Introduction to Grassland Management

Instructor Guide

10-1201-I

In cooperation with
Agricultural Education Department of Practical Arts and Vocational-Technical Education
College of Education and College of Agriculture, Food and Natural Resources
University of Missouri-Columbia

Agricultural Education Section Division of Vocational and Adult Education
Department of Elementary and Secondary Education, Jefferson City, Missouri

Course	Agricultural Science II
Unit	Introduction to Grassland Management
Subunit	Grasslands and Grassland Plants
Lesson	An Introduction to Grasslands
Estimated Time	50 minutes

Student Outcome

Identify different types of grasslands and explain factors that create them.

Learning Objectives

1. Identify a grassland.
2. Describe forages.
3. Describe natural factors that affect the creation of grasslands.
4. Describe native grasslands.
5. Identify a prairie.
6. Identify a glade.
7. Identify a savanna.
8. Describe managed grasslands.
9. Describe grassland management.
10. Describe grassland conservation.

Grade Level Expectations

SC/ME/1/B/09-11/b	SC/EC/1/A/09-11/a	SC/EC/1/A/09-11/b
SC/EC/1/D/09-11/a	SC/EC/1/D/09-11/b	SC/EC/3/C/09-11/d
SC/ST/1/C/09-11/a	SC/ST/3/B/09-11/a	SC/ST/3/B/09-11/b
SC/ST/3/B/09-11/c		

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. PowerPoint Slide
   - ☐ PPt 1 – A Missouri Glade
2. Activity Sheet
   - AS 1 – Word Search
3. *Introduction to Grassland Management* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1997.
4. *Introduction to Grassland Management Curriculum Enhancement,* "Unit I – Grasslands and Grassland Plants." University of Missouri-Columbia: Instructional Materials Laboratory, 2003.

Supplies & Equipment

- ❑ Slides to visually represent grasslands, if available
- ❑ Pictures of a prairie, if available

Supplemental Information

1. Internet Sites
   - ❑ Grassland Types. Grassland Habitat, Hamilton Naturalists' Club, Ontario, Canada. Accessed February 4, 2008, from http://www.hamiltonnature.org/habitats/grasslands/grass_types.htm.
   - ❑ National Grasslands. USDA Forest Service. Accessed February 4, 2008, from http://www.fs.fed.us/grasslands/.

Interest Approach

Ask students what they think a grassland is. List their answers and discuss them. If possible, use slides to visually represent grasslands. Ask the following questions: Is an area a grassland if food for livestock is not raised on it? [Yes.] Is prairie grassland? [Yes.] Is a cornfield grassland? [Ecologically yes, agriculturally no.] What about your front yard? [Yes.]

Have students observe a lawn and explain what actions must take place to establish and maintain the area in grass. Have them answer the following questions: What would happen if weed control stopped? What would happen if mowing stopped? Have students visit another type of grassland convenient for them (pasture, prairie, glade) and evaluate it in the same way.

Communicate the Learning Objectives

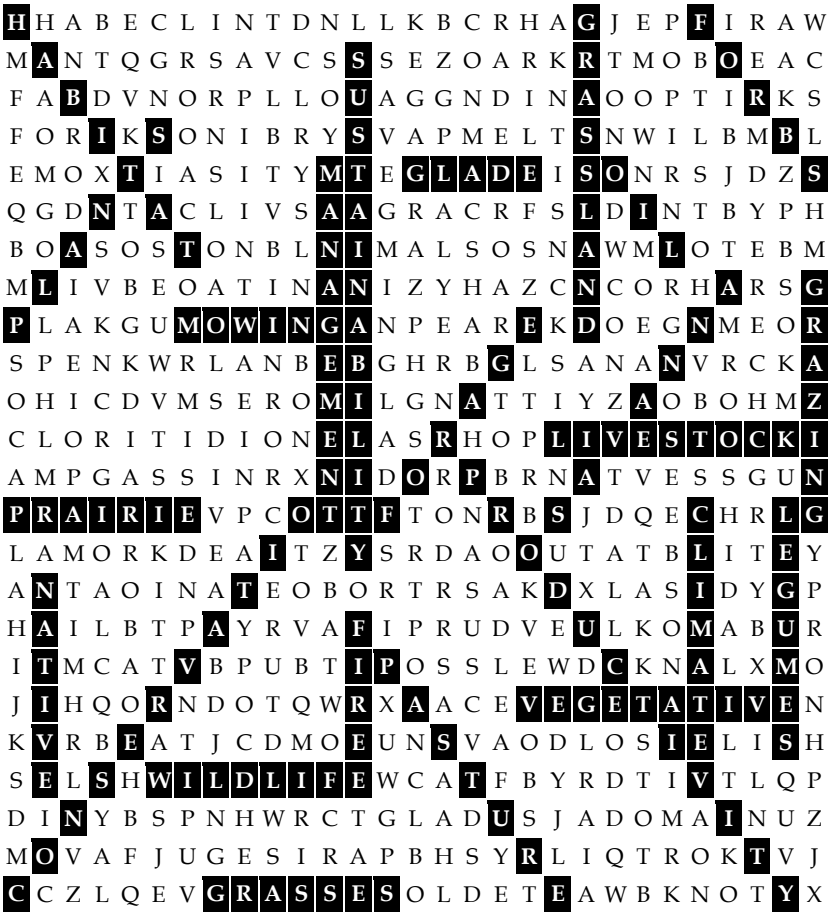
1. Identify a grassland.
2. Describe forages.
3. Describe natural factors that affect the creation of grasslands.
4. Describe native grasslands.
5. Identify a prairie.
6. Identify a glade.
7. Identify a savanna.
8. Describe managed grasslands.
9. Describe grassland management.
10. Describe grassland conservation.

Instructor Directions	Content Outline
Objective 1 *Ask students for a definition of grassland. Discuss the different meanings of the word.*	**Identify a grassland.** 1. Ecologically, a plant community dominated by grasses, whether they exist naturally or because of management practices 2. Agriculturally, an area managed to grow grass, legumes, or other pasture or range plants used mostly for the production of forage
Objective 2 *Ask students to name some of the plants they consider to be forages. Discuss the definition of forages.*	**Describe forages.** Forages are primarily grasses and legumes grown for their soft, vegetative parts, which are used as feed for livestock

Instructor Directions	Content Outline
Objective 3 *Ask students to list natural factors that affect grasslands. Discuss the different factors.*	**Describe natural factors that affect the creation of grasslands.** 1. Climate a. Grasslands usually dominate in areas averaging 10 to 30 inches of rainfall. b. Most of Missouri receives 35 inches of precipitation or more each year, which places the state at the transition point between grassland and forest. 2. Soil a. Some soils (such as shallow or coarsely textured soils, hardpans, and soils with high water tables) discourage tree growth and favor grasslands. 3. Plants a. Many grassland plants have adapted to their environment by becoming dormant when conditions are harsh and producing new growth when conditions improve. b. This adaptation allows them to survive damage from fire, grazing/browsing, drought, and high winds, all of which can kill or limit the growth of trees and shrubs. 4. Grazing a. Grazing is natural to grassland communities. b. Unlike trees and shrubs, which are more severely damaged by grazing and browsing, grassland plants have adapted to grazing. 5. Fire a. Grassland plants tolerate fire better than trees and shrubs. b. Where fires occur often enough to limit forest, grasslands dominate.
Objective 4 *Ask students to explain what native grasslands are. Discuss the changes European settlers and modern agriculture made to the ecology and landscape of Missouri.*	**Describe native grasslands.** 1. Native grasslands are those that existed in America before the arrival of European settlers. 2. The trend toward conservation farming has led to new interest in native grasslands and their plants. 3. Most of Missouri's native grasslands are prairies, glades, or savannas.

Instructor Directions	Content Outline
Objective 5 *Ask students to describe what a prairie is. If possible, show them pictures of a prairie.*	**Identify a prairie.** 1. Prairies are large, continuous native grasslands in which trees and shrubs are nearly absent. 2. While grasses dominate, a rich diversity of native grasses, legumes, and forbs inhabit Missouri's remaining prairies. 3. Different kinds of prairies develop on different sites. a. Dry – Dominated by shorter grasses like little bluestem and sideoats grama – Mostly converted to pasture b. Wet – Dominated by taller grasses like big bluestem and Indiangrass, sometimes reaching 6 to 8 feet in height – Mostly converted to cropland
Objective 6 *Ask the following question: "While admiring a blossoming yucca, you fall from your horse, land seat first on a cactus, get stung by a scorpion, bitten by a tarantula, and struck by a rattlesnake. Aside from a world of hurt, where are you?" Point out that the answer could be a Missouri glade. Refer to PPt 1.* ☐ PPt 1 – A Missouri Glade	**Identify a glade.** 1. Small, isolated native grasslands occurring on hilltops and southwest-facing slopes 2. Found where rocky outcrops, exposure to sunlight, and thin, dry soils create harsh desert-like conditions during the summer 3. Dominated by prairie grasses and forbs 4. Also have plants and animals from western prairies and deserts like yuccas, cacti, tarantulas, and scorpions
Objective 7 *Ask students to describe a savanna. When woodlands and grasslands meet, the sudden presence of trees may look like a distinct change, but actually a more gradual transition is taking place. Grasslands with widely spaced trees and woodlands with a*	**Identify a savanna.** 1. Specialized community that is intermediate between grassland and forest with widely spaced trees, a conspicuous absence of smaller trees and shrubs, and grasses as the dominant ground cover 2. Can be used for wood, wildlife habitat, and forages

Instructor Directions	Content Outline
healthy stand of grass beneath the trees were common in presettlement Missouri.	
Objective 8 *Point out that few native grasslands with their original plant communities are left in Missouri, yet grasslands can be easily found in every part of the state. Ask students about the origin of these grasslands.*	**Describe managed grasslands.** 1. Managed grasslands are areas managed for forage, pasture, or grassland habitat. 2. Over 95% of Missouri's grasslands are privately owned. 3. Most managed grasslands are used for forage production; pasture is the most common type of grassland in Missouri.
Objective 9 *Discuss how grasslands are used today. Have students list factors involved in establishing and maintaining a grassland.*	**Describe grassland management.** 1. Grassland management is the use and care of grasslands. 2. It involves managing the plants, animals, equipment, and practices needed for the successful use of grasslands.
Objective 10 *Ask the class whether grasslands are a natural resource. Have students list other natural resources found on grasslands (soil, water, wildlife, plants). Discuss why conservation is important. Have students complete AS 1.* AS 1 – Word Search	**Describe grassland conservation.** Grassland conservation is the wise use of grasslands and other natural resources found on them to ensure their long-term productivity and sustainability.

Instructor Directions	Content Outline
Application AS 1 – Word Search	Answers to AS 1  Other activities 1. Visit a prairie, glade, or savanna to distinguish between grasslands and other vegetation types. Emphasize the differences between native grasslands and converted grasslands. 2. Show range maps for the Eastern collared lizard, brush mouse, roadrunner, and prairie ringneck snake as examples of western desert and prairie species that live in glades in Missouri. 3. Have students visit a pasture and write a description of it, mentioning the amount of ground cover, the density of the plants, the amount of bare soil, signs of erosion, and the height and quality of the forage. Read descriptions of native grasslands. Compare

Instructor Directions	Content Outline
	these descriptions and ask students which land they would prefer to own. What do they think can be done to improve forage production on the pasture they observed?
Closure/Summary	In agriculture, a grassland is an area managed to grow grass, legumes, or other pasture or range plants for forage production. Forages are primarily grasses and legumes used as feed for livestock. Several basic environmental factors – climate, soil, plants, grazing, and fire – influence the growth of grasslands. Native grasslands, including prairies, glades, and savannas, once covered much of the state, but most have been converted to other uses. Most of Missouri's grasslands now consist of pastures of nonnative plants, although native grasslands and native plants are showing new promise in livestock operations. The key to success in grassland farming is proper management, which focuses on sustaining the productivity of forage plants.
Evaluation: Quiz	Answers: 1. c 2. b 3. d 4. a 5. d 6. a 7. Managed grasslands are areas managed for forage, pasture, or grassland habitat. 8. Grassland management involves managing the plants, animals, equipment, and practices needed for the successful use of grasslands. 9. Forages are primarily grasses and legumes grown for their soft vegetative parts, which are used as feed for livestock. 10. Climate, soil, plants, grazing, fire 11. Agriculturally, a grassland is an area managed to grow grass, legumes, or other pasture or range plants used mostly for the production of forage.

Course	Agricultural Science II
Unit	Introduction to Grassland Management
Subunit	Grasslands and Grassland Plants
Lesson	Plant Classification
Estimated Time	Three 50-minute blocks

Student Outcome

Identify plant classifications found in grasslands.

Learning Objectives

1. Describe how grassland plants can be classified.
2. Describe the characteristics of cool-season grasses.
3. Describe the characteristics of warm-season grasses.
4. Describe the characteristics of legumes.
5. Describe the characteristics of forbs.
6. Describe the characteristics of woody plants.
7. Identify what plant species are found in grasslands.

Grade Level Expectations

SC/LO/1/E/09-11/a SC/LO/1/E/09-11/b

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. PowerPoint Slides
   - ☐ PPt 1 – Cool- and Warm-Season Grass Growth
   - ☐ PPt 2 – Grasses
   - ☐ PPt 3 – Legumes
   - ☐ PPt 4 – Forbs
   - ☐ PPt 5 – Woody Plants
2. Activity Sheets
   - AS 1 – Constructing a Plant Press
   - AS 2 – Identifying Grassland Plants
3. *Introduction to Grassland Management* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1997.
4. *Introduction to Grassland Management Curriculum Enhancement,* "Unit I – Grasslands and Grassland Plants." University of Missouri-Columbia: Instructional Materials Laboratory, 2003.

Supplies & Equipment

- ❑ Several samples of grassland plants or detailed pictures representing different types of foliage found in the local area.
- ❑ See AS 1 and AS 2 for materials and equipment needed to complete the Activity Sheets.

Supplemental Information

1. Internet Sites
   - ❑ Classification. Plants Database, USDA Natural Resources Conservation Service. Accessed on February 7, 2008, from http://plants.usda.gov/classification.html.
2. Print
   - ❑ *Crop and Grassland Plant Identification Manual* (Catalog #10-1203-S). University of Missouri-Columbia: Instructional Materials Laboratory, 1997.

Interest Approach

Have students bring in plant samples from grassland areas near their homes. Discuss what types of plants are found in grasslands and why grassland areas are important to agriculture.

Communicate the Learning Objectives

1. Describe how grassland plants can be classified.
2. Describe the characteristics of cool-season grasses.
3. Describe the characteristics of warm-season grasses.
4. Describe the characteristics of legumes.
5. Describe the characteristics of forbs.
6. Describe the characteristics of woody plants.
7. Identify what plant species are found in grasslands.

Instructor Directions	Content Outline
Objective 1 *Bring in several samples of grassland plants that represent the different types of foliage found in the local area. Include at least one grass, legume, forb, and woody plant. Have the class, as a whole or in groups, brainstorm on what makes these plants similar and different. Make sure that annuals, perennials, and (if possible) biennials are among the samples. Compose a list and discuss the results as they relate to plant types and life cycles.* *Note: If live cuttings are not available, use detailed pictures of the different types of grassland plants from a reference, such as IML's Crop and Grassland Plant Identification Manual.*	**Describe how grassland plants can be classified.** 1. Life cycle: Classification system that identifies plants based on their yearly growth and seeding characteristics a. Annuals – complete life cycle occurs in one growing season b. Biennials – complete life cycle occurs over two growing seasons c. Perennials – grow year after year 2. Plant type: Classification system that identifies plant species and groups them according to their physical characteristics a. Grasses (cool- and warm-season) b. Legumes c. Forbs d. Woody plants
Objective 2 *Separate the grasses from the other plant samples. Discuss how*	**Describe the characteristics of cool-season grasses.** 1. Herbaceous 2. Hollow stems

Instructor Directions	Content Outline
optimum temperature for growth divides them into cool-season or warm-season grasses, using PPt 1 to illustrate the differences in their growing seasons. Point out some examples of cool-season grasses from the samples, such as Kentucky bluegrass, orchardgrass, and smooth bromegrass. Discuss the characteristics of cool-season grasses. PPt 2 can be used to illustrate the physical characteristics of grasses. ☐ PPt 1 – Cool- and Warm-Season Grass Growth ☐ PPt 2 – Grasses	3. Blades and stems joined directly at sheath 4. Parallel venation on leaf blade 5. Grows when soil temperature reaches 40° F in early spring, with optimum growth occurring when air temperatures fall in the 59° to 77° F range in the spring and fall 6. Dormant in summer 7. Annuals or perennials
Objective 3 *Point out some examples of warm-season grasses, such as Indiangrass, big bluestem, and switchgrass. Discuss the characteristics of warm-season grasses.*	**Describe the characteristics of warm-season grasses.** 1. Herbaceous 2. Hollow stems 3. Blades and stems joined directly at sheath 4. Parallel venation on leaf blade 5. Grows when soil temperatures reach 60° F in spring, with optimum growth occurring when air temperatures fall in the 77° to 104° F range in summer 6. Dormant in winter 7. Annuals or perennials
Objective 4 *Grasses are beneficial plants, but they are not the only ones. Because grasslands are made up of ranges and pasture, another plant type that is used for forage and is beneficial to the grassland is the legume. Point out some examples of legumes, such as clovers, alfalfa, and birdsfoot trefoil, and*	**Describe the characteristics of legumes.** 1. One-chambered fruit with seeds in a single row within the pod 2. Alternate leaf arrangement with leaves usually connected to petiole 3. Network of veins 4. Annuals, perennials, or biennials 5. Nodules with nitrogen fixing capacity on most rooting systems

Instructor Directions	Content Outline
discuss the characteristics of legumes. PPt 3 may also be used as an illustration. ☐ PPt 3 – Legumes	
Objective 5 *Other herbaceous plants that are neither grasses or legumes are forbs. Show examples of forbs, like sunflowers, thistles, and ragweed, from the grassland plant samples. Use PPt 4 to further illustrate forbs. Discuss the characteristics of forbs with the class.* ☐ PPt 4 – Forbs	**Describe the characteristics of forbs.** 1. Herbaceous (not woody) 2. Broadleaf plants 3. Annuals, perennials, or biennials
Objective 6 *The only nonherbaceous plant type found in grasslands is woody plants. In a grassland pasture or range, most woody plants will be weedy saplings or small immature trees and shrubs. Use PPt 5 to illustrate woody plants. Show examples of woody plants from the grassland plant samples, such as wild rose, red cedar, and oak, and discuss their characteristics.* ☐ PPt 5 – Woody Plants	**Describe the characteristics of woody plants.** 1. Woody (nonherbaceous) stems 2. Shrubs, vines, or trees 3. Perennials
Objective 7 *Ask students to list the various plant species found in grasslands with which they are familiar. Discuss different plant species found in grasslands. Assign AS 1 and AS 2.*	**Identify what plant species are found in grasslands.** 1. Grasses and grasslike plants: Barley — *Hordeum vulgare* — Annual Barnyardgrass — *Echinochloa crusgalli* — Annual Bermudagrass — *Cynodon dactylon* — Perennial Big bluestem — *Andropogon gerardi* — Perennial

Instructor Directions	Content Outline		
Note: Have students refer to IML's Crop and Grassland Plant Identification Manual during the discussion of plant species, if desired. AS 1 – Constructing a Plant Press AS 2 – Identifying Grassland Plants	Bromegrass	*Bromus inermis*	Perennial
	Broomsedge	*Andropogon virginicus*	Perennial
	Canada bluegrass	*Poa compressa*	Perennial
	Caucasian bluestem	*Andropogon caucasius*	Perennial
	Cheat/Chess	*Bromus secalinus*	Annual
	Corn	*Zea mays*	Annual
	Crabgrass	*Digitaria sanguinalis*	Annual
	Downy chess	*Bromus tectorum*	Annual
	Fall panicum	*Panicum dichotomiflorum*	Annual
	Giant foxtail	*Setaria faberi*	Annual
	Goosegrass	*Eleusine indica*	Annual
	Green foxtail	*Setaria viridis*	Annual
	Indiangrass	*Sorghastrum nutans*	Perennial
	Johnsongrass	*Sorghum halepense*	Perennial
	Kentucky bluegrass	*Poa pratensis*	Perennial
	Little bluestem	*Andropogon scoparius*	Perennial
	Oats	*Avena sativa*	Annual
	Orchardgrass	*Dactylis glomerata*	Perennial
	Perennial ryegrass	*Lolium perenne*	Perennial
	Prairie cupgrass	*Eriochloa contracta*	Annual
	Purpletop	*Tridens flavus*	Perennial
	Quackgrass	*Agropyron repens*	Perennial
	Redtop	*Agrostis alba*	Perennial
	Reed canarygrass	*Phalaris arundinacea*	Perennial
	Rice	*Oryza sativa*	Annual
	Rye	*Secale cereale*	Annual
	Sandbur	*Cenchrus longispinus*	Annual
	Smooth crabgrass	*Digitaria ischaemum*	Annual
	Switchgrass	*Panicum virgatum*	Perennial
	Tall fescue	*Festuca arundinacea*	Perennial
	Three-awn grass	*Aristida oligantha*	Annual
	Timothy	*Phleum pratense*	Perennial
	Wheat	*Triticum aesativum*	Annual
	Wirestem muhly	*Muhlenbergia frondosa*	Perennial
	Witchgrass	*Panicum capillare*	Annual
	Yellow foxtail	*Setaria glauca*	Annual
	Yellow nutgrass or chufa	*Cyperus esculentus*	Perennial
	2. Legumes:		
	Alfalfa	*Medicago sativa*	Perennial
	Alsike clover	*Trifolium hybridum*	Perennial
	Birdsfoot trefoil	*Lotus corniculatus*	Perennial
	Black medic	*Medicago lupulina*	Annual

Instructor Directions	Content Outline		
	Common lespedeza or Japanese bush clover	*Kummerowia striata*	Annual
	Common vetch	*Vicia sativa*	Annual
	Crimson clover	*Trifolium incarnatum*	Annual
	Crown vetch	*Coronilla varia*	Perennial
	Hairy vetch	*Vicia villosa*	Annual/ biennial
	Illinois bundleflower	*Desmanthus illinoensis*	Perennial
	Korean lespedeza	*Kummerowia stipulacea*	Annual
	Lead plant	*Amorpha canescens*	Perennial
	Little hop clover	*Trifolium dubium*	Annual
	Low hop clover	*Trifolium campestre*	Annual
	Partridge pea	*Cassia fasciculata*	Annual
	Red clover	*Trifolium pratense*	Biennial
	Sericea lespedeza or silky bush clover	*Lespedeza cuneata*	Perennial
	Slender lespedeza	*Lespedeza virginica*	Perennial
	Soybean	*Glycine max*	Annual
	Tick trefoil	*Desmodium spp.*	Perennial
	White clover	*Trifolium repens*	Perennial
	Yellow sweet clover	*Melilotus officinalis*	Biennial
	3. Forbs:		
	Black nightshade	*Solanum americanum*	Annual
	Bracted plantain	*Plantago aristata*	Annual
	Buckwheat	*Fagopyrum esculentum*	Annual
	Bull nettle	*Cnidoscolus texanus*	Perennial
	Bull thistle	*Cirsium vulgare*	Biennial
	Bur cucumber	*Sicyos angulatus*	Annual
	Butterfly milkweed	*Asclepias tuberosa*	Perennial
	Canada thistle	*Cirsium arvense*	Perennial
	Cinquefoil	*Potentilla simplex*	Perennial
	Common chickweed	*Stellaria media*	Annual
	Common chicory	*Cichorium intybus*	Perennial
	Common cocklebur	*Xanthium strumarium*	Annual
	Common milkweed	*Asclepias syriaca*	Perennial
	Common morning glory	*Ipomoea purpurea*	Annual
	Common plantain	*Plantago major*	Annual
	Common ragweed	*Ambrosia artemisiifolia L.*	Annual
	Common sunflower	*Helianthus annuus*	Annual
	Common yarrow	*Achillea millefolium*	Perennial
	Corn cockle	*Agrostemma githago*	Annual
	Cotton	*Gossypium hirsutum*	Annual

Instructor Directions	Content Outline		
	Croton	*Croton monanthogynus*	Annual
	Daisy fleabane	*Erigeron strigosus*	Annual
	Dandelion	*Taraxacum officinale*	Perennial
	Field bindweed	*Convolvulus arvensis*	Perennial
	Four-leaf milkweed	*Asclepias quadrifolia*	Perennial
	Giant ragweed	*Ambrosia trifida L.*	Annual
	Hedge bindweed	*Convolvulus sepium*	Annual
	Hemp	*Cannabis sativa*	Annual
	Henbit	*Lamium amplexicaule*	Perennial
	Horse nettle	*Solanum carolinense*	Perennial
	Ironweed	*Vernonia baldwini*	Perennial
	Ivyleaf morning glory	*Ipomoea hederacea*	Annual
	Jimsonweed	*Datura stramonium*	Annual
	Kochia or burning bush	*Kochia scoparia*	Annual
	Lamb's quarters	*Chenopodium album*	Annual
	Lance-leaf ragweed	*Ambrosia bidentata*	Annual
	Musk thistle	*Carduus nutans*	Biennial
	Ox-eye daisy	*Chrysanthemum leucanthemum*	Perennial
	Pale dock	*Rumex altissimus*	Perennial
	Pennsylvania smartweed	*Polygonum pennsylvanicum*	Annual
	Pepper grass	*Lepidium virginicum*	Annual
	Pigweed	*Amaranthus spp.*	Annual
	Prairie dogbane	*Apocynum cannabinum*	Perennial
	Prairie goldenrod	*Solidago missouriensis*	Perennial
	Prickly lettuce	*Lactuca serriola*	Biennial
	Prickly sida	*Sida spinosa*	Annual
	Queen Anne's lace or wild carrot	*Daucus carota*	Biennial
	Sheep sorrel or field sorrel	*Rumex acetosella*	Perennial
	Shepherd's purse	*Capsella bursa-pastoris*	Annual
	Smartweed	*Polygonum lapathifolium*	Annual
	Tabacco	*Nicotiana tabacum*	Annual
	Tall thistle	*Cirsium altissimum*	Perennial
	Three-seeded mercury	*Acalypha ostryaefolia*	Annual
	Velvetleaf	*Abutilon theophrasti*	Annual
	Venice mallow or flower of an hour	*Hibiscus trionum*	Perennial
	Water hemp	*Amaranthus tamariscinus*	Annual
	White avens	*Geum canadense*	Perennial
	White mustard	*Brassica hirta*	Annual

Instructor Directions	Content Outline		
	Wild cucumber	*Echinocystis lobata*	Annual
	Wild garlic	*Allium canadense*	Perennial
	Wild strawberry	*Fragaria virginiana*	Perennial
	4. Woody plants:		
	Black cherry	*Prunus serotina*	Perennial
	Black locust	*Robinia pseudoacacia*	Perennial
	Black oak	*Quercus velutina*	Perennial
	Black raspberry	*Rubus occidentalis*	Perennial
	Coralberry or buckbrush	*Symphoricarpus orbiculatus*	Perennial
	Dewberry	*Rubus flagellaris*	Perennial
	Elm	*Ulmus spp.*	Perennial
	Flowering dogwood	*Cornus florida*	Perennial
	Grape	*Vitis spp.*	Perennial
	Hawthorn	*Crataegus spp.*	Perennial
	Hickory	*Carya spp.*	Perennial
	High bush blackberry	*Rubus pensilvanicus*	Perennial
	Honey locust	*Gleditsia triacanthos*	Perennial
	Osage orange	*Maclura pomifera*	Perennial
	Persimmon	*Diospyros virginiana*	Perennial
	Poison ivy	*Rhus radicans*	Perennial
	Redcedar	*Juniperus virginiana*	Perennial
	Rose	*Rosa spp.*	Perennial
	Sassafras	*Sassafras albidum*	Perennial
	Smooth sumac	*Rhus glabra*	Perennial
	White oak	*Quercus alba*	Perennial
	Wild plum	*Prunus spp.*	Perennial
	Willow oak	*Quercus phellos*	Perennial
Application	Other activities Take a field trip to a nearby pasture or range and discuss the different types of plants found there. Have the students explain the different uses of the plants found for farmers, consumers, wildlife, hunters, landowners, and wildlife enthusiasts.		
Closure/Summary	All plants in the grassland, whether cultivated or native, can be classified as grasses, legumes, forbs, or woody plants. The plants in each classification share characteristics that make the plants in that group similar. With an understanding of these plants and their importance, it is possible to reach reasonable forage crop		

Instructor Directions	Content Outline
	production goals and satisfy the needs of a healthy wildlife population.
Evaluation: Quiz	Answers: 1. c 2. b 3. h 4. d 5. a 6. e 7. f 8. g 9. b 10. c 11. They are nonherbaceous, with woody stems. 12. The life cycle classification system identifies plants based on their yearly growth and seeding characteristics. The plant type classification system identifies plant species and groups them according to their physical characteristics.

Course	Agricultural Science II
Unit	Introduction to Grassland Management
Subunit	Grasslands and Grassland Plants
Lesson	Botanical Characteristics
Estimated Time	Four 50-minute blocks

Student Outcome

Recognize the characteristics of grassland plants that are used in plant identification.

Learning Objectives

1. Identify the structural parts of grasses.
2. Describe how leaf parts can help identify grasses.
3. Describe how the root or modified stem can be used to identify grassland plants.
4. Describe how the type of inflorescence can help identify grassland plants.
5. Identify leaf structures and leaf arrangements used in grassland plant identification.
6. Describe how stem shape can be used to identify plants.
7. Identify the external parts of the woody plant stem.

Grade Level Expectations

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. PowerPoint Slides
   - ☐ PPt 1 – Identifying Characteristics of Grasses
   - ☐ PPt 2 – Roots and Modified Stems
   - ☐ PPt 3 – Inflorescence
   - ☐ PPt 4 – Leaf Structure and Arrangement
   - ☐ PPt 5 – Stem Structure of Woody Plants
2. Activity Sheet
   Refer back to the Activity Sheet on Identifying Grassland Plants from the previous lesson on Plant Classification.
3. *Introduction to Grassland Management* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1997.
4. *Introduction to Grassland Management Curriculum Enhancement,* "Unit I – Grasslands and Grassland Plants." University of Missouri-Columbia: Instructional Materials Laboratory, 2003.

Supplies & Equipment

- ❑ Samples of grassland plants collected in the previous lesson

Supplemental Information

1. Internet Sites
   - ❑ Grassland Plants. Missouri Botanical Garden, St. Louis. Accessed February 8, 2008, from http://www.mbgnet.net/sets/grasslnd/plants/index.htm.
   - ❑ Missouri Forage and Grassland Council/Grazing Lands Conservation Initiative. Accessed February 8, 2008, from http://agebb.missouri.edu/mfgc/index.htm.
2. Print
   - ❑ *Crop and Grassland Plant Identification Manual* (Catalog #10-1203-S). University of Missouri-Columbia: Instructional Materials Laboratory, 1997.

Interest Approach

Have students observe botanical characteristics of the samples collected in the last lesson. Notice the structural parts that make each sample different, such as leaf shapes, leaf arrangement, root structure, flowers, and buds. List the differences for each part on the chalkboard.

Communicate the Learning Objectives

1. Identify the structural parts of grasses.
2. Describe how leaf parts can help identify grasses.
3. Describe how the root or modified stem can be used to identify grassland plants.
4. Describe how the type of inflorescence can help identify grassland plants.
5. Identify leaf structures and leaf arrangements used in grassland plant identification.
6. Describe how stem shape can be used to identify plants.
7. Identify the external parts of the woody plant stem.

Instructor Directions	Content Outline
Objective 1 *Ask students to name the different structural parts that may be used to identify grasses. Along with the schematic drawing of Cool- and Warm-Season Grass Growth provided in the PowerPoint slide from the previous lesson, display a grass sample so they can see the actual parts. Try to obtain a plant sample with roots and flowers.*	**Identify the structural parts of grasses.** 1. Roots 2. Culm (stem) 3. Node 4. Internode 5. Leaf sheath 6. Leaf blade 7. Collar 8. Auricle 9. Ligule 10. Inflorescence (flowering part of the plant)
Objective 2 *Ask students how the structural parts can help in identifying grasses. Discuss the differences in the leaf that can be observed to help distinguish one grass from another. Refer to PPt 1.* ☐ PPt 1 – Identifying Characteristics of Grasses	**Describe how leaf parts can help identify grasses.** 1. Leaf blade shape a. Tapering to tip b. Boat-shaped tip c. Parallel-sided d. Narrowed to base 2. Collar a. Broad b. Narrow c. Divided d. Oblique e. Hairy f. Hairy margins

Instructor Directions	Content Outline
	3. Leaf blade arrangement a. Rolled b. Folded 4. Sheath a. Split b. Split, margins overlapping c. Closed 5. Auricle a. Large b. Small c. Absent 6. Ligule shapes a. Acuminate b. Acute c. Rounded d. Truncate e. Absent
Objective 3 *Ask students to describe different types of root or modified stem structures they have seen on grassland plants, including trees, shrubs, grasses, forbs, and legumes. Discuss the basic structures found in grassland plants. Refer to PPt 2.* ☐ PPt 2 – Roots and Modified Stems	**Describe how the root or modified stem can be used to identify grassland plants.** 1. Roots a. Tap b. Fibrous 2. Modified stems a. Rhizomes b. Stolons
Objective 4 *Ask students to describe different arrangements of flowers they have seen on grassland plants. Display examples of typical grassland flowers for the students to observe. Discuss the six basic*	**Describe how the type of inflorescence can help identify grassland plants.** 1. Spike 2. Raceme 3. Panicle 4. Umbel 5. Terminal 6. Axillary

Instructor Directions	Content Outline
inflorescence structures found in grassland plants. Refer to PPt 3. ☐ PPt 3 – Inflorescence	
Objective 5 *Point out to students that the leaf on a legume, forb, or woody plant is just as important in identifying the plant as the leaf blade on a grass plant. Discuss the different parts and arrangements of leaves. Refer to PPt 4.* ☐ PPt 4 – Leaf Structure and Arrangement	**Identify leaf structures and leaf arrangements used in grassland plant identification.** 1. Parts of a leaf a. Petiole b. Stipules c. Base d. Blade, surface texture – Glabrous – Pubescent – Glaucous 2. Arrangement of leaves and buds a. Alternate b. Opposite c. Whorled d. Basal 3. Types of venation a. Parallel b. Netted – Palmate – Pinnate 4. Types of leaves a. Simple, may be lobed b. Compound – Palmate – Pinnate – Bipinnate – Trifoliate 5. Leaf anatomy a. Leaf shapes: ovate, obovate, oblong, oval, orbicular, linear, lanceolate, oblanceolate b. Margin shapes: entire, serrulate, serrate, doubly serrate, dentate, crenate, sinuate, undulate, lobed, incised c. Base shapes: truncate, cordate, rounded, cuneate d. Tip shapes: emarginate, obtuse, cuspidate, acute

Instructor Directions	Content Outline
Objective 6 *Display cross sections of plants with different stem shapes. Discuss how stem shape can be used to identify plants.*	**Describe how stem shape can be used to identify plants.** 1. Square 2. Round 3. Oval 4. Triangular
Objective 7 *Ask students to identify the external parts of the woody plant stem. Refer to PPt 5.* ☐ PPt 5 – Stem Structure of Woody Plants *Have students complete the Activity Sheet on Identifying Grassland Plants from the previous lesson. The student's individual plant sheets should have the plant sample attached and the type of plant (forb, grass, legume, or woody plant) written in the blank provided. The students can use IML's Crop and Grassland Plant Identification Manual or any other illustrated guides available to identify the plant and fill in the other sections of the guide page. The instructor will need to show the students how to use the plant guide to identify the plants. This activity may be done individually or in groups.*	**Identify the external parts of the woody plant stem.** 1. Buds a. Terminal bud – Bud at the tip of the stem where new growth starts – Usually the largest bud – Can be flowering or vegetative b. Axillary or lateral bud – Bud found on the side of the stem – Can be flowering or vegetative 2. Nodes: joints from which leaves or branches grow 3. Internodes: distance between two adjacent nodes 4. Terminal bud scar: scar left from previous year's terminal bud 5. Lenticels: breathing pores found scattered around stem 6. Leaf scar: scar where leaf was attached to stem
Application	Other activities 1. Take a field trip to a grassland so that students can relate the drawings in this lesson to actual plants. 2. Supply students with examples of less common grassland plants and have them identify them based on their characteristics.

Instructor Directions	Content Outline
Closure/Summary	Plants can be identified by many characteristics. Grasses are usually identified in their vegetative state since they do not flower until late in the season. The structural parts of grasses are used to identify the plant. Each forb, legume, and woody plant is unique, with its own distinct stem structure, bud shape and size, leaf structure, leaf arrangement, and inflorescence. The types of plant species present determine the care a grassland needs.
Evaluation: Quiz	Answers: 1. c 2. b 3. a 4. a 5. d 6. c 7. a 8. d 9. b 10. b

Course	Agricultural Science II
Unit	Introduction to Grassland Management
Subunit	Grasslands and Grassland Plants
Lesson	Grassland Composition
Estimated Time	Two 50-minute blocks

Student Outcome

Appraise the current conditions of the grassland.

Learning Objectives

1. Describe why it is important to determine grassland composition.
2. Describe how grassland composition is determined.
3. Identify what makes a grassland viable for livestock and wildlife.
4. Identify what factors affect forage quality.

Grade Level Expectations

SC/EC/1/A/09-11/a	SC/EC/1/A/09-11/b	SC/EC/1/C/09-11/a
SC/EC/1/C/09-11/b	SC/EC/1/D/09-11/a	SC/EC/1/D/09-11/b
SC/EC/3/B/09-11/a		

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. Activity Sheets
   - AS 1 – Grassland Composition Survey (Instructor)
   - AS 1 – Grassland Composition Survey (Student)
2. *Introduction to Grassland Management* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1997.
3. *Introduction to Grassland Management Curriculum Enhancement,* "Unit I – Grasslands and Grassland Plants." 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. Print
   - ❑ *Crop and Grassland Plant Identification Manual* (Catalog #10-1203-S). University of Missouri-Columbia: Instructional Materials Laboratory, 1997.

Interest Approach

Take a field trip to a nearby grassland area, preferably one used for livestock. Identify the factors that make the area good or bad for its current use. Discuss how all of these factors work together to make the grassland viable.

Communicate the Learning Objectives

1. Describe why it is important to determine grassland composition.
2. Describe how grassland composition is determined.
3. Identify what makes a grassland viable for livestock and wildlife.
4. Identify what factors affect forage quality.

Instructor Directions	Content Outline
Objective 1 *The quality of a grassland depends on the types of plants it contains. For example, a grassland with a lot of weeds and woody plant saplings would not be of as high quality as one with a mixture of cool-season grasses and legumes. Discuss the importance of determining grassland composition.*	**Describe why it is important to determine grassland composition.** 1. Livestock a. Helps when estimating production potential b. Used to determine the length of the grazing season c. Used to adjust plant composition to reach optimum economic yields 2. Wildlife a. Helps when estimating its potential for wildlife management b. Used to adjust plant composition to achieve successful wildlife management
Objective 2 *Ask students how they would determine the composition of a grassland. Have students complete AS 1.* AS 1 – Grassland Composition Survey	**Describe how grassland composition is determined.** 1. Visual appraisal of a given area of land 2. By appraising the grassland using a stick to determine the percentages of different plants in the grassland
Objective 3 *Ask students if they think the basic needs of all animals are the same. Once they realize that animal needs are similar, list some of those needs on the board.*	**Identify what makes a grassland viable for livestock and wildlife.** 1. Food a. Livestock: need quality forages, including native warm-season grasses, cool-season grasses, and legumes

Instructor Directions	Content Outline
Discuss with students the factors that make a grassland viable for both livestock and wildlife.	b. Wildlife: need a greater mixture of plants, since different animals may feed on leaves, stems, twigs, bark, roots, fruits, seeds, insects, or small mammals supported by these plants 2. Shelter a. Livestock: use terrain and large plants like trees to reduce the effects of sun, heat, wind, and cold b. Wildlife: use brush piles, nearby woods, and tall grasslike plants for nesting and protection from predators 3. Water a. Livestock: require a surface source of water, such as a freeze-proof water tank located below a pond or at a water hydrant b. Wildlife: can drink from streams or ponds or obtain moisture from berries, plants, or dew, depending on the species
Objective 4 *Forage quality affects livestock feeding on the forage, the hay or silage produced from it, and the wildlife living off the land. Forage quality refers to the nutritive value of the forage needed to produce a desired level of animal performance. Ask students to list factors that affect forage quality.*	**Identify what factors affect forage quality.** 1. Laboratory analysis a. Moisture: water present in the forage b. Crude protein (CP): includes both true protein and nonprotein nitrogen; indicates the ability of the forage to meet an animal's requirements for protein c. Acid detergent fiber (ADF): percentage of indigestible plant material; as ADF increases, digestibility and energy decrease d. Neutral detergent fiber (NDF): percentage of structural or cell wall material; low NDF correlates to increased feed intake e. Total digestible nutrients (TDN): percentage of digestible material; higher ADF corresponds to lower TDN f. Net energy for lactation (NE_l): measurement indicating the energy available in a forage to meet the requirements of lactating cows g. Net energy for maintenance (NE_m): measurement indicating the energy available in a forage to meet the requirements for maintenance in meat-producing livestock

Instructor Directions	Content Outline
	h. Net energy for gain (NE_g): measurement indicating the amount of energy available in a forage to produce growth or gain 2. Field assessment a. Stage of growth: Nutritive value decreases as plants mature because the plants have more indigestible material due to higher fiber content. b. Type of forage: Plant species differ in digestibility and energy content. c. Growing conditions: Quality is affected by the environment, including the temperature, amount of sunlight, and amount of rainfall. d. Presence of noxious weeds: Weeds affect intake because they are less palatable and also less nutritious.
Application AS 1 – Grassland Composition Survey	Answers to AS 1 Answers will vary.
Closure/Summary	Grassland composition refers to the quality and variety of plants that grow in the grassland; it can be determined by making an appraisal of the land. A knowledge of grassland composition can be used to benefit both livestock and wildlife. A viable grassland should include quality food, shelter, and water. Forage quality depends on many factors, with stage of growth being the most important.
Evaluation: Quiz	1. c 2. a 3. b 4. c 5. a 6. d 7. Quality food, shelter, water 8. Answers may include any four of the following: moisture, crude protein, acid detergent fiber, neutral detergent fiber, total digestible nutrients, net energy for lactation, net energy for maintenance, or net energy for gain. 9. A producer can determine grassland composition by making a visual appraisal of a given area of land or

Instructor Directions	Content Outline
	by using a stick to determine the percentages of different plants in the grassland.

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.

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.

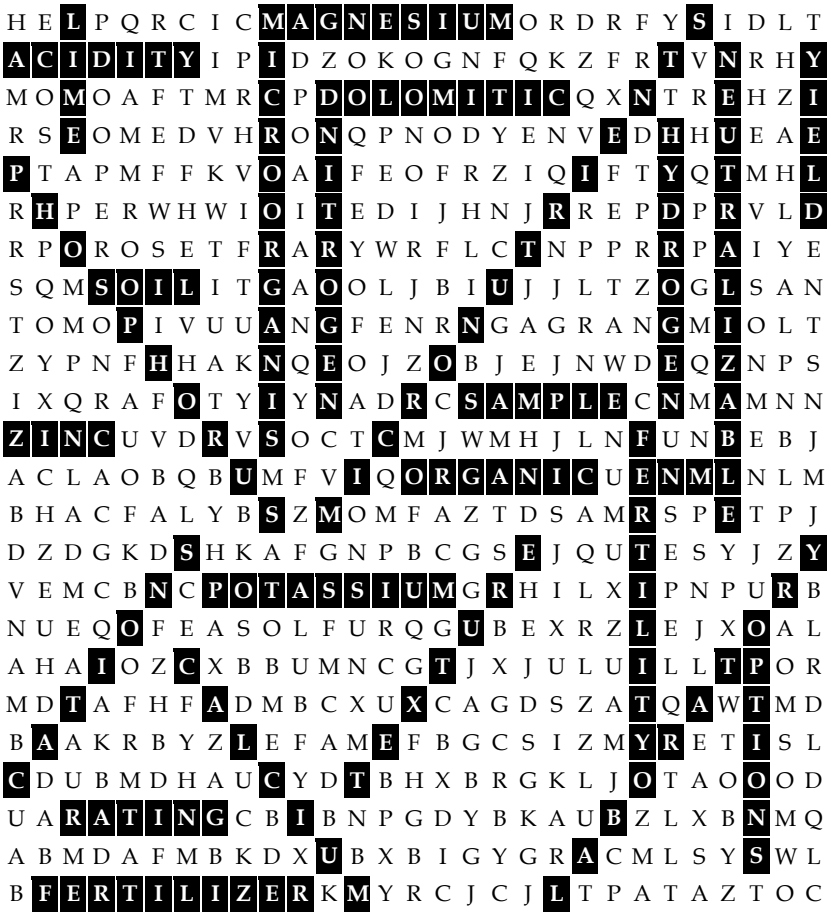
Communicate the Learning Objectives

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 *Ask students if they have ever seen a soil test report. Discuss the information included on a soil test report.*	**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), P_2O_5 (phosphate), and K_2O (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 *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.*	**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 *Have students explain how ratings on the soil report relate to the probable yield response caused by fertilizer application.*	**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 *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.* 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. $\frac{\text{ENM required by the soil test}}{\text{ENM of agricultural limestone}}$ = tons of limestone/acre

Instructor Directions	Content Outline
Application AS 1 – Word Search	Answers to AS 1  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 *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.*	**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 *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.*	**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 *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.*	**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 *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.*	**Identify the possible soil classifications.** 1. Cultivatable 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. Noncultivatable 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 *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.*	**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 *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.* ☐ 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 *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.*	**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

Course	Agricultural Science II
Unit	Introduction to Grassland Management
Subunit	Grassland Management Practices
Lesson	Grasslands and the Nutritional Needs of Livestock
Estimated Time	Two 50-minute blocks

Student Outcome

Analyze the nutrient needs of livestock.

Learning Objectives

1. Describe what determines the nutritional needs of livestock.
2. Describe the daily forage dry matter intake requirements for cattle.
3. Describe when livestock herds have the highest forage quality requirement.
4. Identify how daily dry matter intake is calculated.

Grade Level Expectations

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. PowerPoint Slide
   - PPt 1 – Energy Needs of a Mature Beef Cow for Spring Calving
2. Activity Sheets
   - AS 1 – Calculating Dry Matter Intake
3. *Introduction to Grassland Management* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1997.
4. *Introduction to Grassland Management Curriculum Enhancement,* "Unit III – Grassland Management Practices." University of Missouri-Columbia: Instructional Materials Laboratory, 2003.

Supplemental Information

1. Internet Sites
   - Beef Publications: Feeding Cattle. University of Missouri Extension. Accessed February 14, 2008, from http://extension.missouri.edu/explore/agguides/ansci/beef.htm#Feeding.

Interest Approach

Discuss with students how grass quality affects cattle gains, allowing for quicker sales and higher profits. In addition, point out that people who show and judge cattle appreciate the smoother appearance and better overall composition of the animals due to quality forage.

Communicate the Learning Objectives

1. Describe what determines the nutritional needs of livestock.
2. Describe the daily forage dry matter intake requirements for cattle.
3. Describe when livestock herds have the highest forage quality requirement.
4. Identify how daily dry matter intake is calculated.

Instructor Directions	Content Outline
Objective 1 *Just as the nutritional needs of humans differ according to their growth and life stage, so do the nutritional needs of livestock. Ask students to describe what determines the nutritional needs of livestock.*	**Describe what determines the nutritional needs of livestock.** 1. Type of production (function) a. Maintenance: carbohydrates, fats, protein, and minerals b. Growth: protein, carbohydrates, fats, minerals, and vitamin D c. Fattening: carbohydrates and fats d. Reproduction: protein, carbohydrates, fats, and minerals e. Rebreeding: carbohydrates, fats, protein, and vitamins f. Lactation: carbohydrates, fats, protein, and minerals g. Work: carbohydrates and fats 2. Level of output or production 3. Size of the animal
Objective 2 *Ask students if they know the daily forage dry matter intake requirements for cattle. Emphasize that factors such as size and level of production affect the amount of forage required for production. Point out that dry matter intake is given as a percentage of live bodyweight.*	**Describe the daily forage dry matter intake requirements for cattle.** 1. Dry beef cow: 2% of bodyweight 2. Lactating beef cow (average milk prod.): 2.5% of bodyweight 3. Lactating beef cow (superior milk prod.): 3% of bodyweight 4. Bull (during breeding season): 2.5% of bodyweight 5. Bull (out of breeding season): 2% of bodyweight 6. Growing steers and heifers: 3% of bodyweight

Instructor Directions	Content Outline
Objective 3 *Ask students when the herd needs the highest quality forage. Use PPt 1 to illustrate the changing energy needs of a mature beef cow.* PPt 1 – Energy Needs of a Mature Beef Cow for Spring Calving	**Describe when livestock herds have the highest forage quality requirement.** 1. The herd has the highest forage requirement after the majority of the cows have given birth, when they require energy for lactation and rebreeding (Stage 1). 2. In spring calving, cows calve just before the peak of grass growth in May and June, when forage quality is very high. 3. Fall calving matches the period of highest nutritional needs with another peak in grass growth in October.
Objective 4 *Have students explain how daily dry matter intake is calculated. Point out that optimum production requires close management and supervision. The calculation of daily dry matter intake will help to produce the best livestock possible. Have students complete AS 1.* AS 1 – Calculating Dry Matter Intake	**Identify how daily dry matter intake is calculated.** 1. Daily dry matter intake = # of animals in a class x avg. weight per animal x forage dry matter intake requirement 2. The number of pounds of forage dry matter needed per day for a herd is equal to the total of the daily dry matter intake for all classes of cattle in the herd.
Application AS 1 – Calculating Dry Matter Intake	Answers to AS 1 1. 2,136.5 lbs. 2. 1,010 lbs. 3. 3,964 lbs. Other activities Visit the facilities of a local dairy or beef cattle operation. Have the manager describe the procedures used for feeding the cattle and the changes made based on growth, gestation, lactation, and maintenance.

Instructor Directions	Content Outline
Closure/Summary	The true test of productive grassland is the livestock it produces. If the grassland meets the nutritional needs of the animals during all of their life stages, it is successful. In order to meet these needs, the grassland manager must match the production potential of the grasses to them. The best grasslands will provide nutrients in a sufficient quantity to allow the producer to meet his or her production goals for the herd.
Evaluation: Quiz	Answers: 1. d 2. d 3. b 4. The herd has the highest forage requirement after the majority of the cows have given birth. In spring calving, cows calve just before the peak of grass growth when forage quality is very high. Fall calving matches the period of highest nutritional needs with another peak in grass growth. 5. Any four of the following: maintenance, growth, fattening, reproduction, rebreeding, lactation or milk production, and work 6. 1,615 lbs. of dry forage matter per day

Course	Agricultural Science II
Unit	Introduction to Grassland Management
Subunit	Grassland Management Practices
Lesson	Grazing Management Systems
Estimated Time	Three 50-minute blocks

Student Outcome

Determine the optimal grazing methods for a grassland.

Learning Objectives

1. Identify methods used in harvesting grasslands.
2. Identify advantages and disadvantages of continuous grazing.
3. Identify advantages and disadvantages of rotational grazing.
4. Identify advantages and disadvantages of management-intensive grazing.
5. Describe how the type of grazing system affects grazing efficiency.
6. Identify grazing intensity.
7. Identify what determines the livestock carrying capacity of a grassland.
8. Determine the stage of growth grassland should be grazed to optimize quality and quantity.
9. Describe how the type of grazing affects wildlife.
10. Describe how cool-season grasses, warm-season grasses, and legumes complement each other in a grazing system.
11. Identify how grazing systems benefit wildlife.

Grade Level Expectations

SC/EC/1/C/09-11/b

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. PowerPoint Slide
   - ☐ PPt 1 – Estimated Forage Dry Matter Yield, lbs./acre/in.
2. Activity Sheet
   - AS 1 – Developing a Rotational Grazing System (Instructor)
3. *Introduction to Grassland Management* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1997.
4. *Introduction to Grassland Management Curriculum Enhancement,* "Unit III – Grassland Management Practices." University of Missouri-Columbia: Instructional Materials Laboratory, 2003.

Supplemental Information

1. Internet Sites
   - ❑ Grain Harvesting History. Shenandoah Valley Agricultural Research and Extension Center, Virginia Agricultural Experiment Station. Accessed February 15, 2008, from http://www.vaes.vt.edu/steeles/mccormick/harvest.html.
   - ❑ Livestock: A Powerful Wildlife Management Tool. Integrated Rangeland Management Class, University of Idaho. Accessed February 15, 2008, from http://www.cnr.uidaho.edu/range456/hot-topics/livestock-wildlife.htm.

Interest Approach

With students working in small groups, have them list the different types of grazing systems and any advantages or disadvantages they can think of for each one. The students should consider such factors as seasonal growth, amount of labor involved, quality of plant growth, and amount of land needed in their evaluation of the different grazing systems. Then, talk about the pros and cons of the grazing systems in a class discussion.

Have a local cattle producer speak to the class about his or her operation. Discuss the cattle population, grazing capacity of the land, types of forage plants available for grazing, the grazing system used, and the pros and cons of that system.

Communicate the Learning Objectives

1. Identify methods used in harvesting grasslands.
2. Identify advantages and disadvantages of continuous grazing.
3. Identify advantages and disadvantages of rotational grazing.
4. Identify advantages and disadvantages of management-intensive grazing.
5. Describe how the type of grazing system affects grazing efficiency.
6. Identify grazing intensity.
7. Identify what determines the livestock carrying capacity of a grassland.
8. Determine the stage of growth grassland should be grazed to optimize quality and quantity.
9. Describe how the type of grazing affects wildlife.
10. Describe how cool-season grasses, warm-season grasses, and legumes complement each other in a grazing system.
11. Identify how grazing systems benefit wildlife.

Instructor Directions	Content Outline
Objective 1 *Ask the students to name two ways in which grasslands may be harvested. Channel their answers into a discussion of the various types of harvesting.*	**Identify methods used in harvesting grasslands.** 1. Grazing: by livestock and wildlife a. Continuous – Continuous grazing uses only one pasture to meet the needs of the livestock, which are allowed to graze freely on the plants available. – This type of grazing system allows animals to engage in selective grazing, since they have unrestricted access and can pick and choose plants to consume. b. Rotational – Rotational grazing uses at least two grazing units, with animals alternating between the different pastures in a preplanned cycle.

Instructor Directions	Content Outline
	– Strip grazing and management-intensive grazing are two types of rotational grazing. – This type of grazing system tends to prevent selective grazing, since animals are only provided with the amount of forage they require. 2. Mechanical harvesting: cutting forage for hay, silage, or greenchop
Objective 2 *Have students describe the advantages and disadvantages of continuous grazing.*	**Identify advantages and disadvantages of continuous grazing.** 1. Advantages a. Higher initial performance due to selective grazing b. Low maintenance 2. Disadvantages a. Grassland composition altered by selective grazing b. Poor forage utilization
Objective 3 *Ask students to describe rotational grazing. Have them list advantages and disadvantages of this system.*	**Identify advantages and disadvantages of rotational grazing.** 1. Advantages a. Maintains desired grassland composition by decreasing selective grazing b. Provides rest periods allowing for plant regrowth c. Causes less damage from compaction and animal wastes d. Increases production per acre 2. Disadvantages a. Lower production per animal than selective grazing b. Requires more time and labor to manage the herd c. Requires extra fencing to separate pastures into paddocks, increasing costs to the producer
Objective 4 *Have students describe management-intensive grazing. Ask students to list its advantages and disadvantages.*	**Identify advantages and disadvantages of management-intensive grazing.** 1. Advantages a. Maintains desired grassland composition b. Causes less damage through compaction and animal wastes c. Higher production per acre than rotational grazing systems

Instructor Directions	Content Outline
	d. Provides for long regrowth periods e. Causes the operator to come in contact with the herd on a regular basis, allowing him or her to identify and correct potential problems 2. Disadvantages a. Requires more time to plan and set up the system b. Requires extra fencing to separate the pastures into paddocks, increasing costs over continuous grazing c. Lower production per animal than selective grazing
Objective 5 *Discuss grazing efficiency in the grazing systems.*	**Describe how the type of grazing system affects grazing efficiency.** 1. In continuous grazing systems, only 30-35% of the total forage produced is eaten by the livestock. 2. When management-intensive grazing is used, forage utilization can be as high as 65% of the forage produced. 3. To calculate the actual amount of forage dry matter needed in a pasture to feed a herd during a particular season, the seasonal dry matter intake requirements should be divided by the forage utilization rate.
Objective 6 *Ask students to explain grazing intensity. Discuss the different grazing intensities.*	**Identify grazing intensity.** 1. Grazing intensity refers to the extent to which a plant or grassland is grazed. 2. The three levels of grazing intensity are heavy, moderate, and light grazing. a. Heavy grazing (overgrazing) – Exhausts the energy reserves of forages by removing growth too frequently, before it has a chance to replenish itself – Marked by the presence of less than 4 inches of growth in the fall in cool-season grasses and less than 8 inches in warm-season grasses b. Moderate grazing – Leaves enough vegetation to maintain the vigor of forage plants and protect soil – Indicated by 4-8 inches of growth at the end of the season for cool-season grasses and 8-10 inches of growth for warm-season grasses

Instructor Directions	Content Outline
	c. Light grazing (undergrazing) – Not beneficial if it results in too much tall, dense forage in the fall, since excessive ground litter can interfere with next year's crop – Indicated by more than 10-12 inches left at the end of the growing season for cool-season grasses and more than 12-14 inches for warm-season grasses
Objective 7 *The type of grazing system used will partly depend on the carrying capacity of the pasture, which is the ability of a forage to support a specific number of animals throughout a grazing season. Ask students how the livestock carrying capacity of a grassland is determined. Use PPt 1 as an illustration of dry matter yield.* ☐ PPt 1 – Estimated Forage Dry Matter Yield, lbs./acre/in.	**Identify what determines the livestock carrying capacity of a grassland.** 1. Carrying Capacity = $\frac{\text{Annual Forage Production x Seasonal Utilization Rate}}{\text{Average Daily Intake x Length of Grazing Season}}$ 2. Annual forage production: amount of forage dry matter produced per acre in a year 3. Seasonal utilization rate: percentage of the forage produced that will be consumed by the herd in one year 4. Average daily intake: percentage of the animal's body weight that is consumed in forages on a daily basis 5. Length of the grazing season: days of grazing per year
Objective 8 *Forage quality and quantity at the time of harvest is very important to production. Ask the students what the stage of growth should be when forage is grazed.*	**Determine the stage of growth grassland should be grazed to optimize quality and quantity.** Optimum forage harvesting would take place during the vegetative (leafy) stage, when forage growth is continuous and nutritional quality is high; the vegetative stage ends when plant reproduction begins.
Objective 9 *Wildlife is greatly affected by the type of grazing system utilized, since they are dependent on the grassland for food and shelter. Have students discuss the effect of various types of grazing on wildlife.*	**Describe how the type of grazing affects wildlife.** 1. Continuous grazing: This grazing system is not beneficial to wildlife, although special provisions such as brush piles and fence lines with tall vegetation may aid animals. 2. Rotational grazing: During rest periods, pastures provide habitat and food for wildlife. Rotational grazing systems also favor more diversity in

Instructor Directions	Content Outline
	grassland composition, which improves the food and cover available to wildlife and tends to protect wildlife habitat in woody draws and along bodies of water.
Objective 10 *Discuss how cool-season grasses, warm-season grasses, and legumes can work together in a grazing system.*	**Describe how cool-season grasses, warm-season grasses, and legumes complement each other in a grazing system.** 1. Ideally, one-third of the grazing system should consist of warm-season grasses. They begin the bulk of their growth in June and July, when cool-season grasses are finishing their spring growth. 2. Legumes can lengthen the grazing season of cool-season grasses because they will often grow longer in the summer. They also provide higher quality forage, fertilize the ground, and increase yields. 3. Cool-season grasses reach another peak in forage growth as warm-season grass production declines.
Objective 11 *Discuss how a grazing system that consists of cool-season grasses, warm-season grasses, and legumes can benefit wildlife. Have students complete the activity outlined in the instructor's AS 1.* AS 1 – Developing a Rotational Grazing System	**Identify how grazing systems benefit wildlife.** 1. By the time warm-season grasses are ready to be harvested (hayed or grazed), most wildlife species are finished using them for reproduction. 2. At this time, cool-season grasses are being rested and can be used for cover or nesting.
Application AS 1 – Developing a Rotational Grazing System	Answers to AS 1 Answers will vary.
Closure/Summary	Forages can be harvested either by grazing or mechanical harvesting. Continuous grazing is a low-maintenance system in which the herd remains in one pasture for the majority of the grazing season. Rotational grazing involves the intensive management of pastureland and animals, since the animals are moved between two or more pastures or paddocks based on forage quality, quantity, and utilization. A grazing system that combines cool-season grasses, warm-season grasses, and legumes benefits both livestock and wildlife.

Instructor Directions	Content Outline
Evaluation: Quiz	Answers: 1. d 2. a 3. e 4. c 5. d 6. a 7. d 8. b 9. a 10. By the time warm-season grasses are ready to be hayed or grazed, most wildlife species are finished using them for reproduction. At this time, cool-season grasses are being rested and can be used for cover or nesting. 11. The advantages of rotational grazing are that it maintains desired grassland composition, provides rest periods allowing for plant regrowth, causes less damage through compaction and animal wastes, and increases production per acre. The disadvantages are that it has lower production per animal than selective grazing, requires more time and labor to manage the herd, and requires extra fencing to create paddocks, which increases costs. 12. The rotational systems provide food and habitat for wildlife while the forages are being regrown during rest periods. Rotational grazing systems also tend to protect wildlife habitat in woody hollows and along bodies of water and favor more diversity in grassland composition, which improves the food and cover available to wildlife. 13. Ideally, one-third of the grazing system should consist of warm-season grasses. They begin the bulk of their growth in June and July, when cool-season grasses are finishing their spring growth. Legumes can lengthen the grazing season of cool-season grasses because they will often grow longer in the summer. They also provide higher quality forage, fertilize the ground, and increase yields. Cool-season grasses reach another peak in forage growth as warm-season grass production declines.

Course	Agricultural Science II
Unit	Introduction to Grassland Management
Subunit	Grassland Management Practices
Lesson	Harvesting and Storing Forage Crops
Estimated Time	Two 50-minute blocks

Student Outcome

Determine methods for harvesting and storing forage crops.

Learning Objectives

1. Describe why forages would be mechanically harvested.
2. Identify the two main methods of mechanically harvesting forage crops.
3. Identify the different methods of storing harvested forage crops.
4. Identify factors that affect the quality of stored forage crops.
5. Determine the stage of growth grassland should be mechanically harvested to optimize quality and quantity.

Grade Level Expectations

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. Activity Sheet
   - AS 1 – Sampling Hay
2. *Introduction to Grassland Management* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1997.
3. *Introduction to Grassland Management Curriculum Enhancement,* "Unit III – Grassland Management Practices." University of Missouri-Columbia: Instructional Materials Laboratory, 2003.

Supplies & Equipment

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

Supplemental Information

1. Internet Sites
   - ❑ Forage Resources: Harvesting and Storage. University of Wisconsin Extension. Accessed February 18, 2008, from http://www.uwex.edu/ces/crops/uwforage/storage.htm.
   - ❑ Selecting Fans and Determining Airflow for Crop Drying, Cooling, and Storage. University of Minnesota Extension. Accessed February 18, 2008, from http://www.extension.umn.edu/distribution/cropsystems/DC5716.html.

Interest Approach

Ask students to share any experiences that they have had with harvesting and storing forages. Bringing in samples of silage and hay may help to spur discussion. If students do not have experience with harvesting, discuss what information they do know about storing forages.

Communicate the Learning Objectives

1. Describe why forages would be mechanically harvested.
2. Identify the two main methods of mechanically harvesting forage crops.
3. Identify the different methods of storing harvested forage crops.
4. Identify factors that affect the quality of stored forage crops.
5. Determine the stage of growth grassland should be mechanically harvested to optimize quality and quantity.

Instructor Directions	Content Outline
Objective 1 *Grazing meets the nutritional needs of the herd while the forage is in the vegetative state. Ask students why a grassland might be mechanically harvested instead of grazed.*	**Describe why forages would be mechanically harvested.** 1. To preserve the quality of the forage by maintaining the vegetative state 2. To optimize forage utilization during times when forage production is greater than the herd can consume, maximizing yield 3. To meet the nutritional needs of the herd when pastures are dormant 4. To sell the forage if it is not needed by the herd
Objective 2 *Two main methods of harvesting forages may be used; have students name the two methods. Point out that hay and silage vary in the amount of moisture they contain and the storage methods used for each.*	**Identify the two main methods of mechanically harvesting forages crops.** 1. Harvesting for hay: The green forage is harvested at low moisture levels and cured by drying. 2. Harvesting for silage: The green forage is converted into moist, succulent livestock feed through fermentation that takes place during storage.
Objective 3 *When forages are stored, maintaining the quality of the forage and controlling costs are of the utmost importance. Ask students to describe the different*	**Identify the different methods of storing harvested forage crops.** 1. Hay: formed into stacks, square bales, or round bales a. Barn: provides the most weather protection b. Temporary cover: prevents water penetration and is inexpensive; used for large round bales or loose stacks

Instructor Directions	Content Outline
methods of storing harvested forage crops.	c. Field: provides the least expensive storage, but weather exposure can cause excessive loss of quality 2. Silage: stored in silos to prevent spoilage and quality loss due to leaching of nutrients a. Vertical: have low storage losses, can be located near livestock, and adapt to automatic feeding – Conventional: made of metal, concrete, or tile – Oxygen-limited: sealed or lined with fused glass; have even lower storage losses but cost more per cubic foot b. Horizontal: easier to construct and cost less than vertical silos, but are also subject to more leaching of nutrients and require extensive packing of silage – Bunker: consists of a concrete floor with concrete or plank walls above ground level – Trench: dug into well-drained ground or hillside; may have soil or concrete for floor and walls – Stack: used for temporary or emergency storage; consists of a compacted pile of silage placed on the ground or concrete floor; usually has high spoilage losses, so silage should be used as soon as possible
Objective 4 *Forage quality is dependent on many different factors. Ask students to list these factors. Have students complete AS 1.* AS 1 – Sampling Hay	**Identify factors that affect the quality of stored forage crops.** 1. Moisture content: can cause mold in hay if it is too high or leaf loss if it is too low; can cause mold in silage if it is too low 2. Losses in storage: caused by improper storage and lack of protection from the environment 3. Species composition: have different storage qualities as well as different palatability and nutritional benefits to livestock 4. Stage of growth at harvest
Objective 5 *The production goal of all harvesting is to produce the forage with the highest nutritional value*	**Determine the stage of growth grassland should be mechanically harvested to optimize quality and quantity.** Optimum forage harvesting takes place during the boot (grasses) and early bloom (legumes) stages, depending on the vegetative growth.

Instructor Directions	Content Outline
possible. Ask students to identify the best time to harvest to optimize quality and quantity.	
Application	Other activities Have students develop their own silo models that will prevent spoilage and quality loss due to leaching of nutrients. Place silage samples in the models and check them at a later date to determine the quality of storage.
Closure/Summary	Forage harvesting and storage is a crucial component of livestock management. The two methods of harvesting forages produce hay and silage, which may be stored in many different ways. Forage quality and costs should be considered when selecting the best method of storage for a specific operation. Harvesting time, moisture content, species composition, and storage method all affect the quality of the harvested forage. All forages should be harvested while in the vegetative growth phase during the boot stage in grasses and the early bloom stage in legumes.
Evaluation: Quiz	Answers: 1. c 2. c 3. d 4. b 5. d 6. Hay has low moisture levels, while silage is fermented to form a moist, succulent livestock feed. Hay is cured by drying it before it is stored, while silage is cured through fermentation that takes place during storage. 7. Forages should be mechanically harvested and stored to preserve the quality and quantity of the forage by maintaining the vegetative state; to optimize forage utilization during times when forage production is more than the herd can consume; to meet the nutritional needs of the herd when pastures are dormant; and to sell if not needed by the herd.

Course	Agricultural Science II
Unit	Introduction to Grassland Management
Subunit	Grassland Management Practices
Lesson	Wildlife Management
Estimated Time	Three 50-minute blocks

Student Outcome

Develop a better understanding of the management practices needed to manage both livestock and wildlife on grasslands.

Learning Objectives

1. Identify what wildlife species depend on Missouri grasslands.
2. Identify what the basic habitat needs of wildlife are.
3. Identify what factors affect the value of grasslands for wildlife.
4. Describe how management practices can be adapted for wildlife.
5. Determine how existing wildlife habitat is evaluated.
6. Describe why grassland management plans are written for quail and rabbits.

Grade Level Expectations

SC/EC/1/A/09-11/a	SC/EC/1/A/09-11/b	SC/EC/1/B/09-11/a
SC/EC/1/B/09-11/b	SC/EC/1/C/09-11/b	SC/EC/1/D/09-11/a
SC/EC/1/D/09-11/b	SC/EC/3/B/09-11/a	SC/EC/3/C/09-11/e
SC/ES/3/A/09-11/c	SC/ST/1/C/09-11/a	SC/ST/3/B/09-11/a

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. Activity Sheets
   - AS 1 – Habitat Evaluation
   - AS 2 – Grassland Evaluation for Wildlife Habitat
3. *Introduction to Grassland Management* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1997.
4. *Introduction to Grassland Management Curriculum Enhancement,* "Unit III – Grassland Management Practices." University of Missouri-Columbia: Instructional Materials Laboratory, 2003.

Supplies & Equipment

- ❑ An aerial photograph of a specific grassland unit may be helpful for AS 2.

Supplemental Information

1. Internet Sites
   - ❑ Grassland Management. Missouri Department of Conservation. Accessed February 18, 2008, from http://mdc.mo.gov/landown/wild/landmgmt/grassland.htm.
   - ❑ Habitat Information. Quail Unlimited, Inc. Accessed February 18, 2008, from http://www.qu.org/content/habitat/habitatinformation.cfm.

Interest Approach

Take students on a field trip to different grassland sites and compare poorly managed grassland to well-managed grassland. What problems could reduce livestock production? What are some corrective actions that could be taken? How do these problems and solutions affect wildlife?

Communicate the Learning Objectives

1. Identify what wildlife species depend on Missouri grasslands.
2. Identify what the basic habitat needs of wildlife are.
3. Identify what factors affect the value of grasslands for wildlife.
4. Describe how management practices can be adapted for wildlife.
5. Determine how existing wildlife habitat is evaluated.
6. Describe why grassland management plans are written for quail and rabbits.

Instructor Directions	Content Outline
Objective 1 *Ask students to name wildlife species that use grasslands.* *Note: Other examples of wildlife species found on grasslands could include the prairie king snake, cowbird, field mice, bobcat, coyote, box turtle, and hawks.*	**Identify what wildlife species depend on Missouri grasslands.** 1. Greater prairie chicken 2. Upland sandpiper 3. Meadowlark 4. Rabbit 5. Quail 6. Pheasant 7. Deer 8. Turkey
Objective 2 *Ask students what things they would need to survive if they were lost in the wilderness. Compare the needs of wildlife to those of humans. Discuss how the needs of livestock and wildlife are similar. Both must obtain what they need from the environment.*	**Identify what the basic habitat needs of wildlife are.** 1. Water a. Water comes from rainfall, rivers and streams, plants, and farm ponds. b. Wildlife can use water supplies for livestock, with some modifications. c. Control livestock to keep them from damaging water supplies. 2. Food a. Land next to a pasture can be critical to the carrying capacity for wildlife. b. Producers should supply food for wildlife during winter by avoiding fall plowing and leaving standing seed heads of grasses and grains. 3. Cover a. Cover is important for protection, nesting, and roosting.

Instructor Directions	Content Outline
	b. Wildlife species use four types of cover. – Soft: nonwoody growth of grasses, legumes, and forbs – Shrubby: woody brush and shrubs with multiple stems growing from a common base that are generally less than 20 feet tall – Hard: trees and shrubs 20 or more feet tall – Escape: especially dense shrubby or hard cover where wildlife can escape predators
Objective 3 *Discuss the characteristics of a grassland that affect how wildlife can use it.*	**Identify what factors affect the value of grasslands for wildlife.** 1. Type of grassland a. Cool-season pasture: normally at its peak quality and ready for harvest at the height of the nesting season, which creates problems for ground-nesting birds b. Native warm-season pasture – Provides better food and cover when properly managed than cool-season pasture – Not ready for harvest until midsummer, when most ground-nesting wildlife have produced their broods c. Native grassland – Dominated by a mixture of native warm-season grasses with a good complement of native legumes and forbs – May have hundreds of plant species, attracting many species of wildlife 2. Plant composition: A variety of plants generally makes the grassland more productive and enhances wildlife habitat by improving the quality of cover and the available food supply. 3. Size of the grassland: Different species require grasslands of different sizes. 4. Use of the grassland: This is probably the most critical factor affecting the value of the grassland for both wildlife and livestock. a. Haying b. Grazing

Instructor Directions	Content Outline
Objective 4	**Describe how management practices can be adapted for wildlife.**
Ask students how the different grassland management practices might affect a particular species (e.g., rabbits). Discuss how they can be adapted to benefit wildlife.	1. Grazing a. Continuous grazing is less beneficial for wildlife than rotational grazing. b. Rotational grazing allows managers to move livestock when necessary to give the valuable palatable plants a resting period in which to grow and multiply. c. Rotational grazing allows grazing to be timed to benefit both livestock and wildlife. – Schedule prime nesting areas for rest periods when wildlife need them. – Arrange to have livestock graze next to nesting areas so chicks will have access to open ground with a different mix of foods next to good soft cover. – Schedule paddocks next to woody cover or other wintering grounds for grazing early in the season so they can regrow cover and seed. d. A moderate grazing intensity is most beneficial because it provides adequate food and cover while opening travel lanes between plants and creating some bare ground for seed-gathering and dusting areas. 2. Haying: Grassland managers can adjust location, timing, and mowing height to leave enough food and cover as needed. a. Leave the outer 30 feet of hay fields standing or cut it later. b. Have a balance of warm- and cool-season pastures with different harvest dates so food and cover are always available. c. Stagger haying schedules so harvest takes place over a longer period. 3. Fertilizing a. It can increase grassland production and improve the nutritional quality of food, but other management practices must leave enough food and cover.

Instructor Directions	Content Outline
	b. Native grasslands do not usually benefit from fertilizing, which can change plant composition and allow weeds to take over. 4. Overseeding with legumes a. Seeding pastures with legumes helps wildlife by adding diversity to the types of food and cover available. b. They should not be added to native grasslands because these areas already contain legumes and forbs more suitable to the site. 5. Irrigation: Irrigation could benefit wildlife as an additional source of water, but it could be harmful if it occurred during critical times. 6. Reestablishing native warm-season grasses: Converting much cool-season pasture to native warm-season grasses can benefit wildlife since they have adapted to these grasses. 7. Prescribed burning: Prescribed burning helps in maintaining a vigorous grassland community (e.g., maintaining or increasing the native legumes used by wildlife).
Objective 5 *Wildlife managers use standard guides to help landowners assess wildlife habitat. Ask students what factors might be used in evaluating a grassland for its capacity to support wildlife. Have students complete AS 1 or 2. AS 2 is tied directly to this study question, while AS 1 provides a more general evaluation.* AS 1 – Habitat Evaluation AS 2 – Grassland Evaluation for Wildlife Habitat	**Determine how existing wildlife habitat is evaluated.** Wildlife habitat can be evaluated by looking at eight factors. 1. Extent of the border surrounding the grassland 2. Percent of the field covered by winter or escape cover 3. Percent of canopy coverage from shrubs and herbaceous vegetation 6 to 18 inches tall 4. Grazing pressure 5. Percent of the ground covered or shaded by legumes 6. Plant composition 7. Distance from the center of the field to the edge of the nearest crop field 8. Percent of the grazing unit that is within 250 feet of dense woody cover or ungrazed woodland

Instructor Directions	Content Outline
Objective 6 *Most wildlife management plans for grasslands are written for quail and rabbits. Exceptions include where species of extra importance or need occur (such as the prairie chicken) or where special habitats may be involved (like remnant prairies). Ask students to explain why good habitat for rabbits and quail is often considered ideal for other types of wildlife.*	**Describe why grassland management plans are written for quail and rabbits.** 1. Rabbits and quail are popular game animals. 2. They require a relatively small acreage, so good wildlife management plans can be written for both large and small farms. 3. They are indicator species; if a habitat benefits them, many others will prosper since their needs are similar to those of a variety of other species.
Application AS 1 – Habitat Evaluation AS 2 – Grassland Evaluation for Wildlife Habitat	 Answers to AS 1 Answers will vary. Answers to AS 2 Answers will vary.
Closure/Summary	Wildlife that lives within the grassland community must have their needs for water, food, and cover met by the grassland. Producers can adopt management practices to accommodate wildlife without sacrificing forage production for livestock.
Evaluation: Quiz	Answers: 1. d 2. b 3. d 4. c 5. d 6. b 7. Students may list any three of the following species: greater prairie chicken, upland sandpiper, meadowlark, rabbit, quail, pheasant, deer, or turkey. 8. Escape cover is especially dense shrubby or hard cover where wildlife can escape predators. 9. Native warm-season pasture provides better food and cover when properly managed than cool-season

	pasture. It is also not ready for harvest until midsummer, when most ground-nesting wildlife have produced their broods. 10. Students may list any two of the following factors: extent of the border surrounding the grassland, percent of the field covered by winter or escape cover, percent of canopy coverage from shrubs and herbaceous vegetation 6 to 18 inches tall, grazing pressure, percent of the ground covered or shaded by legumes, plant composition, distance from the center of the field to the edge of the nearest crop field, and percent of the grazing unit that is within 250 feet of dense woody cover or ungrazed woodland.

Course	Agricultural Science II
Unit	Introduction to Grassland Management
Subunit	Grassland Management Practices
Lesson	Grassland Management Plan
Estimated Time	Four 50-minute blocks

Student Outcome

Develop a grassland management plan.

Learning Objectives

1. Identify what is needed to develop a grassland management plan.
2. Identify the steps in developing a grassland management plan.
3. Determine how landowners select a grazing system to suit their needs.
4. Determine how landowners decide what type of forage is to be used.
5. Identify some ways to maintain or renovate grassland.

Grade Level Expectations

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. Activity Sheets
   - AS 1 – Determining Grassland Condition
   - AS 2 – Evaluating a Grassland
2. *Introduction to Grassland Management* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1997.
3. *Introduction to Grassland Management Curriculum Enhancement,* "Unit III – Grassland Management Practices." University of Missouri-Columbia: Instructional Materials Laboratory, 2003.

Supplies & Equipment

- ❑ The Natural Resources Conservation Service *Field Office Technical Guide* used in AS 2 was accessed February 20, 2008, from http://www.nrcs.usda.gov/technical/efotg/. Table 1 titled "Species Compatibility to Pasture Suitability Groups for Pasture and Hayland Planting," found in *Pasture and Hayland Planting Standard (512),* from Section IV, Part B: Conservation Practices, was accessed February 20, 2008, from http://efotg.nrcs.usda.gov/references/public/MO/512_1202.pdf.

Supplemental Information

1. Internet Sites
   - Sargent, M. S and K. S. Carter, ed. "Grassland Management." Part V in *Managing Michigan Wildlife: A Landowners Guide.* East Lansing: Michigan United Conservation Clubs, 1999. Accessed February 20, 2008, from http://www.dnr.state.mi.us/publications/pdfs/huntingwildlifehabitat/Landowners_Guide/Habitat_Mgmt/Grassland/index.htm.
   - Warren G. Magnuson Park Vegetation Management Plan. Seattle Parks and Recreation, Washington. Accessed February 20, 2008, from http://www.seattle.gov/parks/magnuson/vmp.htm.

Interest Approach

Have students visit a livestock operation that monitors production closely to show them that the better grassland management inventory, the better the management.

Communicate the Learning Objectives

1. Identify what is needed to develop a grassland management plan.
2. Identify the steps in developing a grassland management plan.
3. Determine how landowners select a grazing system to suit their needs.
4. Determine how landowners decide what type of forage is to be used.
5. Identify some ways to maintain or renovate grassland.

Instructor Directions	Content Outline
Objective 1 *Ask students what information is needed to complete the grassland management plan. Discuss with students why each of these items is necessary. Review the previous units showing the students how what they have learned fits together.*	**Identify what is needed to develop a grassland management plan.** 1. Soil test results: analysis of soil fertility 2. Soil identification: information on the type of soil and drainage and use classification 3. Maps: visual representation of the land; includes types of soil and physical layout, such as water, slope, and drainage 4. Plant composition: quality, quantity, and variety of plants in a plot 5. Livestock needs: nutritional needs based on species, age, sex, production level, and environment 6. Herd inventory: the quantity of animals within each classification
Objective 2 *Ask students to outline the steps in developing a grassland management plan, based on what they have learned in previous lessons.*	**Identify the steps in developing a grassland management plan.** 1. Acquire an aerial photograph of the grassland and outline the fields included in the plan. 2. Complete soil tests for each field. 3. Conduct a complete grassland inventory looking at plant composition to determine the quality and quantity of pasture available and assist in calculating stocking rates. 4. Evaluate wildlife habitat. 5. Select a grassland management plan, choosing a grazing system and deciding what areas should be grazed and what fields should be mechanically harvested.

Instructor Directions	Content Outline
Objective 3 *Ask students what different factors would affect or change the grazing system used. Point out that these are the same factors used in selecting the appropriate system for grassland.*	**Determine how landowners select a grazing system to suit their needs.** The selection of a grazing system is based on the interaction between the soil, environment, resources, herd needs, wildlife, and plants.
Objective 4 *Discuss with students what plants need for optimum growth and what livestock need from forages. These two factors will determine the type of forage needed.*	**Determine how landowners decide what type of forage is to be used.** 1. Forage management: The goal is persistence of stand and acceptable yields. a. Climate b. Site conditions 2. Livestock management: The goal is profitable gains. a. Nutrient needs b. Intensity of harvest/grazing 3. Forage management should be considered first in selecting a forage.
Objective 5 *Ask students what steps they might take if they wanted to improve a pasture by changing the plant composition. Have students complete AS 1 and/or AS 2.* AS 1 – Determining Grassland Condition AS 2 – Evaluating a Grassland	**Identify some ways to maintain or renovate grassland.** 1. Testing the soil and amending it a. Spreading fertilizer b. Liming c. Disking 2. Suppressing or destroying existing unwanted plants, either chemically or mechanically by disking or plowing 3. Introducing legumes a. Overseeding – White clover, annual lespedeza, red clover, and birdsfoot trefoil are most often used; they may be used in combination with each other. – It involves broadcasting legumes into an existing pasture in which the stand is thinned or grazed close to the ground. – It is usually done in late winter or early in the fall.

Instructor Directions	Content Outline
	b. No-till planting – This method involves using a no-till drill, which can place the seed in the ground at an optimal depth without the ground being worked up. – It is sometimes used to establish additional grass. – Its advantages include lower seeding rates, precise placement of seed, reduction in the loss of valuable organic matter due to tillage; reduction in soil erosion is one of its greatest benefits. 4. Prescribed burning a. Used most commonly for native warm-season grasses b. Removes the previous year's growth, keeps invading woody plants in check, and reduces competition from invading cool-season grasses c. Usually conducted in the spring d. Encourages fast and vigorous growth right after the burn, since it releases nutrients that are locked up in the previous year's growth e. Must be used safely, with training from NRCS or MDC
Application	
AS 1 – Determining Grassland Condition	Answers to AS 1 Answers will vary.
AS 2 – Evaluating a Grassland	Answers to AS 2 1. d 2. a 3. c 4. b 5. d 6. 017 7. 1.1 8. c 9. a 10. a 11. a

Instructor Directions	Content Outline
	12. c 13. c 14. a 15. c 16. c 17. c 18. Adapted Not Adapted a. x b. x c. x d. x e. x f. x g. x h. x i. x j. x 19. a 20. a 21. a 22. b 23. b 24. a 25. a 26. This moderately grazed pasture offers very little food or cover for rabbits and quail due to its location and plant composition. 27. b 28. b 29. a. 1,392 lbs. b. 2,070 lbs. c. 2,052 lbs. 30. Adequate Not Adequate a. x b. x c. x 31. c 32. e 33. d 34. 017 35. 1.1

Instructor Directions	Content Outline
	Other activities 1. Design hypothetical situations where the students are given the current conditions of a livestock operation to determine ways to improve its yield and profitability. 2. Visit a prescribed burn for observation. If the actual burn cannot be attended, visit a field that has been burned and compare it with one nearby that has not.
Closure/Summary	For a grassland management program to be profitable, many aspects of production must be considered when making decisions. An inventory of current conditions helps a grassland manager make educated choices about grazing systems, forage selection, and renovation plans. The complexity of these decisions is due to the many different factors that influence the grassland.
Evaluation: Quiz	Answers: 1. a 2. c 3. d 4. d 5. d 6. The steps in putting together a grassland management plan are as follows. a. Acquire an aerial photograph of the grassland and outline the fields included in the plan. b. Complete soil tests for each field. c. Conduct a complete pasture inventory to determine the quality and quantity of pasture available and assist in calculating stocking rates. d. Consider wildlife needs. e. Select a grassland management plan, choosing a grazing system and deciding what areas should be grazed and what fields should be mechanically harvested. 7. The following information is included in each of the components of a grassland management plan. a. Soil test results: analysis of soil fertility. b. Soil identification: information on the type of soil and drainage and use classification c. Plant composition: quality, quantity, and variety of plants in a plot

Instructor Directions	Content Outline
	d. Maps: visual representation of the land; includes types of soil and physical layout e. Livestock needs: nutritional needs based on species, age, sex, production level, and environment f. Herd inventory: the quantity of animals within each classification 8. Overseeding involves broadcasting legumes into an existing pasture in which the stand is thinned or grazed close to the ground