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# Investigating Rangeland Systems and Practices: A Curriculum for Middle School Students

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**National Association of Agricultural Educators Conference**
**Phoenix, AZ**
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NORTH CENTRAL SARE
Sustainable Agriculture Research & Education

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# Project background

- National Research Council (NRC) published report in 1988
  - Agricultural literacy: ability to understand the food and fiber system, including its history and current economic, social, and environmental significance
  - Report concluded: “most Americans know very little about agriculture, its social and economic significance in the United States, and particularly, its links to human health and environmental quality”
  - Is anything different today?!?!

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# Project background

- U.S. Dept. Of Agriculture published report in 1993
  - Surveyed 2,000 high school students AND adults from Indiana, Michigan, Missouri
  - Nearly 20% of respondents were wrong or didn't know if it was true or false that "Hamburger is made from the meat of pigs"
  - More than 35% of respondents were either wrong or didn't know the answers to **any** of the statements

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# Project background

- Conclusion:
  - Americans lack knowledge about agriculture and the impact it has on their daily lives
  - This is especially true for young people/students!!

- Solution:
  - Introduce agricultural literacy into the classroom and after-school activities (4-H), as well as provide further resources for FFA advisors

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# Conclusions

- Agricultural literacy is critically important
  - Not only in Great Plains, but across the U.S.
  - Objective information
    - Future neighbors, consumers, voters
  - Fosters critical thinking, challenges current ways of knowing
  - 2015-2020; nearly 60,000 job openings in food, agriculture, natural resources
    - 40% of them were unfilled → lack of graduates
      - Lack of interest? Knowledge? Exposure?

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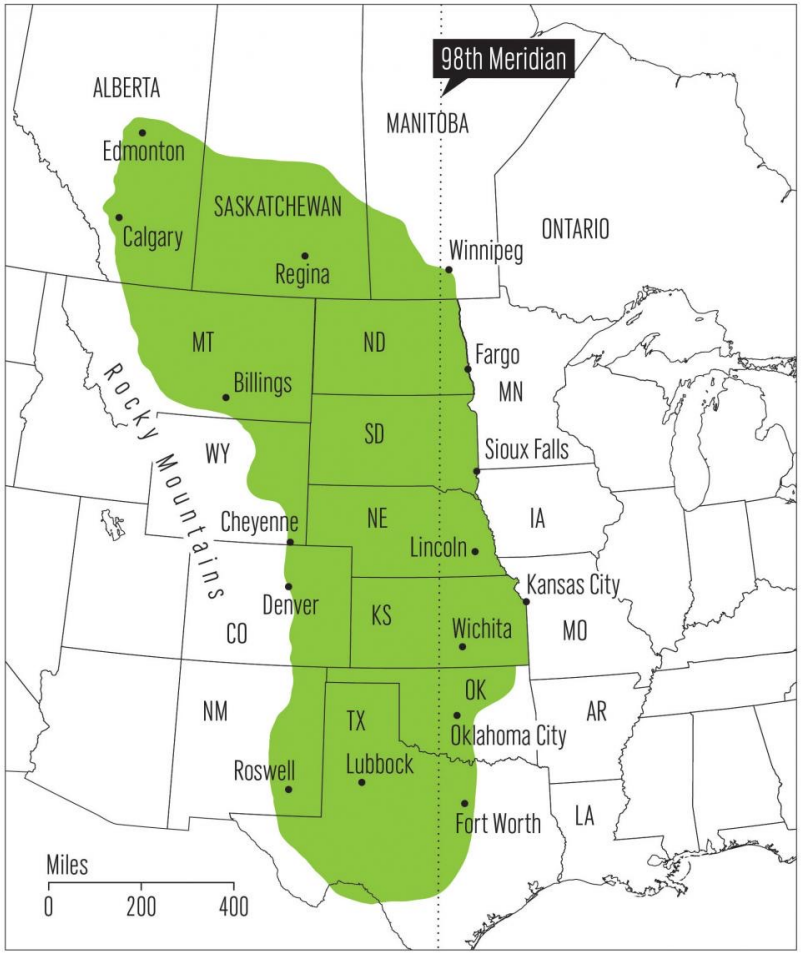
# Project importance in South Dakota




- Great Plains
  - 85 million hectares
    - 40% of that land = livestock production
  - ~90 million head cattle + calves in the United States
    - Majority concentrated in the Great Plains
- South Dakota
  - Rangeland importance
  - ~$26 billion impact from ag
  - 20% of jobs

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# Funding

- Provided by a North Central Region Sustainable Agriculture (SARE) Research and Education (R&E) grant
- Competitive grant program for researchers and educators involved in projects that explore and promote environmentally sound, profitable, and socially responsible food and/or fiber systems

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# Approach/methods

- Workshops
  - Science teachers
  - Ag educators
  - 4-H Youth Advisors
- Modular lesson plans
  - Summary of activity/learning outcomes
  - Alignment w/ Next Generation Science Standards and SD Science Standards
  - Hands-on activities
  - Classroom assessment techniques (CATs)

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# Mobridge Middle School pilot


- Background:
  - Mobridge has about 3,350 people
  - Middle school has about 140 students
    - Most of students are non-rural, non-ag
- Elementary principal also ranches
  - Trying to incorporate ag at an earlier level
  - No high school ag program
- Presented SARE curriculum to principal and middle school science teacher
- Agreed to “pilot” curriculum to help with curriculum development

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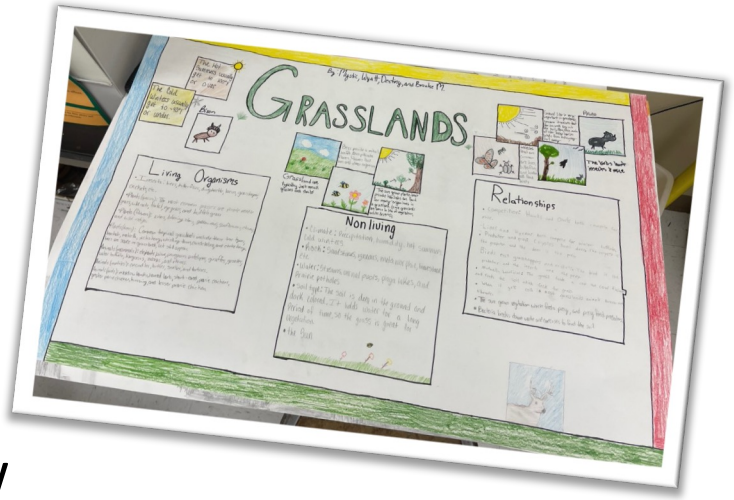
# Mobridge Middle School Pilot




- Overview and feedback:
  - Module 1: Rangelands Overview
    - Students enjoyed creating posters and learning about ecosystems
  - Module 2: Plants
    - Liked the grazing/drought experiment
  - Module 3: Animals
    - Not enough time
  - Module 4: Soils
    - Soil glue activity was a hit!

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# Module Overview

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# Modules

- 1 – Rangeland overview
- 2 – Plants
- 3 – Animals
- 4 – Soils
- 5 – Foraging

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# Module components

Key terms

Education standards

Anticipated time

Material list

Learning outcomes

MODULE 1

# OVERVIEW OF RANGELANDS

## Investigating Rangeland Systems and Practices

### SKILL LEVEL

Middle School: Grades 6, 7, 8

### KEY TERMS

Abiotic, biotic, grassland, shrubland, woodland, savanna, desert, cropland

### EDUCATION STANDARDS

South Dakota Science:
- MS-LS2-2
- MS-LS2-3

NGSS:
- MS-LS2-2
- MS-LS2-3

### TIME NEEDED

Activity 1A: 45 min

Activity 1B: 30 min

Activity 2: 10 min

### MATERIAL LIST

- Chalkboard or whiteboard
- Printable items from Appendices
- Computer with projector
- Materials listed for each activity


### FUNDING ACKNOWLEDGEMENT

This material is based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under agreement number 2019-38640-29879 through the North Central Region SARE program under project number LNC19-419. USDA is an equal opportunity employer and service provider. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.



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For questions, contact Krista Ehlert: krista.ehlert@sdstate.edu


### EXPECTED LEARNER OUTCOMES

**OBJECTIVE 1** – Students will be able to identify rangelands and explain how they differ from other ecosystem types.

**OBJECTIVE 2** – Students will be able to describe the relationships between the organisms and non-living components in a rangeland.




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# Module components

## Background information

### BACKGROUND

Plants are a critical component in rangelands - they prevent soil erosion, provide shelter for grassland birds, food and habitat for ungulate species such as deer and antelope, habitat for pollinators such as butterflies and bees, and food for cattle.

What can plants do that humans can't do? They can use the energy from the sun to make food! All plants - regardless if they are a grass, grass-like, shrub, or forb - perform photosynthesis as their way of making food. If a plant gets hungry, it can't walk into a restaurant or a grocery store to get food. Plants are producers (autotrophs), which means that they make or producer their own food. Specifically, plants are an autotroph that collect energy from the sun and takes that energy and turns in into organic molecules that are used for growth, reproduction, and defense.

**What is Photosynthesis?**
Photosynthesis is the process plants use to make their own "food" from the sun's energy, carbon dioxide, and water. During photosynthesis, carbon dioxide and water combine with solar energy to create glucose, a carbohydrate ($C_6H_{12}O_6$), and oxygen.

The process can be summarized as:

in the presence of sunlight, carbon dioxide + water → glucose + oxygen.

Glucose, the main product of photosynthesis, is a sugar that acts as the "food" source for plants. The glucose is then converted into usable chemical energy, ATP, during cellular respiration. The oxygen formed during photosynthesis, which is necessary for animal life, is essentially a waste product of the photosynthesis process.

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# Module components

**Materials for each activity**

**Any prep needed**

## ACTIVITY #2: PHOTOSYNTHESIS – THE STARCH TEST

**Estimated Time:** 30 minutes (24 hour set up)

**Make sure that students can see what you're doing as you perform the starch test!

**Ask students to write down the steps you are taking in a "lab notebook," or on a piece of paper, so that they can actively and intelligently engage with the demonstration, both by writing out the steps involved in the experiment and by recording their scientific observations.

**Materials**

- 2 plants – Golden Pothos (a forb, Figure 2) is ideal and can be found at many home improvement stores
  - » *For Optional Advancement - 2 Pothos with variegated leaves (white and green leaves)*
- Dark Space (closet or other place without windows)
- Bright Space (window sill or similar location with lots of light)
- 1 Bottles, Ethyl Alcohol or Rubbing Alcohol (Can find at Target/Walmart)
- 1 Beaker (250 ml size)
- 1 Sauce Pan (2 quart size)
- 1 Heat Source (stove top or a hot plate)
- 1 Tweezers
- 2 Shallow Dishes
- 1 Bottle, Iodine Solution (Can find at Target/Walmart)

Figure 2. A golden pothos.

**Preparation**

1. Prep: Place 1 of the 2 plants in a dark room for 24 hours; place the other plant on a sunny windowsill.
2. Wait 24 hours (note that you can place the plants 24 hours before the class period, and then start with step 3, or you can start at the very beginning with a discussion of the characteristics of the plant as you introduce the lesson (green, large shiny leaves, vine-like, it's a forb, not a grass, etc.).

**Activity - Demonstration**

1. Discuss with students what you did with the plants – they were placed in two different locations for 24 hours.
   a. Can students tell a difference between which plant was in the dark room and which was by the window? Why or why not?
2. Fill the beaker with ethyl alcohol (Figure 3).
3. Place the beaker in a saucepan full of water.

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# Module components

**Pre-developed worksheets/handouts**



HANDOUT #2

## RANGE PLANT DISCOVERY EXPERIMENT

Student name: _____

| Treatment | Observations |
|---|---|
| Card 1 - GRASS cut to 1 inch tall and jiffy pellet kept evenly moist. When grass reaches 3 inches tall, it gets cut again to 1 inch tall. | |
| Card 2 - GRASS not cut at all and jiffy pellet kept evenly moist. | |
| Card 3 - GRASS not cut at all, jiffy pellet receives only 10 drops of water every 5 days. | |
| Card 4 - GRASS not cut at all, jiffy pellet is kept in a plastic cup that always has 2 inches of water in it. | |
| Card 5 - FORB cut to 1 inch tall and jiffy pellet kept evenly moist. When forb reaches 3 inches tall, it gets cut again to 1 inch tall. | |
| Card 6 - FORB not cut at all and jiffy pellet kept evenly moist. | |
| Card 7 - FORB not cut at all, jiffy pellet receives only 10 drops of water every 5 days. | |
| Card 8 - FORB not cut at all, jiffy pellet is kept in a plastic cup that always has 2 inches of water in it. | |

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# Videos with producers

- Short, easily digestible
- Examples:
  - Branding
  - Haying
  - Farming
  - Federal grazing
  - Cow-calf production cycle

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# Module 1: Overview of Rangelands

- Rangelands
  - What they are and are not
  - Where they are located
  - How they're different from other ecosystems

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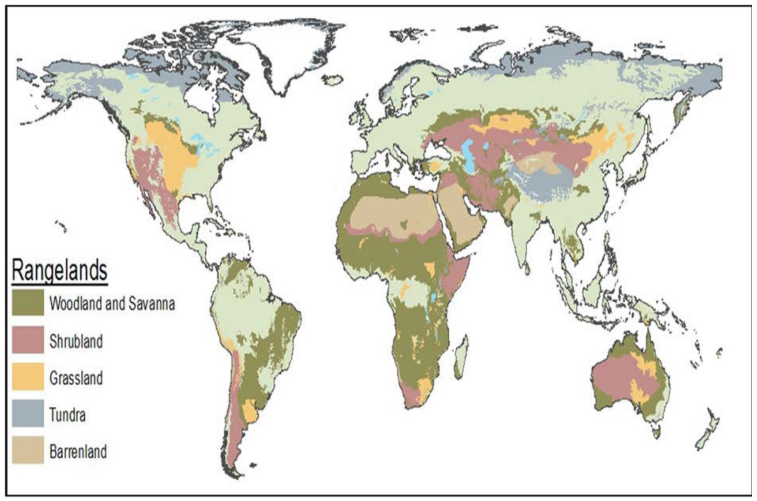
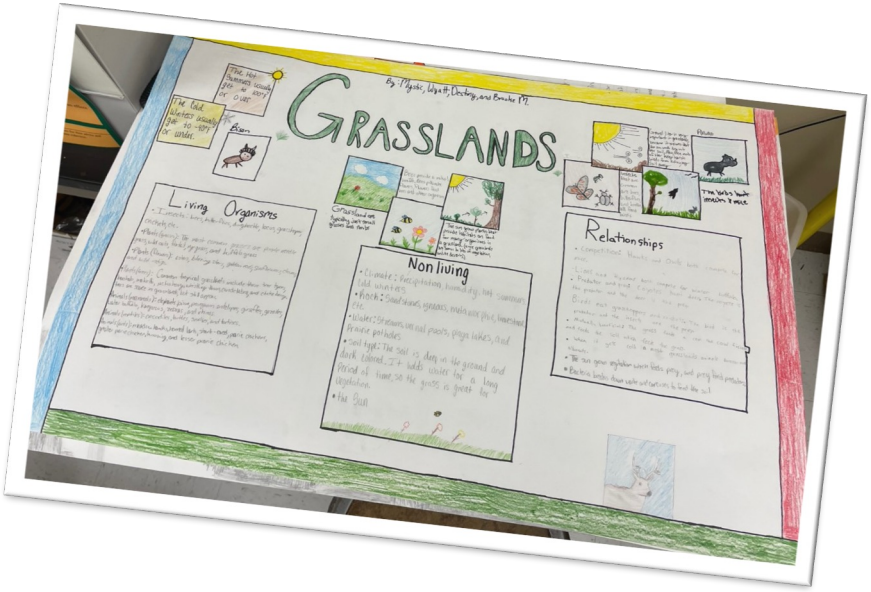
# Module 1: Overview of Rangelands

- Activity example:
  - Rangelands Around the World
    - Different types: grasslands, shrublands, etc.
    - Biotic and abiotic components (e.g. compare/contrast)
    - Relationships (e.g. competition, predator/prey, mutualism)
    - Cycling of matter (e.g. plant decomposition)
    - Flow of energy (e.g. sun provides energy for plants)



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# Module 2: Plants

- Critical component in rangelands – plants
  - Students discuss photosynthesis
  - Investigate drought and grazing effects on plants

MODULE 2

## PLANTS

Investigating Rangeland Systems and Practices

### SKILL LEVEL

Middle School: Grades 6, 7, 8

### KEY TERMS

Autotroph, drought, forbs, grasses, grass-like plants, shrubs, photosynthesis

### EDUCATION STANDARDS

South Dakota Science:
- MS-LS1-6
- MS-LS2-2

NGSS:
- MS-LS1-6
- MS-LS2-2

### TIME NEEDED

Activity 1: 20 min

Activity 2: 30 min (24 hr set up)

Activity 3A: 50 min

Activity 3B: 50 min

Activity 3C: 50 min

Activity 4: 10 min

### MATERIAL LIST

- Chalkboard or whiteboard
- Printable items from Appendices
- Computer with projector
- Materials listed for each activity


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### EXPECTED LEARNER OUTCOMES

**OBJECTIVE 1** – Students will be able to identify products and reactants of photosynthesis.

**OBJECTIVE 2** – Students will understand the impact of drought and grazing in a rangeland system.

**OBJECTIVE 3** – Students will analyze the growing process of native rangeland plants.

**OBJECTIVE 4** – Students will learn that grazing causes a more concentrated root system in range grasses compared to non-grazing.

**OBJECTIVE 5** – Students will understand that drought and flooding have negative consequences on rangeland plants.

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# Module 2: Plants

- Activity example:
  - Photosynthesis Starch Test
    - 2 plants – 1 in sunlight, 1 in dark room
    - The hot water acts to kill the leaf
    - The ethyl alcohol breaks down the chlorophyll, which removes the green color from the leaf.
    - Add iodine to the leaves → one turns blue-black and one stays reddish-brown
      - Iodine is a starch indicator and turns blue-black when starch is present, a by product of photosynthesis

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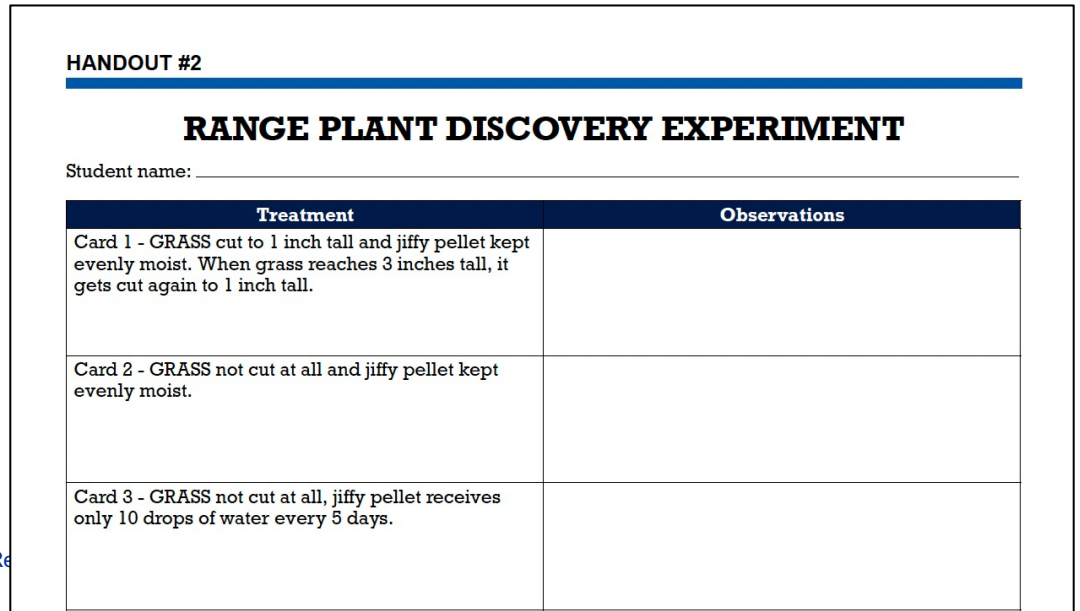
# Module 2: Plants

- Activity example:
  - Range Plant Discovery Experiment
    - Students grow forbs (flowering plants) and grasses in a Jiffy greenhouse
    - Different levels of “grazing” (i.e., cutting the plants)
    - Different levels of precipitation (drought → flood)



HANDOUT #2

**RANGE PLANT DISCOVERY EXPERIMENT**

Student name: _____

| Treatment | Observations |
|---|---|
| Card 1 - GRASS cut to 1 inch tall and jiffy pellet kept evenly moist. When grass reaches 3 inches tall, it gets cut again to 1 inch tall. | |
| Card 2 - GRASS not cut at all and jiffy pellet kept evenly moist. | |
| Card 3 - GRASS not cut at all, jiffy pellet receives only 10 drops of water every 5 days. | |

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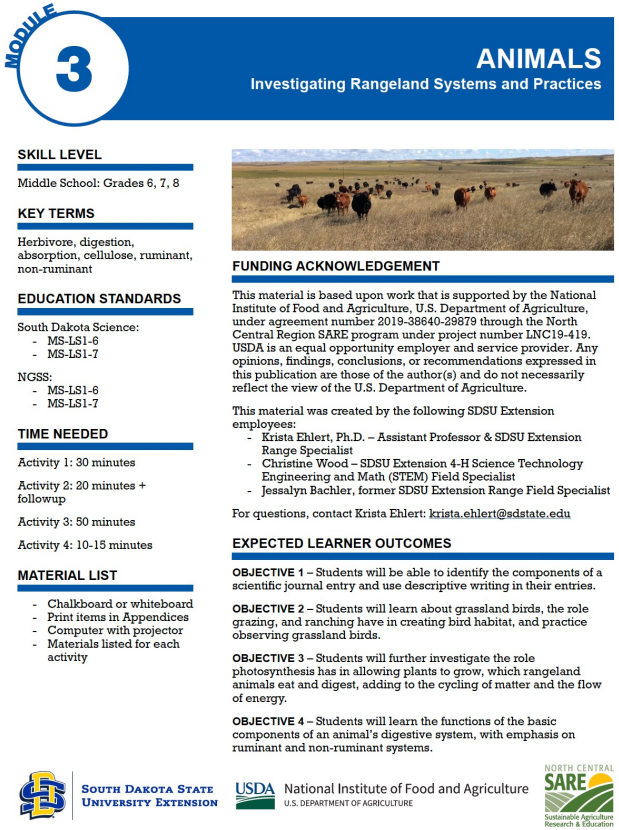
# Module 3: Animals

- Highlights and teaches students about rangeland animals
  - Wildlife
    - Grassland birds
  - Ruminant digestive system
    - Why cows are so important!!



MODULE 3

ANIMALS

Investigating Rangeland Systems and Practices

**SKILL LEVEL**

Middle School: Grades 6, 7, 8

**KEY TERMS**

Herbivore, digestion, absorption, cellulose, ruminant, non-ruminant

**EDUCATION STANDARDS**

South Dakota Science:
- MS-LS1-6
- MS-LS1-7

NGSS:
- MS-LS1-6
- MS-LS1-7

**TIME NEEDED**

Activity 1: 30 minutes

Activity 2: 20 minutes + followup

Activity 3: 50 minutes

Activity 4: 10-15 minutes

**MATERIAL LIST**

- Chalkboard or whiteboard
- Print items in Appendices
- Computer with projector
- Materials listed for each activity



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**EXPECTED LEARNER OUTCOMES**

**OBJECTIVE 1** – Students will be able to identify the components of a scientific journal entry and use descriptive writing in their entries.

**OBJECTIVE 2** – Students will learn about grassland birds, the role grazing, and ranching have in creating bird habitat, and practice observing grassland birds.

**OBJECTIVE 3** – Students will further investigate the role photosynthesis has in allowing plants to grow, which rangeland animals eat and digest, adding to the cycling of matter and the flow of energy.

**OBJECTIVE 4** – Students will learn the functions of the basic components of an animal's digestive system, with emphasis on ruminant and non-ruminant systems.

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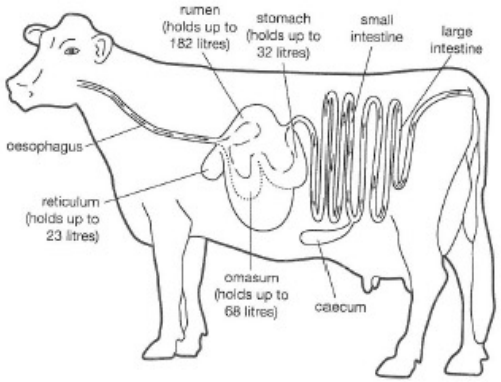
# Module 3: Animals

- Activity example:
  - Grassland Birds
    - Students learn about scientific journal entries – recording their observations, posing questions
    - Watch a video about conservation-focused ranching with the Audubon Society
  - Ruminating on the Digestive System
    - Students learn about ruminant digestion
    - Connect to photosynthesis and plants
    - Also discover lengths and volumes of digestive system

Prairie chicken




Ruminant digestive system

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# Module 3: Animals

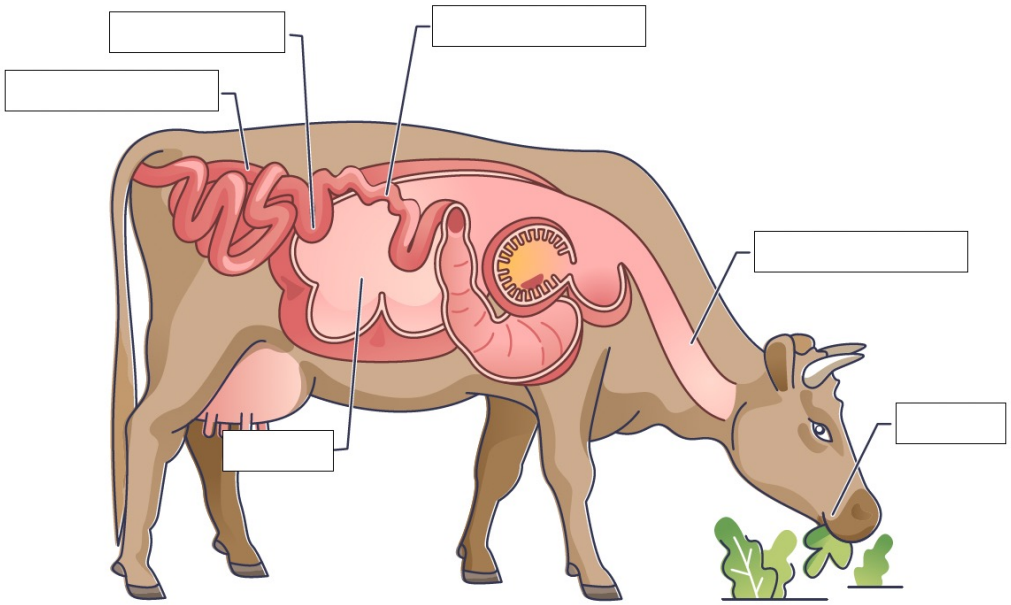
- Ruminating on the Digestive System
  - Students learn about ruminant digestion
  - Connect to photosynthesis and plants
  - Also discover lengths and volumes of digestive system

HANDOUT #2

## RUMINANT DIGESTIVE SYSTEM

**Name:** _____

1. The purpose of the digestive system is to _____.
2. Bacteria help ruminants digest forage such as grass because the bacteria can break down _____, which is found in plant _____. Humans and non-ruminants do not have the enzymes to break down cellulose.
3. The largest section of a ruminant's digestive system is called the _____.
4. Using what you've learned, label this cow's digestive system with the following terms:
   A. Mouth
   B. Large intestine
   C. Esophagus
   D. Small intestine
   E. Rumen
   F. Cecum



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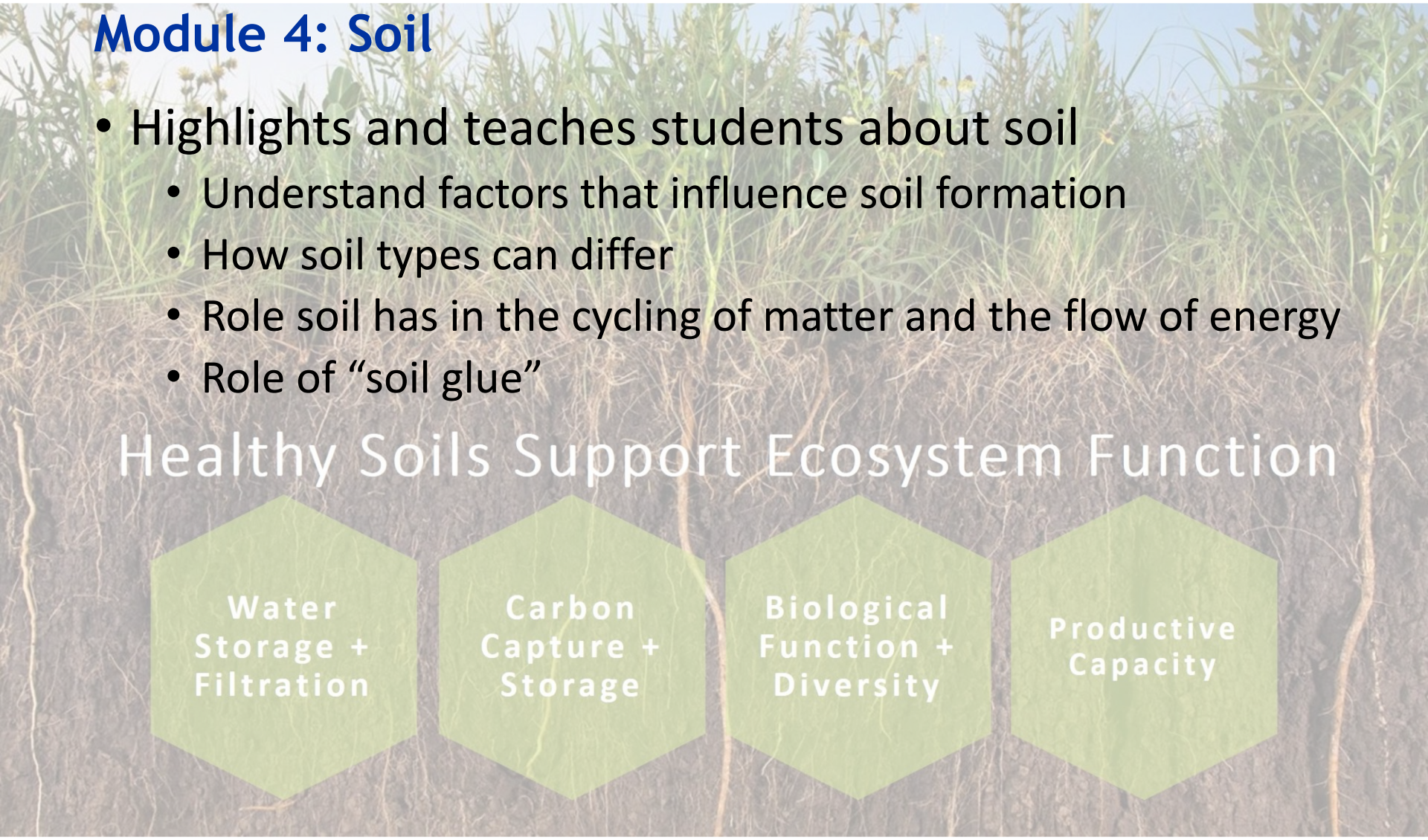
# Module 4: Soil

- Highlights and teaches students about soil
  - Understand factors that influence soil formation
  - How soil types can differ
  - Role soil has in the cycling of matter and the flow of energy
  - Role of “soil glue”



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# Module 4: Soil

- Activity example:
  - Soil Glue and Soil Food Web
    - Compare 2 different soils (e.g. one from a tilled field and one from a more native/natural area like a rangeland)
    - Soils that are tilled will fall apart – water will become cloudy
      - There is less organic matter in the soil and fewer living organisms → less "glue"

**HANDOUT #4**

**SOIL GLUE DEMONSTRATION**

Student name: _____

1. What is the source of each soil sample? Where is it from? Record it in the table below.

| Soil 1 | Soil 2 |
|---|---|
| | |

2. Once your teacher lowers the soil sample into the water, watch the results and record your observations in the table below.

| Soil 1 | Soil 2 |
|---|---|
| | |

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# Module 5: Foraging

- Exposes students to different range plants
- Learn historical uses of the plants by Native Americans

MODULE 5

FORAGING

Investigating Rangeland Systems and Practices

**SKILL LEVEL**

Middle School: Grades 6, 7, 8

**KEY TERMS**

Grasslands, native plants, foraging

**EDUCATION STANDARDS**

South Dakota Science:
- MS-LS1-6*

NGSS:
- MS-LS1-5*
- MS-LS1-6*

** Peripherally related.*

**TIME NEEDED**

Activity 1: 40-50 minutes

Activity 2: 10-15 minutes

**MATERIAL LIST**

- Chalkboard or whiteboard
- Print items in Appendices
- Computer with projector
- Materials listed for each activity

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**EXPECTED LEARNER OUTCOMES**

**OBJECTIVE 1** – Students will learn about the Native American historic uses of rangeland plants.

**OBJECTIVE 2** – Students will learn what rangelands plants are edible and can be foraged.

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**Foraging Supplies**

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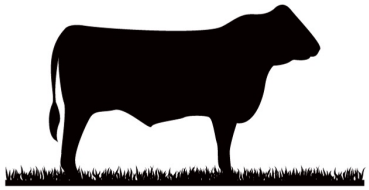
## Modules

SCAN ME

## YouTube Videos

SCAN ME



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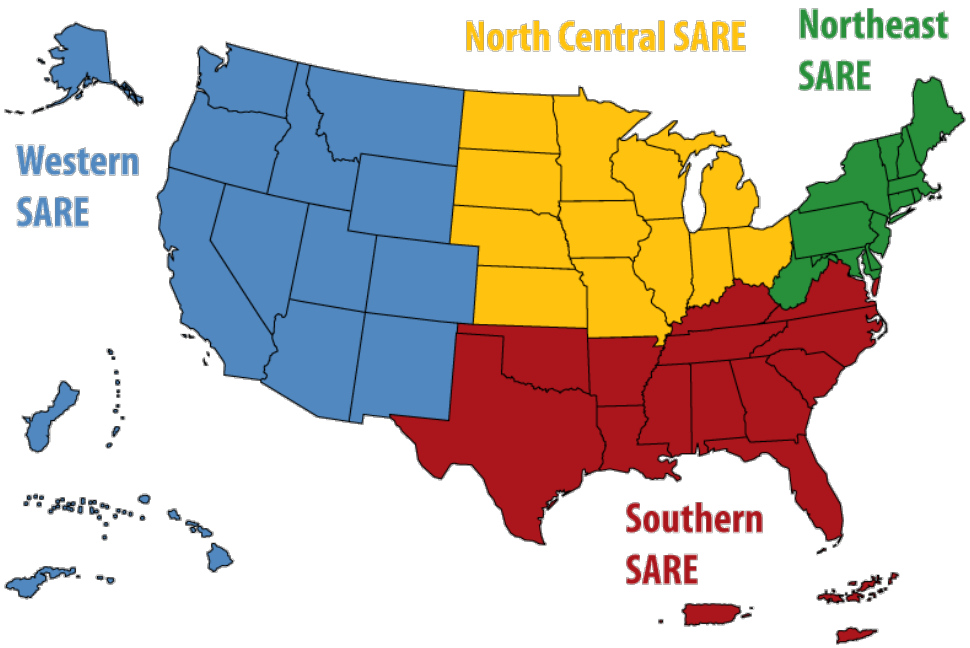


## SARE Grants

SCAN ME

- Youth Educator, $6k
- Professional Development, $120k
- Research & Education, $250k

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# Get in touch!!


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