

Course	Agricultural Science II
Unit	Introduction to Grassland Management
Subunit	Soil Management
Lesson	Soil Tests
Estimated Time	Two 50-minute blocks
Student Outcome	

Interpret soil test information.

Learning Objectives

1. Determine what information is included on a soil test report.
2. Describe how the interpretation of the current soil analysis affects the nutrient requirements for a selected cropping option.
3. Describe how the probability of yield response to fertilizer application is determined.
4. Describe how the amount of lime needed per acre is determined.

Grade Level Expectations

SC/ME/1/B/09-11/b

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. Activity Sheets
 -  AS 1 – Word Search
 -  AS 2 – Taking a Soil Sample
2. *Introduction to Grassland Management* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1997.
3. *Introduction to Grassland Management Curriculum Enhancement, “Unit II – Soil Management.”* University of Missouri-Columbia: Instructional Materials Laboratory, 2003.

Supplies & Equipment

- ☐ Soil samples and test results for samples taken previously, if possible
- ☐ See AS 2 for materials and equipment needed to complete the Activity Sheet.

Supplemental Information

1. Internet Sites

- ❑ Buchholz, D. D., J. R. Brown, and R. G. Hanson. *Using Your Soil Test Results* (Catalog #G9111). Columbia: University of Missouri Extension, 1993. Accessed February 11, 2008, from <http://extension.missouri.edu/explore/agguides/soils/g09111.htm>.
- ❑ Lory, J. A., P. Scharf, and M. V. Nathan. *Interpreting Missouri Soil Test Reports* (Catalog #G9112). Columbia: University of Missouri Extension, 1998. Accessed February 11, 2008, from <http://extension.missouri.edu/explore/agguides/soils/g09112.htm>.
- ❑ Scharf, P. C. *Liming Missouri Soils* (Catalog #G9102). Columbia: University of Missouri Extension, 2000. Accessed February 11, 2008, from <http://extension.missouri.edu/explore/agguides/soils/g09102.htm>.
- ❑ Soil and Plant Testing Laboratory. University of Missouri Extension. Accessed February 11, 2008, from <http://soilplantlab.missouri.edu/soil>.
- ❑ Soil Testing. Department of Agriculture and Consumer Services, North Carolina. Accessed February 11, 2008, from <http://www.agr.state.nc.us/cyber/kidswrld/plant/soiltest.htm>.

2. Print

- ❑ *Soil Science* (Catalog #10-5050-I: Instructor). University of Missouri-Columbia: Instructional Materials Laboratory, 1995.
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Interest Approach

Demonstrate how to take a soil sample. If possible, show students soil test results for samples taken earlier from the same area. Have students take soil samples using AS 2.

Communicate the Learning Objectives

1. Determine what information is included on a soil test report.
2. Describe how the interpretation of the current soil analysis affects the nutrient requirements for a selected cropping option.
3. Describe how the probability of yield response to fertilizer application is determined.
4. Describe how the amount of lime needed per acre is determined.

Instructor Directions	Content Outline
Objective 1 <i>Ask students if they have ever seen a soil test report. Discuss the information included on a soil test report.</i>	Determine what information is included on a soil test report. 1. Field information: contains information provided by the producer to identify the field and summarize previous management 2. Soil test information: b. Provides the results of the soil tests performed on the sample a. Provides the necessary data to develop nitrogen, phosphate, potash, and agricultural lime recommendations for the intended cropping option 3. Rating: provides a rating for the salt pH and nutrients tested 4. Nutrient requirements: contains three parts – cropping options, yield goal, and fertilizer recommendations 5. Cropping options: lists cropping plans or crops for which fertilizer recommendations were requested 6. Yield goal: shows the level of production selected for the crops listed in the cropping options section 7. Pounds per acre: a. Lists the fertilizer recommendations for the crops and yield goals listed in pounds of N (nitrogen), P₂O₅ (phosphate), and K₂O (potash) b. Designed to provide an agronomic recommendation of the nutrients needed to meet the yield goal and improve soil fertility over time

Instructor Directions	Content Outline
	8. Limestone suggestions: a. Gives the suggested amount of limestone to raise soil salt pH to an optimal level for the cropping options listed b. Given for the cropping option requiring the highest salt pH range c. Reported as pounds of effective neutralizing material (ENM) per acre 9. Special notes: helps the producer interpret and use the results and recommendations
Objective 2 <i>Understanding how to interpret the results of the soil analysis will help students to comprehend why treatments are needed to improve the soil. Ask students why it is important to provide the soil test laboratory with different cropping options. Point out that the treatments provided are crop specific for the best growth, optimum yields, and lowest economic cost.</i>	Describe how the interpretation of the current soil analysis affects the nutrient requirements for a selected cropping option. 1. Basic soil test results a. pH_s (salt pH) - Indicates the relative level of soil acidity - Improves root development and provides a good environment for soil microorganisms b. Phosphorus (P) - Measured in terms of its relative availability for plant growth, not the total amount in the soil - Range from very low to very high c. Potassium (K) - Measured by the amount available for plant growth and not by the amount in the soil - Used with the cation exchange capacity (CEC) to determine the additional amount of potassium needed d. Calcium (Ca) - Used to calculate CEC - Based on the soil pH e. Magnesium (Mg) - Only added if levels are very low to medium - Can be applied with lime in dolomitic limestone, which contains calcium and magnesium

Instructor Directions	Content Outline
	f. Organic matter (O.M.) - Refers to the decayed plant material, or humus, in the soil - Used in estimating the potential nitrogen available to a crop during the growing season g. Neutralizable acidity - Measures exchangeable hydrogen - Aids in calculating liming requirements for the soil h. Cation exchange capacity (CEC): measures the ability of the soil to hold positively charged nutrients called cations (calcium, magnesium, potassium, and hydrogen) 2. Routine fertilizer recommendations a. Nitrogen (N): determined by cropping option, soil texture, and organic matter b. Phosphorus and potassium: added to the fertilizer mix based upon the soil test and the desired yield of a particular crop
Objective 3 <i>Have students explain how ratings on the soil report relate to the probable yield response caused by fertilizer application.</i>	Describe how the probability of yield response to fertilizer application is determined. 1. The soil test rating provides information on the probability that the application of a particular fertilizer will increase crop yield. 2. The probability of an increase in yields from fertilizer drops as the soil test rating rises.
Objective 4 <i>Ask students if they have ever helped lime a field. If they have, ask them how the tons of lime needed per acre was determined. Have students complete AS 1.</i>  AS 1 – Word Search	Describe how the amount of lime needed per acre is determined. Calculate the amount of lime required per acre by dividing the effective neutralizing material (ENM) value from the soil test by the ENM of the limestone. ENM indicates the ability to reduce soil acidity. $\frac{\text{ENM required by the soil test}}{\text{ENM of agricultural limestone}} = \text{tons of limestone/acre}$

Instructor Directions	Content Outline
Application  AS 1 – Word Search	Answers to AS 1 H E L P Q R C I C M A G N E S I U M O R D R F Y S I D L T A C I D I T Y I P I D Z O K O G N F Q K Z F R T V N R H Y M O M O A F T M R C P D O L O M I T I C Q X N T R E H Z I R S E O M E D V H R O N Q P N O D Y E N V E D H H U E A E P T A P M F F K V O A I F E O F R Z I Q I F T Y Q T M H L R H P E R W H W I O I T E D I J H N J R R E P D P R V L D R P O R O S E T F R A R Y W R F L C T N P P R R P A I Y E S Q M S O I L I T G A O O L J B I U J J L T Z O G L S A N T O M O P I V U U A N G F E N R N G A G R A N G M I O L T Z Y P N F H H A K N Q E O J Z O B J E J N W D E Q Z N P S I X Q R A F O T Y I Y N A D R C S A M P L E C N M A M N N Z I N C U V D R V S O C T C M J W M H J L N F U N B E B J A C L A O B Q B U M F V I Q O R G A N I C U E N M L N L M B H A C F A L Y B S Z M O M F A Z T D S A M R S P E T P J D Z D G K D S H K A F G N P B C G S E J Q U T E S Y J Z Y V E M C B N C P O T A S S I U M G R H I L X I P N P U R B N U E Q O F E A S O L F U R Q G U B E X R Z L E J X O A L A H A I O Z C X B B U M N C G T J X J U L U I L L T P O R M D T A F H F A D M B C X U X C A G D S Z A T Q A W T M D B A A K R B Y Z L E F A M E F B G C S I Z M Y R E T I S L C D U B M D H A U C Y D T B H X B R G K L J O T A O O O D U A R A T I N G C B I B N P G D Y B K A U B Z L X B N M Q A B M D A F M B K D X U B X B I G Y G R A C M L S Y S W L B F E R T I L I Z E R K M Y R C J C J L T P A T A Z T O C Other activities Take a soil sample from a school-owned planting area. Use the results to determine what amendments would provide increased yields or improve plant growth in that area. This activity would be most beneficial as an ongoing project, so students could see how the soil has changed from year to year. If this is to be done, be sure to keep the soil test reports and the treatments for each year.
Closure/Summary	Soil tests are helpful in reaching production yield goals. They report the current status of the soil and provide suggestions to improve the soil and increase crop yields.

Instructor Directions	Content Outline
Evaluation: Quiz	Answers: 1. b 2. d 3. a 4. a 5. d 6. 1.9 tons/acre 7. The soil test rating provides information on the probability that the application of a particular fertilizer will increase crop yield. The probability of an increase in yields from fertilizer drops as the soil test rating rises. 8. The data can be used to develop recommendations for nitrogen, phosphate, potash, and agricultural lime.

Course	Agricultural Science II
Unit	Introduction to Grassland Management
Subunit	Soil Management
Lesson	Using Soil Survey Manuals
Estimated Time	Four 50-minute blocks
Student Outcome	

Interpret soil survey manuals and recommend plants for a soil type.

Learning Objectives

1. Identify parts of the soil survey manual that apply to grassland management.
2. Describe how property is located in a soil survey manual.
3. Describe how the uses of the soil type are determined.
4. Identify the possible soil classifications.
5. Identify what soil factors affect plant selection.
6. Identify what the common drainage classifications are.
7. Determine where soil survey manuals/maps can be obtained.

Grade Level Expectations

SC/ME/1/B/09-11/b

SC/EC/3/C/09-11/d

SC/ES/3/A/09-11/e

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. PowerPoint Slide
 - ☐ PPt 1 – Forage Adaptation by Soil Drainage Class
2. *Introduction to Grassland Management* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1997.
3. *Introduction to Grassland Management Curriculum Enhancement*, Unit II – Soil Management.” University of Missouri-Columbia: Instructional Materials Laboratory, 2003.

Supplies & Equipment

- ☐ Local soil survey manuals

Supplemental Information

1. Internet Sites
 - ☐ Soil Survey Program. USDA Natural Resources Conservation Service. Accessed February 13, 2008, from <http://www.mo.nrcs.usda.gov/technical/soils.html>.
 - ☐ The Missouri Cooperative Soil Survey Website. Center for Agricultural, Resource and Environmental Systems (CARES), College of Agriculture, Food and Natural Resources, University of Missouri. Accessed February 13, 2008, from <http://soils.missouri.edu/>.

Interest Approach

Bring in copies of local soil survey manuals. Allow the students to attempt to locate their home and read the information concerning the soils found in that area. Discuss the various ways this information might be useful.

Communicate the Learning Objectives

1. Identify parts of the soil survey manual that apply to grassland management.
2. Describe how property is located in a soil survey manual.
3. Describe how the uses of the soil type are determined.
4. Identify the possible soil classifications.
5. Identify what soil factors affect plant selection.
6. Identify what the common drainage classifications are.
7. Determine where soil survey manuals/maps can be obtained.

Instructor Directions	Content Outline
Objective 1 <i>Ask students what soil information <u>not</u> provided on the soil test report they would need to know if they were managing a grassland area. Use the answers as a bridge into the list provided below.</i>	Identify parts of the soil survey manual that apply to grassland management. 1. How to use the soil survey: provides an introduction to or review of the survey; includes the general soils map for land use planning 2. Soil maps: aerial photographs on which phases of soil series are drawn to be used in making land use decisions 3. Use and management of the soils: descriptions of land use potential and management for all areas of interest 4. Descriptions of the soils: series by series soil description with information on characteristics, limitations on use, land capability, and suggested management practices 5. Formation and classification of the soil: information on uniform systems of soil classification
Objective 2 <i>Discuss the maps provided in the manual. Ask students why they might be included. Using the local manual, show the location of the school as an example of the procedure for locating specific plots of land. Have students refer to the instructions in the front of the soil survey manual.</i>	Describe how property is located in a soil survey manual. 1. Use the "Index to Map Sheets" to locate the property. 2. Go to the page number of the map sheet indicated by the index. 3. Locate the property on the map using landmarks and features and/or the US standard land survey system.

Instructor Directions	Content Outline
Objective 3 <i>The soil scientist interprets all the information for a particular area and determines the uses of that soil. Ask students how this determination is made.</i>	Describe how the uses of the soil type are determined. 1. Permanent limitations: cannot be easily changed; includes severe slope, soil depth, flooding, and large rocks 2. Temporary limitations: can be removed or improved; includes soil nutrient content, moderate slope, and minor drainage problems
Objective 4 <i>Some soils are more useful than others. For example, a plot of land on a rocky mountain is not going to be nearly as productive as a river bottom plot with a deep topsoil layer. Therefore, soils are classified according to the permanent limitations and hazards that affect the productivity of the soil. Have students describe the classification system and soil classifications.</i>	Identify the possible soil classifications. 1. Cultivable a. Class I (1): very few limitations b. Class II (2): has a few limitations that reduce plant choices or require moderate conservation practices c. Class III (3): requires special conservation practices with extra effort and costs because of severe limitations that reduce plant choices d. Class IV (4): requires very careful management and/or special conservation practices because of very severe limitations 2. Noncultivable a. Class V (5): suitable for pasture and wildlife; limitations are difficult to remove and prevent the use of standard farm equipment b. Class VI (6): used for grassland, range, or wildlife due to severe limitations c. Class VII (7): very severe limitations d. Class VIII (8): mountainous areas 3. E, W, S: additional labels for Classes II through VIII, standing for erosion (E), wet (W), and stoniness, shallowness, or droughtiness (S)
Objective 5 <i>Many aspects of the soil affect plant growth. These are therefore important to consider when selecting plants for the grassland. Have students list factors that influence plant selection.</i>	Identify what soil factors affect plant selection. 1. Soil texture: relative proportions of sand, silt, and clay particles in soil; affects the amount of contact plant roots have with available water, air, and nutrients 2. Soil depth: area that plant roots have available to extend downward; limits the type of plants that can root in the soil 3. Slope: steepness of the land's surface; affects erosion and ability to use farm machinery

Instructor Directions	Content Outline
	4. Erosion: loss of soil by wind or water; decreases soil depth by removing topsoil 5. Surface runoff: rate at which water disappears from the soil surface by absorption or flowing over the soil; leads to erosion, leaching of soil nutrients, and washing away of seeds or nutrients 6. Permeability: movement of air and water through the soil; affects root penetration, water movement in and on the soil, and nutrient leaching 7. Drainage: speed at which the water moves from the soil's surface; affects plant growth through a lack of or an excessive amount of water
Objective 6 <i>Water movement in and above the soil also affects the productivity of a grassland. Ask students how soils are distinguished by drainage classifications. Use PPT 1 to show plant adaptation by soil drainage classes.</i>  PPT 1 – Forage Adaptation by Soil Drainage Class	Identify what the common drainage classifications are. 1. Excessively drained soils: very porous and freely permeable 2. Somewhat excessively drained soils: free movement of water and air, but less than excessively drained soils 3. Well-drained soils: sandy or intermediately textured; uniform color with mottling near deep water table 4. Moderately well-drained soils: slower internal water movement and more mottling further up the profile; artificial drainage needed for alfalfa 5. Somewhat poorly drained soils: surface wet for many weeks; mottling just below surface; artificial drainage usually needed 6. Poorly drained soils: surface wet for many months; mottling throughout profile; artificial drainage required 7. Very poorly drained soils: wet almost every month; usually gray with mottling on surface; artificial drainage difficult to install but required
Objective 7 <i>County soil survey manuals are free to all Missouri residents. A fee is charged to all non-Missouri residents. Ask students where they can be obtained.</i>	Determine where soil survey manuals / maps can be obtained. 1. Soil and Water Conservation districts 2. Natural Resources Conservation Service offices

Instructor Directions	Content Outline
Application	Other activities 1. Have the students locate their homes in the soil survey manual. Using the information in the manual, the students should write a report on what they think is the best use of the land and why. Ask them to defend the answers with soil facts from the manual. 2. Use the soil survey manuals to simulate exercises. They should allow the students to practice map reading and interpretation of the information provided in the manual. Ask for information pertinent to grassland management. Land uses and crop selection should be derived by the students. Factual information provided by the manual may also be incorporated into the activity. The extent of this activity is dependent on the objectives of the teacher.
Closure/Summary	Soil survey manuals contain a lot of material that is useful to the grassland manager. However, the manual is only useful if the user has an understanding of the organization of the manual and a basic knowledge of soils. Soil type and drainage affect the productivity of plants and should therefore be considered when selecting plants for the grassland.
Evaluation: Quiz	Answers: 1. b 2. a 3. b 4. g 5. f 6. d 7. e 8. c 9. a 10. Use the "Index to Map Sheets" to locate the property. Go to the page number of the map sheet indicated by the index. Locate the property on the map using landmarks and features and/or the US standard land survey system. 11. Permanent limitations cannot be easily changed, while temporary limitations can be removed or improved. Examples of permanent limitations include

Instructor Directions	Content Outline
	severe slope, soil depth, flooding, and large rocks. Examples of temporary limitations include soil nutrient content, moderate slope, and minor drainage problems. 12. b 13. h 14. e 15. d 16. a 17. g 18. c 19. f 20. Decreases soil depth and removes topsoil 21. Affects root penetration, water movement, and nutrient leaching 22. Affects the amount of contact roots have with water, air, and nutrients