 13)

Sager, Robert J., et al. *Modern Earth Science*. Austin, Texas: Holt, Rinehart, and Winston, Inc., 1998. (Textbook, Chapter 12)

VAS U4052a, *Understanding Soils*. Urbana, Illinois: Vocational Agriculture Service.

List of Equipment, Tools, Supplies, and Facilities

Writing surface
Overhead projector
Soil monolith
Transparencies from attached masters

Terms. The following terms are presented in this lesson (shown in bold italics):

Additions
Eluviation
Illuviation
Losses
Soil profile
Solum
Subsoil
Substratum
Topsoil
Transformations
Translocations

Interest Approach. Ask students what is meant by a human profile. If you were to view a profile of another person, what type of view would you see? Relate this to a soil profile. It is the same type of view, but within a section of soil. Go on and ask students what they would expect to see in a soil profile. Would the entire section look the same? How might various sections appear to be different? Would you find certain living organisms in some sections of the profile but not in other sections?

Summary of Content and Teaching Strategies

Objective 1: Explain the soil profile.

Anticipated Problem: What is 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
 2. Slope
 3. Native vegetation
 4. Weathering (time)
 5. Climate
 - B. A soil profile is usually studied to a depth of 3 to 5 feet.

Use a variety of techniques to help students master this objective. Students need text materials to help understand a soil profile. Chapter 2 in Soil Science & Management or Chapter 7 in Introduction to Plant and Soil Science and Technology are recommended. Use TM: C1–3A to show the primary layers of a soil profile. Help students to see that there are differences in the soil throughout the profile. It would also be helpful to have a soil pit where students can see firsthand the various layers of a profile.

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

Anticipated Problem: How do soils within a soil profile change over time?

- 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:
 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.
 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.

A variety of techniques may be used to help students learn this objective. The text materials may be helpful. Chapter 2 in Soil Science & Management is recommended. Use TM: C1–3B to discuss the processes of change in a soil profile. Give students the names of processes and ask for their ideas of soil profile changes for that process. Use notes above to enhance class discussion.

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

Anticipated Problem: What are the major horizons of a soil profile and how do they differ?

- 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:
- 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.
 - C. “E” horizon. This is the zone of greatest eluviation. Because the clay, chemicals, and organic matter are very leached, the color of the E horizon is very light. It usually occurs in sandy forest soils with high amounts of rainfall.
 - D. “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.
 - E. “C” horizon. This horizon is referred to as the **substratum**. 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.
 - F. “R” horizon. This is the underlying bedrock, such as limestone, sandstone, or granite. It is found beneath the C horizon.

Use a variety of techniques to help students master this objective. Students need text materials to help them understand the various layers of a soil profile. Chapter 2 in Soil Science & Management or Chapter 7 in Introduction to Plant and Soil Science and Technology are recommended. If you have access to a soil

monolith, it and the notes above would be helpful in showing students the various layers of a soil profile. Use TM: C1–3A and TM: C1–3C to enhance discussion of soil horizons.

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 at end of chapters in the suggested resources may also be used in the review/summary.

Application. Application can involve the following student lab activity:

Examination of Soil Profiles in the *Soil Science & Management Lab Manual*, Chapter 2.

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 activities. A sample written test is attached.

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: C1–3A 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.

Test

Lesson C1–3: Explaining a Soil Profile

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 |

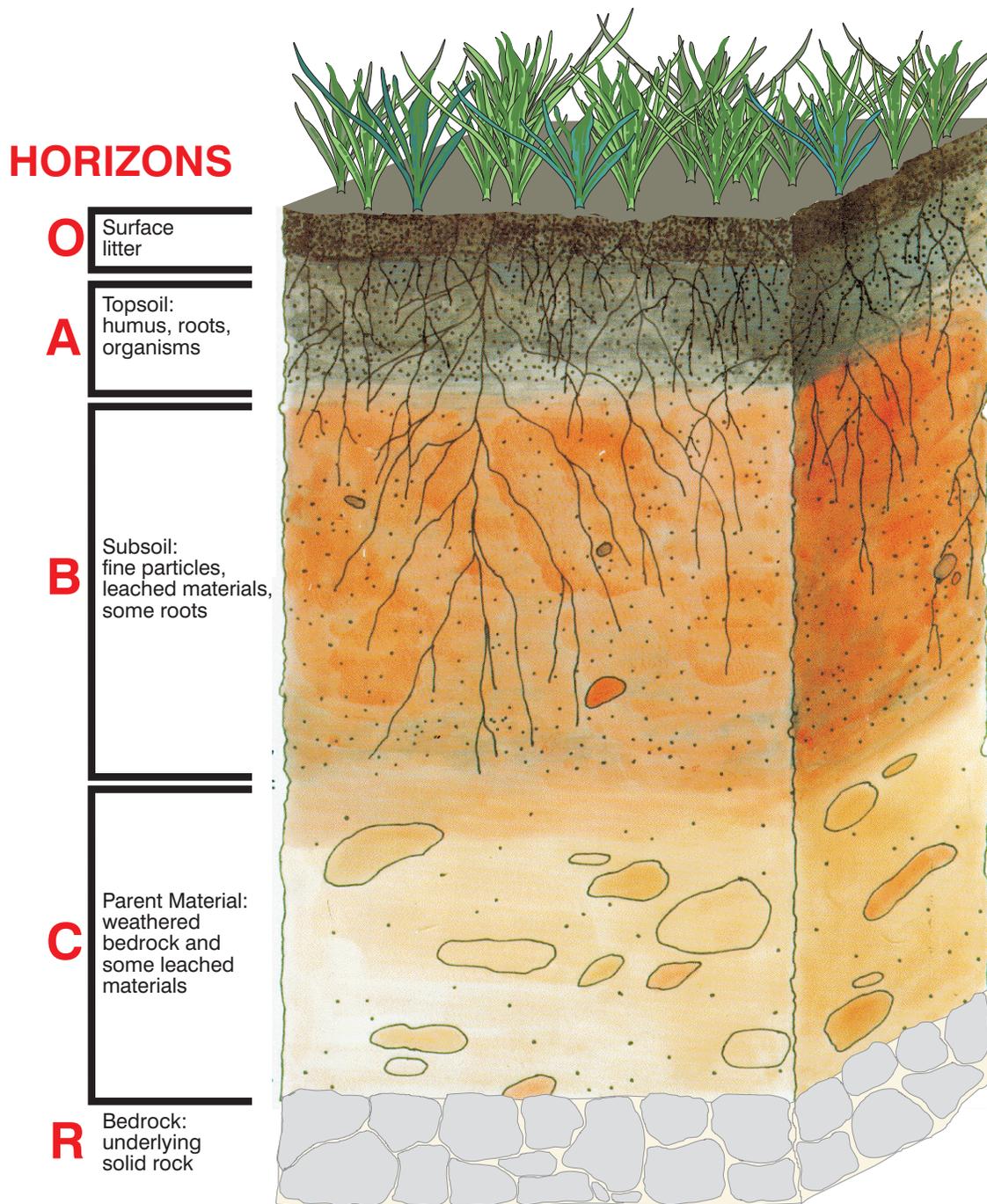
- _____ 1. Area where most plant roots grow.
- _____ 2. C horizon. Usually composed of the parent material of the soil and has had little soil forming activity.
- _____ 3. A vertical cross-section of the soil.
- _____ 4. Process of materials moving within the soil horizons.
- _____ 5. The accumulation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

Part Two: Fill in the blank

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.

Primary Layers of a Soil Profile



Causes of Changes Within a Soil Profile

- 1. Additions — fallen leaves, dust, chemicals**
- 2. Losses — materials lost due to erosion or leaching**
- 3. Translocation — materials moved within the soil**
- 4. Transformation — materials being altered in the soil**

Soil Profile Horizons

O Horizon — organic layer of leaves, roots, and decaying material

A Horizon — Topsoil

B Horizon — Subsoil

C Horizon — Substratum

R Horizon — Bedrock or solid rock below the C Horizon