Course	Agricultural Science II
Unit	Soil Science
Lesson	Soil Texture
Estimated Time	Two 50-minute blocks

Student Outcome

Explain the importance of soil texture.

Learning Objectives

1. Explain the term soil texture.
2. Identify the three major separates in fine earth.
3. Explain what the different soil textures are and how they are determined.
4. Explain what rock fragments are and how they are identified.
5. Explain the term pore space.
6. Describe the importance of pore space.
7. Explain the relationship between soil texture and pore space.
8. Describe how other factors are affected by soil texture.

Grade Level Expectations

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. PowerPoint Slides
   - ☐ PPt 1 – Flowchart for Estimating Textural Class
   - ☐ PPt 2 – Relative Sizes of Sand, Silt, and Clay
   - ☐ PPt 3 – Textural Triangle
   - ☐ PPt 4 – The Soil Triangle
2. Activity Sheet
   - AS 1 – Are All Soil Particles the Same Size?
3. Minor, Paul E. *Soil Science* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1995.
4. *Soil Science Curriculum Enhancement.* University of Missouri-Columbia: Instructional Materials Laboratory, 2003.

Supplies & Equipment

- ❑ See AS 1 for materials and equipment needed to complete the Activity Sheet.

Supplemental Information

1. Internet Sites
   - ❑ Horizon Properties: Soil Texture. Goddard Space Flight Center, NASA. Accessed May 15, 2008, from http://soil.gsfc.nasa.gov/pvg/texture1.htm.
   - ❑ Soil Texture. Institute of Food and Agricultural Sciences Extension, University of Florida. Accessed May 15, 2008, from http://edis.ifas.ufl.edu/SS169.
   - ❑ Soil Texture (animation showing what kind of soils are created from different silt, sand, and clay content levels). Soil Science Department, North Carolina State University. Accessed May 15, 2008, from http://courses.soil.ncsu.edu/resources/physics/texture/soiltexture.swf.
   - ❑ Soil Texture Calculator. USDA Natural Resources Conservation Service. Accessed May 15, 2008, from http://soils.usda.gov/technical/aids/investigations/texture/.
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

Illustrate how texture influences the workability of soil. Compare working clay and sandy soil.

Communicate the Learning Objectives

1. Explain the term soil texture.
2. Identify the three major separates in fine earth.
3. Explain what the different soil textures are and how they are determined.
4. Explain what rock fragments are and how they are identified.
5. Explain the term pore space.
6. Describe the importance of pore space.
7. Explain the relationship between soil texture and pore space.
8. Describe how other factors are affected by soil texture.

Instructor Directions	Content Outline
Objective 1 *Have students assist you in doing a demonstration on soil texture. Perform the ribbon or feel test to determine how easily the soil can be molded. Refer to PPt 1.* ☐ PPt 1 – Flowchart for Estimating Textural Class	**Explain the term soil texture.** 1. Refers to the percentage by weight of sand, silt, and clay in a soil. 2. A balanced mixture is called loam. 3. Texture affects soil behavior. 4. Texture classifications also refer to the presence of gravel or cobblestones.
Objective 2 *Show PPt 2 to the students. Have the students demonstrate the surface area of soil particles by pouring water over a pile of marbles. Most of the water runs quickly away. Droplets clinging to the surface of the marbles are the only water retained in the pile, since water cannot soak into the marbles. Using the rule about particle size, a pile of small beads holds more water than a pile of marbles because it has more surface area. Complete AS 1 with the students.*	**Identify the three major separates in fine earth.** 1. Sand: particles are large and can be seen with the naked eye. a. Range in size from 0.05 mm to 2 mm b. Feels gritty c. Will not stick together when wet d. Low capacity for holding moisture and storing nutrients 2. Silt: particles are smaller than sand and cannot be seen without a hand lens or microscope. a. Range in size from 0.002 mm to 0.05 mm b. Feels smooth (like flour or corn starch) c. Not sticky d. Holds large amounts of water in a form plants can use

Instructor Directions	Content Outline
☐ PPt 2 – Relative Sizes of Sand, Silt, and Clay 🖹 AS 1 – Are All Soil Particles the Same Size?	3. Clay: particles are very small and flat and can be seen only with high-powered microscopes. a. Less than 0.002 mm in size b. High water holding capacity c. Feels sticky; can be molded into ribbons or wires
Objective 3 *Discuss the fact that all soil contains a mixture of the three major separates of sand, silt, and clay. Show the students PPt 3. Explain that loam is a balanced mixture of the three separates. Discuss how soil texture can be thought of in terms of one of nine steps from this balanced mixture. Using the soil samples, have the students feel and discuss the soil texture of each sample. Refer to PPt 4 as well.* ☐ PPt 3 – Textural Triangle ☐ PPt 4 – The Soil Triangle	**Explain what the different soil textures are and how they are determined.** 1. Textural names give clues as to the soil's combinations of the three major separates (sand, silt, and clay), as well as clues to its position on the soil triangle. a. Sand b. Loamy sand c. Sandy loam d. Sandy clay loam e. Clay loam f. Loam: contains all three separates though slightly less clay g. Silt h. Silt loam i. Silty clay loam j. Clay k. Sandy clay l. Silty clay 2. Laboratory analysis shows exact percentages of sand, silt, and clay. Mark points on the soil triangle corresponding with the percentage of at least two soil separates. 3. Field estimates are determined by working the soil between the thumb and fingers to estimate the amounts of sand, silt, and clay by the feel and behavior of the soil. a. First estimate the percentage of sand by noting grittiness. – More than 50% sand: textural name contains the word sand – Less than 20% sand: textural name usually contains the word silt

Instructor Directions	Content Outline
	b. Next, estimate the percentage of clay by the length of ribbon formed. – More than 40% clay: name usually contains only the word clay – Between 27% clay and 40% clay: name contains both the words clay and loam – Below 27% clay: textural name doesn't contain the word clay – Assume the rest of the content is silt
Objective 4 *Discuss rock fragments found in local soils.*	**Explain what rock fragments are and how they are identified.** 1. Rock fragments include all fragments larger than 2 mm. a. Gravel: rounded rock fragments with a diameter between 2 mm and 7.5 cm (3 inches) b. Cobbles: rounded or partly rounded with diameters from 3 inches to 10 inches c. Channer: more flat than round with diameters from 2 mm to 13 cm (6 inches) in length d. Flagstones: more flat than round with diameters from 6 inches to 15 inches in length e. Stones and boulders: round fragments more than 10 inches in diameter and flat fragments larger than 15 inches, considered a site characteristic (See Lesson 11.) 2. Textural names based on fine earth must be modified if soil contains a significant amount of gravel, cobbles, channers, or flagstones. 3. Modifier names depend on the volume of the soil mass occupied by rock fragments. (See Figure 4.2 in the student reference.) a. The percentage of rock fragments by volume is estimated to be equal to the percentage of rock fragments on the surface of a vertical soil profile. b. If a soil contains both gravel and cobbles, at least 60% of the rock fragments must be gravel to use the term gravelly. c. Use the term cobbly if more than 40% of the rock fragments are cobbles. d. Use the same calculations for channers or flagstones.

Instructor Directions	Content Outline
Objective 5 *Discuss how soil texture affects the distribution of pore space.*	**Explain the term pore space.** 1. Pore space is the space between soil particles. 2. Pore space contains either air or water. 3. The A horizon contains about equal amounts of solids and pore space. 4. The B and C horizons usually contain more than one-half pore space because of finer soil particles.
Objective 6 *How does pore space (soil porosity) influence water retention in the soil? Discuss pore space as it relates to root penetration.*	**Describe the importance of pore space.** 1. Pore space influences the behavior of soil for maximum plant growth. a. Infiltration b. Percolation c. Available water capacity d. Aeration
Objective 7 *Discuss why it is important to have good balance of particle sizes to incur maximum plant growth.*	**Explain the relationship between soil texture and pore space.** 1. Sandy soil has the largest pore spaces but cannot hold water as it passes, leaving soil droughty. 2. Clayey soil holds too much water in a thin film of hygroscopic water unavailable to plants and does not allow air flow. 3. A balanced soil texture will have a balanced mixture of large and small pores that will have the best soil properties for maximum plant growth. 4. Excessive tillage reduces pore space.
Objective 8 *Discuss physical properties and how they affect soil texture.*	**Describe how other factors are affected by soil texture.** 1. Soil texture affects the shrink-swell potential of a soil. It affects how buildings and highways are designed to prevent damage from cracking. 2. Content of rock fragments affects the load-bearing capacity for construction of roads, buildings, and earthen dams. 3. Soil texture affects soil behavior concerning water. a. Functioning of septic tank filter fields and sewage lagoons b. Affects the available water capacity c. Leaching of pesticides 4. Soil texture affects the tillage of crops.

Instructor Directions	Content Outline
Application AS 1 – Are All Particles the Same Size?	Answers to AS 1: 1. The sample with the most silt 2. The sample with a favorable proportion of sand, silt, and clay. Other activities: 1. Mix silt, sand, and clay particles together. Fill a jar half full from the mixture. Add water, cover with a lid, and shake vigorously. Set aside and allow the particles to settle out for one day. Record how the different particle sizes separated. 2. Each student is asked to bring in a soil sample. Have each student estimate soil texture by feel. Have students trade soil samples for more practice.
Closure/Summary	Soil texture is the percentage by weight of sand, silt, and clay. Soil texture is important to the aspects of soil behavior. Texture affects the amount of water a soil will hold, the rate of water movement through the soil, and the ease of root development. Texture also determines the porosity of a soil, shrink-swell potential, and the bearing capacity for roads, buildings, and dams. Soil texture can be determined by laboratory analysis or by field estimate (working the soil between the thumb and fingers). Textural class names (based on fine earth) are determined using a textural triangle and are modified if the soil contains a significant amount of rock fragments.
Evaluation: Quiz	Answers: 1. b 2. f 3. h 4. j 5. d 6. i 7. g 8. e 9. c 10. a 11. Loam