

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

Student Outcome

Explain the importance of soil structure.

Learning Objectives

1. Explain the term soil structure (ped).
2. Explain the importance of soil structure.
3. Describe how soil structures are formed.
4. Identify the different types of soil structural units.
5. Explain the difference between structure grade and type.
6. Explain how soil structure can be improved.

Grade Level Expectations

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. PowerPoint Slide
 - PPT 1 - Types of Soil Structure
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 samples

Supplemental Information

1. Internet Sites
 - Horizon Properties: Soil Structure. Goddard Space Flight Center, NASA. Accessed May 16, 2008, from <http://soil.gsfc.nasa.gov/pvg/prop1.htm>.
 - Soils. Master Gardner, Ohio State University Extension. Accessed May 16, 2008, from <http://www.hcs.ohio-state.edu/mg/manual/soil2.htm>.
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.
-

Interest Approach

Use soil samples to demonstrate the different types of structure.

Communicate the Learning Objectives

1. Explain the term soil structure (ped).
2. Explain the importance of soil structure.
3. Describe how soil structures are formed.
4. Identify the different types of soil structural units.
5. Explain the difference between structure grade and type.
6. Explain how soil structure can be improved.

Instructor Directions	Content Outline
<p>Objective 1</p> <p><i>Discuss how soil structure facilitates movement of water.</i></p>	<p>Explain the term soil structure (ped).</p> <ol style="list-style-type: none"> 1. Soil structure forms when individual grains of sand, silt, and clay are bound together physically and/or chemically into larger units called peds. 2. A ped is a single unit of soil structure. 3. Peds range in size from 1 mm to 10 cm depending on their shape.
<p>Objective 2</p> <p><i>Discuss the soil samples on display. Which soil sample has good structure and will provide an ideal environment for plant growth?</i></p>	<p>Explain the importance of soil structure.</p> <ol style="list-style-type: none"> 1. Soil structure modifies some of the effects of texture on soil behavior by creating relatively large pores. <ol style="list-style-type: none"> a. Provides for water infiltration b. Provides for good aeration c. Provides for good soil tilth d. Provides an ideal environment for plant root growth 2. Soil structure can be destroyed. <ol style="list-style-type: none"> a. Over-tilling b. Tilling while soil is wet
<p>Objective 3</p> <p><i>Ask the students why organic matter is essential if you want to maintain good soil structure.</i></p>	<p>Describe how soil structures are formed.</p> <ol style="list-style-type: none"> 1. Weathering converts original (structureless) parent material into soil. 2. Soil is loosened and pore spaces are formed when shrinking and swelling occur. <ol style="list-style-type: none"> a. Wetting and drying b. Freezing and thawing c. Root penetration

Instructor Directions	Content Outline
	<p>3. Organic matter produces cementing agents that bind and stabilize soil into small clumps with definite shapes (aggregates). Soil then resists breakdown.</p>
<p>Objective 4</p> <p><i>Show the students PPT 1 and discuss the different types of soil structure.</i></p> <p><input type="checkbox"/> PPT 1 – Types of Soil Structure</p>	<p>Identify the different types of soil structural units.</p> <p>Structured</p> <ol style="list-style-type: none"> 1. Granular <ol style="list-style-type: none"> a. Roughly spherical b. Usually 1 to 10 mm in diameter c. Common in surface (A) horizons 2. Platy <ol style="list-style-type: none"> a. Flat peds that lie horizontally b. Most less than 2 cm thick c. Occur mostly in subsurface (E and Bx) horizons 3. Blocky <ol style="list-style-type: none"> a. Roughly cube-shaped with generally flat surfaces <ul style="list-style-type: none"> - Angular (sharp edges and corners) - Subangular (rounded edges and corners) b. Sizes from 5 to 50 mm in diameter c. Typical of subsoil (B horizons) d. Formed by expansion and contraction of clay minerals 4. Prismatic <ol style="list-style-type: none"> a. Peds taller than wide b. Often have 5 sides c. Most common in lower part of subsoil (B and BC horizons) d. Columnar prisms with rounded tops and corners <ul style="list-style-type: none"> - Found in strongly developed soils - Caused by eluviation (downward movement of material) <p>Compound structures: Large aggregates can be broken into smaller aggregates of a different shape.</p> <p>Unstructured</p> <ol style="list-style-type: none"> 1. Single grain <ol style="list-style-type: none"> a. Unit found in very sandy soils b. Each grain acts independently c. Permeability is rapid d. Fertility and available water low

Instructor Directions	Content Outline
	<ol style="list-style-type: none"> 2. Massive <ol style="list-style-type: none"> a. Compact, coherent soils b. Not separated into peds c. Small pores d. Slow permeability e. Poor aeration
<p>Objective 5</p> <p><i>Demonstrate soil structure by holding a clod of soil in both hands and applying gentle pressure. If the soil breaks easily along a natural plane of weakness, it is breaking into units of soil structure. Discuss the difference between structure grade and type.</i></p>	<p>Explain the difference between structure grade and type.</p> <p><u>Structure grade</u> refers to the strength and stability of structural peds. (The ease with which the soil mass breaks into peds and the amount of unaggregated soil that remains indicate the structural grade.)</p> <ol style="list-style-type: none"> 1. Strong <ol style="list-style-type: none"> a. Peds are distinct in undisturbed soil b. Peds separate cleanly into whole units when disturbed c. Peds have stable structures d. Peds provide favorable air-water relationship e. Peds have good soil tilth 2. Moderate <ol style="list-style-type: none"> a. Well formed and evident in undisturbed soil b. Separate into a mixture of whole peds and broken units when disturbed 3. Weak <ol style="list-style-type: none"> a. Barely observable b. Become broken when disturbed c. Unstable structures d. Readily slake (break down) e. Readily seal (form a crust) f. Slow water movement g. Increase erosion hazard <p><u>Structure type</u> refers to the shape of the soil peds that are broken out of the soil mass.</p> <ol style="list-style-type: none"> 1. Granular 2. Platy 3. Blocky 4. Prismatic (columnar) 5. Unstructured (lack of soil peds)

Instructor Directions	Content Outline
<p>Objective 6</p> <p><i>Discuss the advantages of using deep rooted legumes to improve soil structure. Have students suggest other ways to improve soil structure.</i></p>	<p>Explain how soil structure can be improved.</p> <p>Time</p> <ol style="list-style-type: none"> 1. Soil structure gets stronger and more distinct 2. It takes several years to improve very weak structures. <p>Residue management</p> <ol style="list-style-type: none"> 1. Adding organic matter <ol style="list-style-type: none"> a. Deep rooted legumes b. Barnyard manure c. Green manure crops (plowed under grasses or legumes) 2. Using minimum tillage (or no-till) <ol style="list-style-type: none"> a. Avoid over-tilling b. Avoid tilling when wet 3. Rotating crops, including hay crops
<p>Application</p>	<p>Other activities:</p> <ol style="list-style-type: none"> 1. Have students bring in soil samples and observe the difference in structure. 2. Invite the county extension agent or soil conservation representative to visit your class and discuss the importance of soil structure. 3. Use the soil judging pit to examine the structure of the subsoil.
<p>Closure/Summary</p>	<p>Soil structure is important because it modifies some of the effects of texture on soil behavior. Structure is related to water infiltration, aeration, soil tilth, and the environment for plant root growth. The type and grade of soil structure can be determined by observing the soil and gently breaking it apart. Soil structure can be improved by increasing organic matter content, using minimum-tillage or no-till, and applying good residue management. Soil structure is broken down by over-tilling or tilling when the soil is wet.</p>
<p>Evaluation: Quiz</p>	<p>Answers:</p> <ol style="list-style-type: none"> 1. b 2. d 3. f 4. g 5. h

Instructor Directions	Content Outline
	6. i 7. j 8. e 9. c 10. a 11. b 12. c 13. b
