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