

Course	Agricultural Science II
Unit	Soil Science
Lesson	Soil Horizons
Estimated Time	50 minutes

Student Outcome

Describe a soil profile.

Learning Objectives

1. Explain the term pedon.
2. Explain the term soil profile.
3. Describe a master soil horizon.
4. Explain what horizon boundaries are.
5. Describe transitional horizons.
6. Describe the subordinate divisions of master horizons.
7. Describe the subdivisions of thick horizons.
8. Explain lithologic discontinuities.

Grade Level Expectations

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. PowerPoint Slides
 - PPT 1 – Soil Pedons: How They Relate to Landscape
 - PPT 2 – Master Horizons
 - PPT 3 – Transitional Horizons
2. Minor, Paul E. *Soil Science* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1995.
3. *Soil Science Curriculum Enhancement*. University of Missouri-Columbia: Instructional Materials Laboratory, 2003.

Supplies & Equipment

- Soil monoliths

Supplemental Information

1. Internet Sites
 - A Soil Profile. USDA Natural Resources Conservation Service. Accessed May 16, 2008, from http://soils.usda.gov/education/resources/K_12/lessons/profile/.
 - Francek, Mark. *Soil Horizons*. Science Education Resource Center, Carleton College, Northfield, Minnesota; and Central Michigan University, Mount Pleasant. Accessed May 16, 2008, from http://serc.carleton.edu/NAGTWorkshops/visualization/collections/soil_horizons.html.

2. Print

- ❑ Ashman, Mark R., and Geeta Puri. *Essential Soil Science: A Clear and Concise Introduction to Soil Science*. Malden, MA: Blackwell Publishing, 2002.
 - ❑ Brady, Nyle C., and Ray R. Weil. *The Nature and Properties of Soils*. 14th ed. Upper Saddle River, NJ: Prentice Hall, Inc., 2007.
 - ❑ Coyne, Mark S., and James A. Thompson. *Fundamental Soil Science*. Clifton Park, NY: Delmar CENGAGE Learning, 2005.
 - ❑ Donahue, Roy L., and Roy Hunter Follett. *Our Soils and Their Management*. Danville, IL: Interstate Publishers, Inc. 1990.
 - ❑ Plaster, J. Edward. *Soil Science and Management*. 2nd ed. Albany, NY: Delmar Publishers, Inc., 1992.
 - ❑ White, Robert E. *Principles and Practice of Soil Science: The Soil as a Natural Resource*. 4th ed. Malden, MA: Blackwell Publishing, 2005.
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Interest Approach

Use soil monoliths for observing the different horizons.

Communicate the Learning Objectives

1. Explain the term pedon.
2. Explain the term soil profile.
3. Describe a master soil horizon.
4. Explain what horizon boundaries are.
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Instructor Directions	Content Outline
<p>Objective 1</p> <p><i>Arrange a field trip to observe how different soils are formed. Show slides of soil profiles or actual soil profiles so the students may observe the factors in soil formation. Discuss how soil horizons are formed. Discuss how a soil pedon is formed. Use PPT 1 to illustrate #2.</i></p> <p><input type="checkbox"/> PPT 1 – Soil Pedons: How They Relate to Landscape</p>	<p>Explain the term pedon.</p> <ol style="list-style-type: none">1. The smallest volume that can be called “soil” is a pedon.2. A pedon is three-dimensional and large enough to permit study of all horizons.3. The area of a pedon may vary from 10 to 100 square feet (1 square meter to 10 square meters) depending on how much the soil changes.
<p>Objective 2</p> <p><i>Have students observe the several soil profiles. Point out the different soil horizons until the students can identify the horizons themselves. Display PPT 2 to show the master horizons.</i></p> <p><input type="checkbox"/> PPT 2 – Master Horizons</p>	<p>Explain the term soil profile.</p> <ol style="list-style-type: none">1. A soil profile is a vertical section of a soil pedon from the surface through all of its horizons including parent material.2. A single soil profile never has all the horizons that are possible.
<p>Objective 3</p> <p><i>Discuss the six master horizons. Discuss management strategies as</i></p>	<p>Describe a master soil horizon.</p> <ol style="list-style-type: none">1. A soil horizon is a layer of soil parallel to the earth’s surface.

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<p><i>they relate to different soils. Refer to PPT 2 to illustrate the six master horizons.</i></p> <p><input type="checkbox"/> PPT 2 – Master Horizons</p>	<ol style="list-style-type: none"> 2. A master soil horizon is one of the six general kinds of horizons that occur in soil profiles with a distinct set of properties. 3. Each is named with capital letters: O, A, E, B, C, or R. <ol style="list-style-type: none"> a. O Horizon (O = organic) <ul style="list-style-type: none"> - This horizon has a layer of organic debris. - O horizons are nearly 100% organic matter material. - Forest soils have thin organic horizons. - Wet soils in bogs or drained swamps often have O horizons of peat or muck. - Most soils in Missouri have only thin O horizons. - O horizons are destroyed by plowing and do not occur in cultivated areas. b. A Horizon <ul style="list-style-type: none"> - Surface horizon of mineral soil - Usually dark color from the accumulation of humus - Thickness ranges from a few inches (most forested soils) to over 30 inches (some upland prairie soils and some alluvial soils in flood plains) - Every cultivated agricultural soil has an A horizon - Extremely important in maintaining soil fertility and providing a favorable environment for root growth c. E Horizon (E = eluviation) <ul style="list-style-type: none"> - Strongly leached horizon - Occurs immediately beneath an O or an A horizon - Grayish-brown to white in color; nearly all the iron and organic matter removed - Occurs in most forested soils that have not been cultivated and in several of the prairie soils in Missouri - Contains noticeably less clay than the B horizon beneath it d. B Horizon <ul style="list-style-type: none"> - The subsoil layer that generally changes the most because of soil-forming processes

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	<ul style="list-style-type: none"> - Has the brightest yellowish-brown or reddish-brown colors - Has more clay than other horizons - Clay films visible <p>e. C Horizon: Weathered unconsolidated geologic material below the A or B horizon. Anything that is soft enough to dig with a spade but which has not been changed very much by soil-forming processes is considered C horizon.</p> <p>f. R Horizon (R = rock): Hard bedrock that you cannot dig with a spade</p>
<p>Objective 4</p> <p><i>Discuss what horizon boundaries are. Use sample profiles or judging pits to illustrate horizon boundaries.</i></p>	<p>Explain what horizon boundaries are.</p> <ol style="list-style-type: none"> 1. A horizon boundary is the division line between two distinct horizons, where one horizon ends and the other begins. 2. Terms used to describe boundary distinctness and the nature of the boundary may provide clues to soil development and behavior. <ol style="list-style-type: none"> a. Abrupt: boundary is less than 1 inch (2.5 cm) wide <ul style="list-style-type: none"> - Sudden change to another kind of material or texture - May limit root penetration - May signal a different rate of water movement b. Clear: boundary is 1 to 2.5 inches (2.5 to 6 cm) wide c. Gradual: boundary is 2.5 to 5 inches (6 to 12.5 cm) wide, may indicate very young or highly weathered old soil d. Diffuse: boundary is more than 5 inches (12.5 cm) wide 3. The form or shape of horizon boundaries requires careful examination to determine the true relationship between soil horizons. <ol style="list-style-type: none"> a. Smooth: nearly a plane b. Wavy: shallow pockets wider than their depth c. Irregular: pockets deeper than their width d. Broken: parts of the horizon unconnected with other parts

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<p>Objective 5</p> <p><i>Discuss what transitional horizons are. Talk about how soils have formed in more than one kind of parent material. Discuss how a flooding river deposits fresh silt on top of older sands and gravels. Refer to Ppt 3.</i></p> <p><input type="checkbox"/> Ppt 3 – Transitional Horizons</p>	<p>Describe transitional horizons.</p> <ol style="list-style-type: none"> 1. Areas between master horizons where changes occur gradually throughout a zone that may be 5 or 10 inches thick. 2. Transitional horizons are named with two letters, three of which are common in Missouri soils <ol style="list-style-type: none"> a. AB horizon <ul style="list-style-type: none"> - This occurs between the A and B master horizons with dominant A properties, but some properties of the B are evident. - Dark colors associated with organic matter are fading because organic matter is decreasing. - Structure often changes from granular to subangular blocky. b. BA horizon <ul style="list-style-type: none"> - This also occurs between the A and B, but it has more characteristics of the B. - Structure will generally be the same type as the B, but less strongly expressed. - Colored darker than the B or the clay content may be less than the maximum in the B. c. BC horizon <ul style="list-style-type: none"> - This horizon has a transition from the B to C with dominant B horizon properties, but some influence of the C horizon is evident. - Often the clay content will be less than the maximum in the B, but more than in the C, or the color will be fading. - The C is massive, and the BC has structure, but it may have larger units and more weakly expressed than the B.
<p>Objective 6</p> <p><i>Have students observe profiles and assist them in determining subordinate distinctions in each horizon. Discuss what the subordinate divisions of master horizons are.</i></p>	<p>Describe the subordinate divisions of master horizons.</p> <p>Subordinate divisions of master horizons are horizons resulting from unique processes that leave a distinct mark on the horizon.</p> <p>Subordinate divisions within master horizons are named by adding lowercase letters immediately following the master horizon symbol. Over 25 letters and combinations of letters are possible.</p>

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	<p>Eight subordinate divisions are common in Missouri.</p> <ol style="list-style-type: none"> 1. Oi horizon: The organic layer covering the A horizon with a layer of slightly decomposed twigs and leaves 2. Ap horizon (p = plow layer) <ol style="list-style-type: none"> a. The surface horizon of soil in which cultivation has mixed the upper 8 to 12 inches and destroyed natural horizons b. Plowing an exposed B or C horizon would automatically make the surface horizon an Ap 3. Bt horizon (t = translocated clay) <ol style="list-style-type: none"> a. Has distinctly more clay than the horizons above or below it b. Clay usually moved from horizons above by water carrying fine clay particles with it c. Clay possibly coming from the weathering of original minerals in the Bt horizon d. Has well-developed blocky or prismatic structure 4. Bg horizon (g = gleyed) <ol style="list-style-type: none"> a. Horizon gleyed (wet for long periods of time); indicates poorly drained soil b. Iron chemically reduced by leaching leaving soil dark gray c. Not restricted to Bg; other gleyed horizons: the Ag, Eg, BAg, BCg, and Cg 5. Bw horizon (w = weathered) <ol style="list-style-type: none"> a. This horizon has been changed by weathering, but not enough to form a Bt or Bg b. In Missouri soils, the Bw differs from the C by having weak or moderate blocky structure c. The Bw may also have a brighter color and it may be more leached than the C d. Bw horizons are common in young soils of flood plains and low stream terraces 6. Bx horizon <ol style="list-style-type: none"> a. This refers to a fragipan b. Horizon is a massive, dense, but not cemented soil horizon c. It is often mottled and has seams of gray silt scattered throughout. d. The fragipan is so dense that neither plant roots nor water can readily penetrate, except in the gray silt seams.

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	<ul style="list-style-type: none"> e. In Missouri, fragipans occur mostly in gently sloping upland soils and some high terrace soils in southern Missouri 7. Bk horizon <ul style="list-style-type: none"> a. This horizon has an accumulation of calcium carbonate, or free lime, leached from upper horizons and redeposited in the Bk b. White streaks or nodules of lime are visible and can be tested with hydrochloric acid (HCl) c. Use the k only to indicate horizons enriched in visible deposits of carbonates by translocation (not for soils on the Missouri River flood plain and uplands of northwest Missouri that have free lime in original amounts) 8. Cr horizon (r = bedrock) <ul style="list-style-type: none"> a. Weathered bedrock, or rock that is soft enough to slice with a knife or spade b. Original rock structure is often visible c. Not hard enough to be designated R
<p>Objective 7</p> <p><i>Discuss what subdivisions of thick horizons are.</i></p>	<p>Describe the subdivisions of thick horizons.</p> <ul style="list-style-type: none"> 1. Very thick master horizons or subordinate divisions need to be classified into special subdivisions 2. Vertical sequences within any single horizon indicated by small changes in texture, color, or structure 3. Indicated by using Arabic number, as in A1, A2, or Bw1, Bw2, and Bw3
<p>Objective 8</p> <p><i>Observe soil horizons to see if they are developed in more than one material. Discuss what lithologic discontinuities are.</i></p>	<p>Explain lithologic discontinuities.</p> <ul style="list-style-type: none"> 1. Soil horizons developed in more than one parent material 2. Indicated by a number placed in front of the horizon name showing its position from the top down <ul style="list-style-type: none"> a. The geologic material at the surface is always assumed to be the first one, so the number 1 is never used. b. The second geologic material is indicated by a 2, the third by a 3, and so on. c. An example of soil developed in silt over gravel could have the following set of horizons: A-AB-B-2BC-2C.

Instructor Directions	Content Outline
Application	<p>Other activities:</p> <ol style="list-style-type: none"> 1. Study the history of the soils in your vicinity and state. 2. Prepare a soil pit and have students determine the soil horizons.
Closure/Summary	<p>The smallest volume that can be called “soil” is a pedon. A soil profile is a vertical section of a soil pedon beginning at the surface and continuing down through all of the horizons, including the parent materials. Six master horizons may occur in soil profiles. The distinctness of boundaries, special features of horizons, subdivisions of thick horizons, and lithologic discontinuities further define the soil horizons.</p>
Evaluation: Quiz	<p>Answers:</p> <ol style="list-style-type: none"> 1. e 2. a 3. i 4. c 5. g 6. d 7. j 8. b 9. f 10. h 11. b 12. d 13. f 14. e 15. c 16. a