IOWA STATE UNIVERSITY
Extension and Outreach

Paddocks, Pastures, and People

A curriculum about sustainable pasture management for youth. Written by Maya Hayslett, Iowa State University Integrated Pest Management and 4-H Youth Development and Dr. Amy Powell, Iowa State University Animal Science and 4-H Youth Development. Supported by a grant from the North Central Sustainable Agriculture Research and Education Program.

Educational Goals

Through the activities in this program youth will learn how to improve sustainability of pasture by focusing on maintenance of pastureland and livestock with minimum inputs and reduced environmental impact. Specifically, youth should understand that:

- Good pasture management can help Iowans make better use of land and natural resources while meeting nutritional needs of livestock and increasing profit.
- More than one plant species is better for a managed pasture system and plants need time to recover after grazing.
- Rotational grazing increases animal grazing efficiency and allows plant recovery
- Stocking rate, nutrition and diseases all need to be considered for proper animal health

Educational Standards

1. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
2. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
3. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

Curriculum

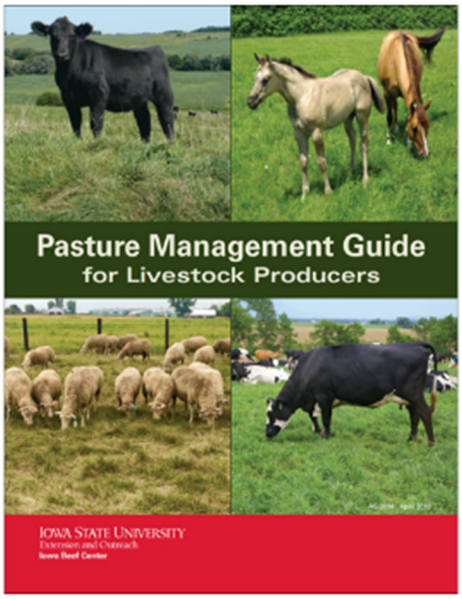
Paddocks, Pastures, and People is aimed at teaching high school youth the basics of pasture management. The core activities are one hour with 30 minutes focused on plant management and 30 minutes focused on animal management. The activities do not require any previous knowledge of plants, animals or pasture. Some background information is provided for the instructor. Supplemental activities are included to expand and deepen knowledge beyond the one-hour program.

Curriculum Outline

1. Curriculum goals
2. Background information for instructors
3. Managing plants for sustainable pasture
4. Managing animals for sustainable pasture
5. Supplemental activities

Background Information

Background resources include Pasture Management Guide for Livestock Producers available on the ISU Extension Store at https://store.extension.iastate.edu/product/5256



Lessons on managing plants for sustainable pasture

Learning Goals

- Learn about grasses and forbs role in animal nutrition
- Be able to identify some common pasture grasses and forbs
- See pasture as an ecosystem and learn about ecosystem services
- Learn why plant diversity in pasture helps the ecosystem and producers

Materials (for group of 12)

- 3 grass and 3 forbs and 3 weed samples to ID. Cooler with fresh samples.
- Printed ID guides or tablets for accessing websites
- 5 white boards (4 groups of 3 plus one for instructor with a stand) and 10 markers
- Poster about monocots and dicots

Preparing Materials

- Collect some common pasture plants immediately before the lesson. They could be collected the day before and kept cool in a refrigerator or cooler. If plants sit out they will dry up and be difficult to identify.
- Print out ID guides from these websites. Or provide access to the websites on smart-phones or tablets
    - https://www.agry.purdue.edu/ext/forages/ForageID/forageid.htm
    - http://pss.uvm.edu/pdpforage/Materials/ID/A3637_GrassID_UWis.PDF

- You may also want a weed ID guide such as the Weed Identification Field Guide https://store.extension.iastate.edu/product/13358

Activity 1: Grasses and Forbs

Directions (script in italics)

Introduction (5 min)

- *Today we are going to talk about pasture management. What is pasture? Talk to the person next to you and come up with a definition.*
- Share. Discuss. Best answer: pasture is an area of plants for animals to eat.
- *What types of animals use pasture.*
- Discuss. Best answers: Ruminants like cattle, goats, and sheep make the best use of plant leaves for food. Horses also make good use of pasture. They get the most nutrition from them.
- *What plants are in a pasture?* Best answer: grasses and forbs.
- *Let's talk about grasses and forbs using these posters. Grasses are monocots. The name monocot means that they have one seed leaf. Monocots have long thin leaves with parallel veins. They have fibrous roots systems that spread out below ground. They generally have small flowers that are wind pollinated.*
- *Name some different kinds of monocots.* Best answers: corn, wheat, Kentucky blue grass (lawns), big blue stem or other prairie grasses
- *Forbs are dicots. Dicots have two seed leaves. They generally have rounder leaves with leaf veins that branch. They tend to have a tap root system with one main large root. The tend to have flowers that are larger, more colorful, and attract insect pollinators.*
- *Name some different dicots*. Possible answers: most anything that is not a grass, should include soybeans
- *Soybeans are a type of legume. Legumes have a specific relationship with bacteria that grow in their roots and provide them with nitrogen. Nitrogen is an important component of protein, so legumes are higher in protein. Why might we care about protein in a pasture?* Answer: animals need to eat protein so having a legume in pasture can provide protein.

Plant ID (8 min)

- *Work with a partner to ID the plant you have. Start first by identifying it as a grass, a legume, or a weed. Then use the plant ID resources to identify what it is.*
- Discussion questions
  - How hard was it to ID the plant?
  - Why is it important to know what plants are in a pasture?
  - How do you choose the right plants for a pasture? What things do you need to consider?

Activity 2: Pasture as an ecosystem

Introductions (3 min)

- *We came up with considerations for what kind of plants should be in a pasture based on the abiotic conditions and the need of the animals. But what if I told you that a pasture is really an ecosystem and that there are things to consider about the entire ecosystem?*
- *What is an ecosystem? Talk to the person next to you and come up with a definition.* Share. Discuss. Best answer: an ecosystem is all the living things in an area that interact.
- *Let's brainstorm a list of all the types of organisms you might find in a pasture.* Use one white board to make a list. Should include: a pasture animal like sheep, at least one grass and one forb species, insects (above and below ground), mammal wildlife like rabbits, birds, microbes. Get a list of 8-12 organisms.

Draw interactions (6 min)

- *Work in a group of 3-4 to show how these organisms interact with each other. Draw arrows between them and write the interaction – for example insects eat plants (however you might need two arrows because some insects damage plants while others pollinate plants).*
- Share at least one group. Can share more if time.

Ecosystem services (4 min)

- *Has anyone heard of the term ecosystem services? This is when a diverse and well- functioning ecosystem provides benefits to humans. What are some benefits of a diverse ecosystem like a prairie or a woodland?* Use the white board to make a list of 6-8 ecosystem services. It can include: pest management, water filtration, erosion reduction, oxygen production, pollinators, nutrient recycling, reduction of CO2, recreation or others.

How can we manage for diversity? (4 min)

- *So, let's go back to our pasture. How can we manage our pasture to increase diversity and ecosystem services?* Answers include: Plant diversity including flowering forbs for pollinators, perennial pasture to maintain wildlife habitat, rotational grazing to maintain a more natural pasture, reduced pesticide use to reduce negative impacts on beneficial microbes, insects and wildlife

Lessons on managing animals for sustainable pasture

Learning Goals

- Explain why grazing management in important
- Explain the difference in grazing management systems
- Explain why and how animals utilize pasture
- Discuss advantages and disadvantages of different grazing systems

Materials

- 3 different flavors/types of wrapped candy for each student. Try to get one that you know students might not like: tootsie rolls, circus peanuts, licorice etc.
- 3 Bowls
- Dry Erase Board
- Dry Erase Markers
- Questions
- Animal Skulls – horse, sheep or goat, cow

Activity 1: How livestock use pasture

Directions (script in italics)

Introduction

- Ask the students the following questions?
    - *Who likes candy?*
    - *What type of candy do you like the best?*
    - *Are there candies/ flavors you don't like?*

Livestock are similar to us, they like different "flavors" of plants. There are some plants that cows will eat that horses won't and today we are going to talk about pastures for livestock.

Procedures (script in italics)

Lay out all the candy on a table. *Tell the students that they may come up and get their favorite piece of candy from the table but do not eat the candy.*
Why did you choose that particular type of candy?
We will call this candy legumes because for most livestock, legumes such as clover or alfalfa taste like candy to them.
What is left on the table?
Repeat the activity again
What did you choose the second time? We will call this grass, livestock like grasses but not as well as they like legumes. What is left on the table?
Repeat the activity again
What did you choose the third time? We will call this weeds.
What do you notice about the table now?
Livestock are no different, there are plants in pastures that they will tend to eat first because they are more palatable to them.

Livestock producers and land managers need to know what types of plants are preferred by livestock so that they can create a grazing management system that allows plants to grow back and reseed. If we graze the same location continuously – what happens to the pasture? The weeds would overtake the area and the pasture would become unsuitable for grazing.

Activity 2: Types of grazing systems:

How can we control the grazing? What are some ways that we can keep our plant diversity, yet still meet the needs of our animals?
There are several different types of grazing systems- but we can divide each of them into two main categories: continuous and controlled.

What do you think continuous means? (Have them write down their ideas on a dry erase board). Ask them to hold up their responses. *Continuous means that the animals eat whatever they want whenever they want until it is gone.*

What does controlled mean? (Have them write down their ideas on a dry erase board). Ask them to hold up their responses. *Controlled means the manager moves animals between different pastures or paddocks every couple of days.*

What are some of the reasons why we would use a rotational system? (Have them write down their ideas on a dry erase board). Ask them to hold up their responses.

To prevent livestock from eating all the good "candy" at once. To rest the pastures so that the "good candy" can grow back. To promote plant diversity, improves soil health, minimizes damage to streams, rivers and ponds, allows for frequent human-livestock contact. Reduces parasite loads on pastures. Can stock more animals per acer because you are moving them frequently.

What are some of the disadvantages of rotational grazing? (Have them write down their ideas on a dry erase board). Ask them to hold up their responses. *Must have access to water in every field (can be expensive). Need good fences, more labor.*

How do livestock eat grass?
Hold up the sheep skull and ask each group to write down on their white board what species they think it is. Have them reveal their answers. Ask them about the skull – *why do they think it is a sheep skull?*

Now hold up the cow skull (Have them write down their ideas on a dry erase board). Ask them to hold up their responses.

Now hold up the horse skull (Have them write down their ideas on a dry erase board). Ask them to hold up their responses.

Compare the sheep and cow skulls – *what are the differences*?

How would their skull and size of the animal affect how the animal eats grasses?

Use the chart below to create an activity where the student's try to fill in the blanks or sort out the answers based on what they have observed about the skulls.

Specie	*Cattle*	*Sheep*	*Horse*
Hours Grazing	*Graze 8-12 hours*	*Graze 6-8 hours*	*Graze 16 hours*
Digestive System Type	*Ruminant*	*Ruminant*	*Hind gut fermenter The first section of the horse's system is similar to a human but the second section or hind gut is where the majority of food digestion occurs. The hind gut is 22 feet long in a horse*
How they eat	*Bring forage to their mouth with tongue and tear or shear it off with teeth on their lower jaw*	*Use upper and lower lips to grab forage and then lower teeth bite the grass*	*Upper and lower teeth are used to nip the grass*
Preferred grazing Height	*4-10" best height*	*2-6" best height*	*Selective – prefer young, immature plants and will graze to bare ground. Especially like to spot graze and will not graze where they dung.*
Stocking Rate	*1 cow/calf to acre*	*5 ewes/acre*	*1 horse to acre*

Now that we know these characteristics – *how does that affect the way we set up pastures for these species?*

- Don't expect sheep to be able to graze as effectively in really tall grass.
- Rotate your pastures to prevent overgrazing and to keep the animals from eating all the candy.

Supplemental Activities

Activity 1: Parasites
One of the reasons that was mentioned for rotational grazing was to help reduce the parasite load. *What is a parasite?* (Have them write down their ideas on a dry erase board). Ask them to hold up their responses.

A parasite can be external (tick or lice) or internal like a worm. There are many types of parasites and they live off another organism called a host. *What is the life cycle of a parasite?* Use the http://www.wormboss.com.au/worms/roundworms/roundworm-life-cycle.php to illustrate the cycle. Cut the cycle apart and have the students put it back in order.

Dung stage

Worm eggs that have passed from the sheep in dung hatch and develop through first (L1) and second (L2) larval stages to become infective larvae (L3). The success and speed of this development depends on weather conditions, specifically warmth and moisture, and require a minimum of 4 days and rarely more than 10 days. Temperature requirements vary for each worm type, but most require about 15 mm of rain over a few days (but also depends on evaporation rates) to provide sufficient moisture for development. The L3 leave the dung moving onto pasture and soil, rarely more than 25 cm from where they were deposited in the dung.

Pasture stage

The writhing movement of L3 results in them moving in moisture films onto the pasture and soil. L3 are carried in water films (from dew, mist or rain) onto the leaves and stems of pasture (and less commonly into the soil). Most L3 are concentrated near the base of the pasture, rarely higher than 10 cm. While the larvae do move toward light, it is not conclusively known whether larvae migrate up and down the grass blades according to light and temperature changes. Much of their movement is thought to be random or non-directional.

L3 do not feed but survive on energy reserves, dying when these have been used. L3 numbers on pasture decline very rapidly when temperatures exceed 40℃, as they die from desiccation.

Host stage

When L3 on the pasture are eaten by sheep they develop into 4th stage larvae in the gut and then become adults to complete their life cycle. Adult male and female worms live and mate inside a sheep's gut. After a minimum of 18 days developing to adults (pre-patent period), females lay worm eggs that are then passed onto the ground in the sheep's dung.

Key life cycle points that affect the control of and contamination by roundworms

The time for eggs to pass from the sheep after an effective drench

An effective drench will take some hours to kill all the worms present and therefore stop further egg-laying by female worms. Some viable worm eggs will already be in the sheep's gut at the time of drenching and these won't be affected by most drenches. It will take 3–4 days after an effective drench for the gut contents to carry most of the worm eggs out of the sheep. Bear this in mind if you wish to move sheep to a paddock that is to be kept uncontaminated.

The pre-patent period

This is the time taken for infective larvae, eaten by a sheep grazing pasture, to develop to adult worms in the gut, mate and start laying eggs, which appear in dung. The time depends on the worm species with barber's pole worm completing this period in a minimum time of 18 days under ideal conditions. Most scour worms take about 21 days.

Therefore, little, if any, worm egg contamination of pastures will come from sheep in the pre-patent period from a few days after they have been given an effective drench that kills 98% or more of the worms present. Allow sheep to graze up to 21 days in barber's pole worm areas and to 30 days in southern scour worm areas. This is a principle used in 'Smart Grazing'.

The auto-infection period

This is the time between eggs being deposited on pasture (in the sheep's dung) and when the larvae that have developed from those eggs appear on pasture ready to re-infect sheep. This is 4–10 days; the shorter period when temperature and moisture conditions are ideal for the particular worm species.

This principle is used in fast-rotation grazing systems, where sheep are grazed on paddocks for a time shorter than the auto-infection period. They are then moved before they can become infected with larvae that have developed from eggs recently deposited by the same mob. This allows the sheep to continue through further paddocks, picking up infection at a slower rate from larvae already on the pasture.

Periods when the life cycle will be stopped

As worms require both warmth and moisture for eggs to develop to larvae (above 10–18℃ depending on worm species, but ideally below 35℃, and with usually more than 15 mm rain over 4–7 days of rainy or overcast weather when the evaporation rate is low), there can be extended periods of the year in some locations when worms cannot successfully complete their life cycle. These include regions with particularly cold winters or hot summers or where there are lengthy dry periods.

Barber's pole worm eggs will die if these conditions are not met within about 10 days of them being deposited on the pasture. Scour worm eggs are able to survive a few more weeks awaiting suitable conditions for hatching.

During these conditions, sheep carrying worms can graze paddocks destined to be low worm-risk pastures for lambing ewes or weaners without contaminating them further. The deposited eggs won't develop and will die within 1–2 weeks (1 week for barber's pole worm, longer for other worms).

Note that during these periods the sheep will continue to be infected with any larvae surviving on the paddock from when conditions were suitable for development in the weeks or months beforehand.

The time for worm larvae to die

Infective larvae are relatively tough and can withstand dry, cold and moderately hot conditions. All populations of living things vary in their life expectancy and worms are no different; some larvae will die within days, but some will live to around a year or more. Generally, over 90% of larvae will be dead within 6 months under cooler conditions and as little as 3 months when temperatures are ideal (about 25–30℃). Under extremely hot, dry conditions larvae will be desiccated and can die in a few days to weeks of these conditions, explaining why worms are rarely a problem in the arid zone.

This principle can be used when deciding how long it will take for paddocks previously contaminated with worms to become low worm-risk (i.e. when over 90% of the worm larvae have died).

Location of larvae on the pasture

As few larvae move higher than 10 cm up pasture plants, tall pastures or crops are a considerably lower worm-risk. As the pasture or crop is grazed lower, the sheep will consume more of the larvae that are present. Use this principle when choosing or preparing lower worm-risk pastures. Remember, however, that with crop there may be shorter grass around the edges of the paddock where larvae will be more available.

What would be some of the symptoms of a sheep or goat with a heavy internal parasite load?

- Skinny
- Scours
- Bottle jaw
- Abnormal fleece or hair coat
- Depression/Lethargy
- Anemia
- Fever or cold extremities
- Fast breathing or coughing (lung worms)

We do have drugs on the market that we call anthelmintics or dewormers that can force an animal to shed parasites through their dung. However several of the parasites have become resistant to these products. Several years ago the general practice was to deworm your sheep on a regular schedule but research has shown us that it is better to only treat those sheep that have symptoms of parasites rather than unnecessarily

administering medication to those that don't need it. So how do we know if our sheep has parasites? What do you think?

FAMACHA was a test developed by three South African researchers to determine if a sheep is anemic. By matching this card to the mucous membrane in the eye a producer can quickly tell if the sheep is showing signs of anemia. Use this link https://web.uri.edu/sheepngoat/files/FAMACHA-Scoring_Final2.pdf and print off copies of the FAMACH card. You can have them look at the pictures to determine if an animal is anemic.

So what is anemia? What do parasites eat? BLOOD! So if you are lacking blood-specifically iron in your blood your tissues will look pale. This is how we know that a sheep or goat might have a heavy parasite load and can treat only the infected animals.

Activity 2: Measuring diversity

Increasing biodiversity in your pasture system can help increase its longevity and sustainability. It can also provide additional resources and services for the ecosystem (more flowers for pollinators for example). One way scientists investigate the biodiversity of an area is to use a ***quadrat****. A quadrat is just a square of a standard area used to take either random or systematic sample. The quadrat is layed on the ground and all the species inside are counted. For this activity you will create and use your own quadrat. Biodiversity can be measured in different ways. You can measure* ***species richness*** *which is how many different species there are in an area but you can also measure* ***species evenness*** *which is the proportion of different species in the whole. If a pasture has 40 different species in it, but 95% of all the plants are one species of grass, that pasture would have high species richness but low species evenness.*

Objectives

1. Learn about the importance of biodiversity in pasture systems
2. Experience how biodiversity research is done

Key concept

Biodiversity in ecosystems is important for proper functioning and for maintenance of ecosystem services that we all use. Biodiversity can be measured and studied.

Challenge

Create a quadrat and use it to measure the biodiversity of a pasture near you.

Materials

String, scissors, maker, tape measurer or yard stick

How to make a quadrat:

Your quadrat will be a square with half meter sides.

1. Take your yardstick and start by measuring 5 cm and marking it, this will be the extra string on each side to tie it together.
2. Then measure 2 meters from the mark. Mark the other end.
3. Measure 5 more centimeters and cut there.
4. Tie together as close to the marks as you can.

How to use a quadrat:

1. Choose a pasture record the location.
2. Lay the quadrat on the ground and arrange it into as perfect a square as you can achieve (see photos from the first page)
3. Take a picture
4. Count and record the number of different plant species you can see.
5. Repeat 10 times. Decide if you are going to take evenly spaces samples or random samples.

How to count plant species:

When you first glance at the area, it may seem like all one species, but if you look closer you will see there are at least a few different species even in an area that looks pretty uniform. Pay close attention to leaf shape and size, flower color and arrangement, stem color and arrangement, as well as the general size and height of the plant. Go carefully and systematically through the area. I like to start in the top left corner and look at an area a few inches across to the opposite corner, then go to the left side a few inches lower and go back across, like reading a book. You should be able to get a good count of plant species. You may also wish to try to identify the species using the resources from the previous lesson.

Discussion

How many different species did you find in total?
Did you choose evenly spaced or random samples? Why?
Are your ten samples representative of the area? Why or why not?
In general, would you say there is high or low species richness? Is there high or low species eveness? What would you expect for a pasture?

Are there more grasses, more legumes, or more weeds? What does that tell you about the pasture?

For questions or more information about this program or any other programs offered through ISU Extension and Outreach please contact:

Amy Powell
ampowell@iastate.edu

Maya Hayslett
hayslett@iastate.edu

Funding for Paddocks, Pastures and People was provided by a grant from the Sustainable Agriculture Research and Education Program.