



"Steer" Toward STEM

Careers in Animal Agriculture

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California Foundation for Agriculture in the Classroom

Vision: An appreciation of agriculture by all.

Mission: To increase awareness and understanding of agriculture among California's educators and students.



California Foundation for
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Table of Contents

Getting Started

Introduction.....	5
Unit Overview	6

Lessons

Significant Surroundings	9
Build It Better	19
Roll of the Genes	28
Got Guts?	41
Homes on the Range	54

Teacher Resources

Answers to Commonly Asked Questions	67
Agricultural Organizations	71
Teacher Resources and References	74
Related Websites	83
Related Literature	87
Matrix of Standards	92
Glossary	99

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The California Foundation for Agriculture in the Classroom is dedicated to fostering a greater public knowledge of the agriculture industry. The Foundation works with K-12 teachers, community leaders, media representatives, and government executives to enhance education using agricultural examples, helping young people acquire the knowledge needed to make informed choices.

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The Foundation would like to thank the people who helped create, write, revise, and pilot test "*Steer*" *Toward STEM: Careers in Animal Agriculture*. Their comments and recommendations contributed significantly to the development of this unit. Their participation does not necessarily imply endorsement of all statements in the document.

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Introduction

Science, technology, engineering, and mathematics (STEM) are essential educational disciplines in the field of agriculture. To meet complex agricultural challenges and create a workforce that can compete globally in the 21st century, students must develop an interest in STEM careers and have the skills necessary to succeed in these careers. Educators have an important role in incorporating STEM education into the classroom environment. This comprehensive, agriculture-themed unit equips teachers to incorporate STEM education into their state-mandated curriculum.

The framework for California public schools emphasizes the need to make education meaningful to students so they can apply what they learn in the classroom to their daily lives. Since all students eat food and wear clothing, one natural connection between academic education and the real world is agriculture.

Agriculture is an important industry in the United States, especially in California. As more rural areas become urbanized and more challenges exist to maintain and improve the quality of the planet and feed the people of the world, it is extremely important to educate students about their environment, agriculture, and the modern technologies that continue to make Earth a viable and productive planet. *“Steer” Toward STEM: Careers in Animal Agriculture*, a third through fifth grade unit, introduces students to the science, technology, engineering, and math involved in animal agriculture. Students will hypothesize and use their observation skills to test the environmental preferences of mealworms, and then apply their findings to the preferred care for livestock. Another activity challenges students to use their math and reasoning skills to create a board game that educates others about California rangelands. They will also discover the important role of genes in trait selection, and practice using a Punnett square to determine the probability of a calf inheriting its parents’ quirky traits. Students will practice planning, designing, and building models of animal digestive systems and livestock facilities. Students will also conduct several short research projects, strengthening their ability to locate information and build their knowledge around animal behavior, animal breeds, and livestock facilities.

This unit teaches subject matter reinforced by the Content Standards for California Public Schools and the Common Core State Standards. The standards, located on the sidebar of each lesson, specify grade level, subject matter, and standard reference. A content standard matrix for the entire unit, with includes standard descriptions, is located on pages 92-98. *“Steer” Toward STEM: Careers in Animal Agriculture* is one of many educational units developed and distributed by the California Foundation for Agriculture in the Classroom.

Unit Overview

Unit Length

Approximately twelve 50-minute sessions.

Objectives

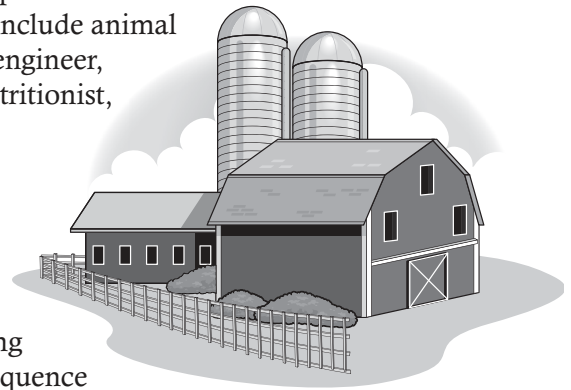
Students will:

- ▶ Identify basic animal behaviors and hypothesize what causes them.
- ▶ Discover the responsibilities of an animal physiologist.
- ▶ Investigate animal handling preferences.
- ▶ Use online resources to research solutions to real-life problems.
- ▶ Plan and construct models.
- ▶ Design a cattle corral system that is durable, efficient, and effective.
- ▶ Learn about the skills needed to be an agricultural engineer.
- ▶ Consider how genes affect traits.
- ▶ Discover the role of an animal geneticist.
- ▶ Investigate the different digestive systems of livestock.
- ▶ Learn how animals have unique nutritional needs.
- ▶ Discover the responsibilities of an animal nutritionist.

Brief Description

This five-lesson unit for grades 3-5 promotes the development of STEM abilities and critical thinking skills, while fostering an appreciation for the people involved in livestock production. The new curriculum includes real-life challenges for students to investigate, inquiry-based labs, and opportunities to plan and construct models. Featured careers include animal physiologist, agricultural engineer, range manager, animal nutritionist, and animal geneticist.

The lessons can be used separately or together and may be taught in any order. To fully address the concepts, however, teaching the unit in the provided sequence and in its entirety is recommended.



Curriculum Content Standards

A concerted effort to improve student achievement in all areas has impacted education throughout California. California Foundation for Agriculture in the Classroom provides educators with numerous resource materials and lessons that can be used to teach and reinforce the Content Standards for California Public Schools and Common Core State Standards. The lessons encourage students to think for themselves, ask questions, and learn problem-solving skills while learning the specific content needed to better understand the world in which they live.

This unit, *“Steer” Toward STEM: Careers in Animal Agriculture*, includes lessons that can be used to teach and reinforce many of the educational content standards covered in grades three through five. The purpose of the unit is to strengthen STEM skills and abilities while introducing students to careers in agriculture.

The specific content standards addressed are listed on the sidebars of each lesson. A matrix chart showing how the entire unit is aligned with the Curriculum Content Standards for California Public Schools and Common Core State Standards is included on pages 92-98.



Unit Overview

- ▶ Design a board game about California rangelands.
- ▶ Learn about the responsibilities of a range manager.
- ▶ Predict the outcome of an investigation.
- ▶ Conduct an experiment to test a hypothesis.
- ▶ Create a double bar graph.
- ▶ Use appropriate tools to measure length, width, depth, and perimeter.

Key Vocabulary

A glossary of terms is located on pages 99-100.

Auction yard
Behavior
Breed
Browse
Cattle chute
Corral
Cultivate
Diet
Domestic
Environment
Feedlot
Fertilizer
Forage
Gene
Graze
Habitat
Handling
Heredity
Implement
Invasive
Irrigation

Evaluation

This unit incorporates numerous activities and questions that can be used as evaluation tools, many of which can be included in student portfolios. With an emphasis on student inquiry, few lessons have “right” or “wrong” answers, but rather engage students in thinking critically about their learning experience and applying what they learn to real-life experiences. Embedded assessment includes oral and written responses to open-ended questions, group presentations, and other knowledge-application projects. Two lessons, *Build It Better* and *Homes on the Range*, include evaluation rubrics that students may use to assess their peers.

Visual Display Ideas

- ▶ Showcase agriculture careers in your local community. In addition to displaying pictures, include required skills, education level, and salary information. USDA’s Living Science website offers extensive information about science-based agriculture careers: www.agriculture.purdue.edu/usda/careers.
- ▶ Display digestive tract diagrams of different species. Make the display interactive by posting an envelope with matching labels. Students can use push pins to match the label to the correct digestive organ.
- ▶ Take photos of student work as they construct various projects. Display the photos in chronological order, starting with a photo of the raw materials and ending with a photo of the finished product. Celebrate student progress.
- ▶ Exhibit bar graphs and drawings students create in the lessons.
- ▶ Create a living “KWL” chart that documents what students know (K), want to know (W), and learned (L).
- ▶ Have each student draw a picture of an animal they learned about. Post these on a bulletin board with interesting facts about each animal.



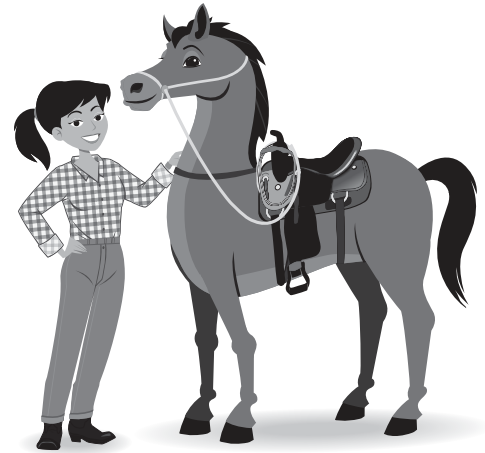
Unit Overview

Livestock
Microorganism
Native
Offspring
Physiology
Preference
Ranch
Species
Threatened
Trait
Well-being

Thank you for recognizing the importance of helping students understand and appreciate agriculture. We hope you find this resource useful in your teaching endeavors.

Before You Begin

1. Skim over the entire unit. Make appropriate changes to the lessons and student worksheets to meet the unique student needs and personal teaching style.
2. The following resources may be helpful in learning about various commodities:
 - ▶ California Foundation for Agriculture in the Classroom's *Teacher Resource Guide*. This guide will provide you with contact information for various commodity groups as well as other useful information. Also available online at www.LearnAboutAg.org/trg.
 - ▶ California Department of Food and Agriculture's website, www.cdfa.ca.gov. This site contains general and specific information on various aspects of agriculture.
 - ▶ California Farm Bureau Federation's website, www.cfbf.com. This site has articles on current issues in agriculture as well as agricultural information for each county.
 - ▶ The agricultural organizations listed on pages 71-73.
3. Read "Answers to Commonly Asked Questions" on pages 67-70 to gain background knowledge to use during the unit. Also review the glossary on pages 99-100. Use these definitions with your students as you see appropriate.
4. Arrange classroom visits from people involved in the livestock industry. Guest speakers may include farmers, ranchers, veterinarians, scientists, animal physiologists, agricultural engineers, range managers, animal nutritionists, and animal geneticists.
5. Organize appropriate field trips. Possibilities include ranches, auction yards, vet clinics, feed companies, and universities.
6. Obtain the necessary supplies for the unit.



Significant Surroundings

Purpose

In this lesson, students will identify basic animal behaviors and hypothesize what causes them. Students will also discover the responsibilities of an animal physiologist.

Time

Teacher Preparation:

30 minutes

Student Activities:

Two 60-minute sessions

Materials

For the teacher:

All About Mealworms
information sheet (page 13)

For the class:

- ▶ Masking tape
- ▶ Stapler

For each group:

- ▶ Shoebox
- ▶ Flashlight
- ▶ Construction paper
- ▶ Sandpaper
- ▶ Two resealable, quart-size plastic bags
- ▶ Lightweight paper

Background Information

An animal's behavior is determined by genetics as well as experiences in its social (other animals of the same species) and physical (where it was raised) environment. These experiences can cause changes in physiology, the nervous system, and physical structures of the body. Animals change throughout their lives based on their experiences. However, experiences early in life often have the greatest effect on animals and can even affect gene expression.

Animal physiologists study how animals function and behave, including how animals interact with things outside their body, such as temperature, lighting, or sound, plus things inside their body, such as disease, poisons, or diet. This knowledge helps animal physiologists recommend the environmental specifications needed for the animal's well-being, including housing and nutrition. In this lesson, students will explore how animal physiologists study cattle, horses, poultry, and other livestock in the field, on a smaller scale by conducting experiments with mealworms in the classroom.

Mealworms are the larval form of the mealworm beetle, a species of darkling beetle. They go through four life stages: egg, larva, pupa, and adult. Mealworms are available for purchase at pet stores and bait shops.

Procedure

Part I

1. Have students brainstorm the senses they use to interact with the world around them. Ask students to close their eyes and use their remaining senses (hearing, taste, touch, and smell) to observe their current environment. Facilitate this interaction by prompting them to notice their surroundings with the following questions:
 - ▶ What do you feel?
 - ▶ What do you smell?
 - ▶ What do you hear?
2. Ask students to open their eyes and briefly discuss their observations. Explain that by making observations, they are acting as animal physiologists. The word "physiologist" comes from the Greek word "physis," meaning "nature" or "natural" and

Significant Surroundings

- ▶ Ten mealworms*
- ▶ Timer
- ▶ Pencil
- ▶ Scissors
- ▶ Hand lens
- ▶ Ruler

For each student:

- ▶ *Significant Surroundings Lab* handout (pages 14-18)
- ▶ Three sheets of colored construction paper
- ▶ Crayons, markers, or colored pencils

**Mealworms may be purchased from a pet or bait store.*

“ologist,” which means “one who studies.” Animal physiologists make observations, or study, how animals naturally interact within their environment. “Environment” is a term that describes the surroundings or conditions in which a person, animal, or plant lives or operates. An animal’s environment can positively or negatively affect the animal’s well-being. An animal physiologist works to make sure that an animal’s environment includes the ideal temperature, air flow, and shelter they need to be healthy. Remind students that animals can’t explain how they feel, so it is essential that an animal physiologist have excellent observation skills.

3. Tell students that today they are going to be animal physiologists. Their first responsibility is to evaluate the environmental preferences of mealworms (the larval stage of the darkling beetle). To determine these preferences, they will experiment with different temperatures, lighting, and surface textures and observe how the mealworms respond.

4. Divide students into small groups and distribute the materials. Instruct students to observe their mealworms using a hand lens and record their findings on the “My Observations” section of the *Significant Surroundings Lab* handout on pages 14-18. If needed, guide observation with the following questions:

- ▶ How many segments does your mealworm have?
- ▶ How many legs does it have?
- ▶ Does a mealworm have antennae?
- ▶ Can you see the mouthparts?
- ▶ How do we know the mealworm is the larval stage of an insect and not a true worm?
- ▶ How does the mealworm move?



5. In this lab, students will carry out three different experiments to test the environmental preferences of mealworms. Each half of the shoebox will offer the mealworms a different environment to choose. Students will record their findings on the *Significant Surroundings Lab* handout. Instruct students to complete the lab activities. Assist and clarify as necessary.

Significant Surroundings

Content Standards

Grade 3

Science

Life Sciences 3b, 3d
Investigation and
Experimentation 5c, 5d, 5e

English Language Arts

Reading Information Text
3.1
Writing 3.2
Speaking and Listening 3.1

Mathematics

3.NF.1, 3.MD.3

Grade 4

Science

Life Sciences 3a, 3b
Investigation and
Experimentation 6e, 6f

English Language Arts

Reading Information Text
4.1
Writing 4.2
Speaking and Listening
4.1, 4.4

Mathematics

4.NF.1

Grade 5

Science

Investigation and
Experimentation 6b, 6g, 6i

Part II

- Building on the discoveries made in part one, students will choose a livestock animal (an animal raised in an agricultural setting to produce food, fiber, or labor) to research and create a guide for their ideal environmental conditions, which may include:
 - ▶ Temperature
 - ▶ Shelter
 - ▶ Space
 - ▶ Sound
 - ▶ Nutrition
 - ▶ Bedding
 - ▶ Lighting
- Demonstrate how to create a three-dimensional graphic organizer to record students' research. This educational tool helps students organize information in a kinesthetic way. For a step-by-step video on how to create a three-dimensional graphic organizer, visit www.LearnAboutAg.org/stem.
 - ▶ Stack three different colored sheets of paper (8 ½" x 11") together, placing each consecutive sheet around ¾ of an inch higher than the sheet in front of it.
 - ▶ Bring the top of the sheets downward and align the edges so that all of the layers or tabs are the same distance apart.
 - ▶ When all of the tabs are equal distance apart, fold the papers and crease well.
 - ▶ Staple the sheets of paper together along the center fold.
 - ▶ Fold the graphic organizer in half to create a booklet with a front and back cover.
- Instruct students to decorate the cover of their three-dimensional graphic organizer with their name and a picture of their livestock animal. On each tab, students should write the type of environmental condition considered and the preferred condition for their specific animal. Research sources should include books or databases in the library, Internet searches (validating sources), and interviews (primary sources) if possible.

Significant Surroundings

Content Standards

Grade 5 (*continued*)

English Language Arts

Reading Information Text

5.3, 5.9

Writing 5.2

Variation

- ▶ Use online resources, such as the National Center for Education Statistics “Create a Graph” tool, nces.ed.gov/nceskids/createagraph, to make graphs that illustrate how many mealworms prefer each type of environment.
- ▶ Set up a station for each experiment. Prepare and provide several shoeboxes at each station. Have students rotate around the room to complete each lab experiment.
- ▶ Prepare the shoeboxes for students prior to starting the lesson.

Extensions

- ▶ Have students research a variety of careers (e.g., construction worker, engineer, animal nutritionist, and veterinarian) that may rely on the expertise of an animal physiologist. Challenge students to devise a scenario that integrates each career with animal well-being.
- ▶ Plan and build a model of an “ideal environment” for each livestock animal that the students research. Have students think critically to determine the elements that could negatively affect the environment they create.
- ▶ Students research the educational background and skills required to be an animal physiologist.

ELL Adaptations

- ▶ This lesson incorporates hands-on activities. Kinesthetic learning events provide an excellent learning environment for English language learners.
- ▶ Demonstrate how students may set up their experiment prior to student investigations. ELL students will benefit from observing the procedures before they get started.



All About Mealworms

Background

Mealworms are the larval stage of the mealworm beetle, *Tenebrio molitor*, a species of darkling beetle. Like all insects, mealworms have a hard brownish/yellow exoskeleton that surrounds and protects their bodies. Mealworms have large segmented (sectioned) bodies; they move by using their three pair of legs located near their head. Mealworms have three main body parts: the head, the thorax (the middle where the legs are attached), and the abdomen (tail end). Mealworms are scavengers—they eat grains and decomposing plants and animals.

Mealworms are typically used as a food source for reptiles, fish, and birds. In some cultures, baked or fried mealworms are sold as a snack food.

Raising Mealworms

Mealworms are easy to maintain and are useful for biological research. In a relatively short amount of time (30-60 days), students can observe the complete metamorphosis of the insect.

Mealworms grow best in well-ventilated containers eight to 10 inches deep with large surface areas and smooth sides to prevent them from escaping. They are mostly nocturnal and prefer a dark environment. The insects will consume fresh oats, whole wheat bran, or grain, with sliced potato, carrots, or apple pieces as a water source. Replace the moist food every few days so mold doesn't form inside the mealworms' shelter.

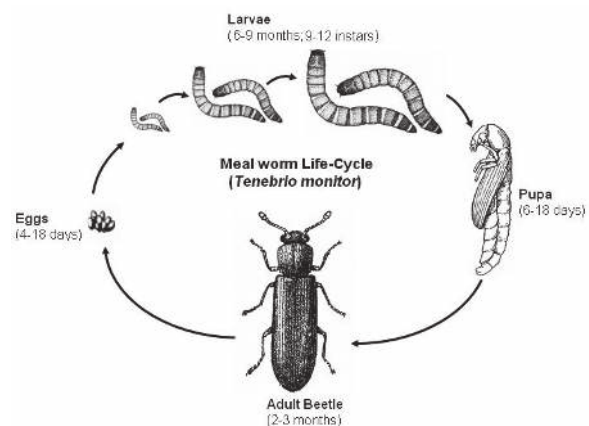
Complete Metamorphosis

A darkling beetle experiences a complete metamorphosis which means it has four distinct stages of life. The four stages are egg, larva, pupa, and adult. The amount of time a darkling beetle spends in each stage can vary greatly due to environmental factors like temperature, humidity, food, and water.

Discoveries

Scientific discoveries about mealworms will be plentiful for students. If the mealworms are kept at room temperature, their life cycle should take between 30 and 60 days.

- ▶ Students will discover the role of exoskeletons (hard outer covering) as the mealworms grow. Mealworms may shed their exoskeleton nine to 20 times depending on their rate of growth.
- ▶ Students will learn about the pupa life stage. The mealworm pupa has no mouth or anus, and does not eat. It does have leg and wing buds, but they do not function. This stage of life will last one to three weeks.
- ▶ Students will explore the final stage of metamorphosis as an adult insect. The darkling beetle has wings, but does not fly. The beetles live approximately three weeks and eat voraciously. Mealworm beetles (darkling beetles) are prolific breeders. Students can observe the mating process. A few days after mating, the female will burrow into soft ground and lay about 500 eggs.



Concluding the Lesson

Once learning opportunities have been concluded, donate your mealworms (in whatever stage they're in) to a reptile owner. Mealworms make excellent feed for a variety of reptiles.

Significant Surroundings Lab

Name: _____

As an animal physiologist, it is your job to determine the mealworm's preferred environment. You will observe their responses to different temperatures, lighting, and surface textures. Take time to write your hypothesis before beginning each experiment. After each experiment, remove the mealworms from the box.

My Observations of a Mealworm

Draw and write your observations.

Experiment I: Creep and Crawl

Testable Question: What type of surface do mealworms prefer to crawl on?

Hypothesis: _____

Materials:

- ▶ Sandpaper
- ▶ Construction paper
- ▶ Ruler
- ▶ Timer
- ▶ Ten mealworms
- ▶ Shoebox
- ▶ Scissors
- ▶ Masking tape

Procedure:

1. Carefully measure the inside of the shoebox using the ruler. Cut a piece of construction paper that fits inside half of the shoebox. Cut a piece of sandpaper that fits into the other half of the shoebox. Use masking tape to tape the seam between the two types of paper.
2. Count out 10 mealworms and place them in the center of the shoebox. Set the timer for three minutes.
3. Observe the mealworm's movement for three minutes. Record the number of mealworms in each half of the shoebox in the data chart below. Express the mealworm preferences as a fraction in its simplest form. For example, if eight out of 10 mealworms prefer sandpaper, write $\frac{8}{10}$ as $\frac{4}{5}$. Indicate which condition most mealworms prefer.

Significant Surroundings Lab *(continued)*

Results

	Construction Paper	Sandpaper
Number of Mealworms		
Expressed in Fraction Form		
Mealworm Surface Preference <i>(check preference)</i>		

Experiment II: Icy Hot

Testable Question: What temperature do mealworms prefer?

Hypothesis: _____

Materials:

- ▶ Ten mealworms
- ▶ Timer
- ▶ Shoebox
- ▶ Two resealable plastic bags
- ▶ Lightweight paper

Procedure:

1. Fill one resealable plastic bag one-fourth full with warm (not hot) water. Fill one resealable plastic bag one-fourth full with cold water. Carefully remove excess air from the bags before sealing.
2. Place the plastic bags on opposite sides of the shoebox. Make sure that they are evenly spaced and as flat as possible.
3. Label one side of the paper “cold” and the other “warm.” Place the lightweight paper over the plastic bags making sure the labels match the water temperature. Fold the edges of the paper upward if necessary to create a smooth surface for the mealworms.
4. Count out 10 mealworms and place them in the center of the shoebox. Set the timer for three minutes.
5. Observe the mealworm’s movement for three minutes. Record the number of mealworms in each half of the shoebox in the data chart below. Express the mealworm preferences as a fraction in its simplest form.

Significant Surroundings Lab *(continued)*

Results

	Warm Water	Cold Water
Number of Mealworms		
Expressed in Fraction Form		
Mealworm Temperature Preference <i>(check preference)</i>		

Experiment III: Insect Illumination

Testable Question: What lighting do mealworms prefer?

Hypothesis: _____

Materials:

- ▶ Ten mealworms
- ▶ Scissors
- ▶ Shoebox with lid
- ▶ Flashlight
- ▶ Timer
- ▶ Ruler

Procedure:

1. Measure the length of the top of the shoebox. Mark the middle. Using scissors cut the lid in half widthwise.
2. Count out 10 mealworms and place them in the center of the shoebox.
3. Place the lid on half of the shoebox and shine a flashlight on the other half of the box. Set the timer for three minutes.
4. Observe the mealworm's movement for three minutes. Record the number of mealworms in each half of the shoebox in the data chart below. Express the mealworm preferences as a fraction in its simplest form.

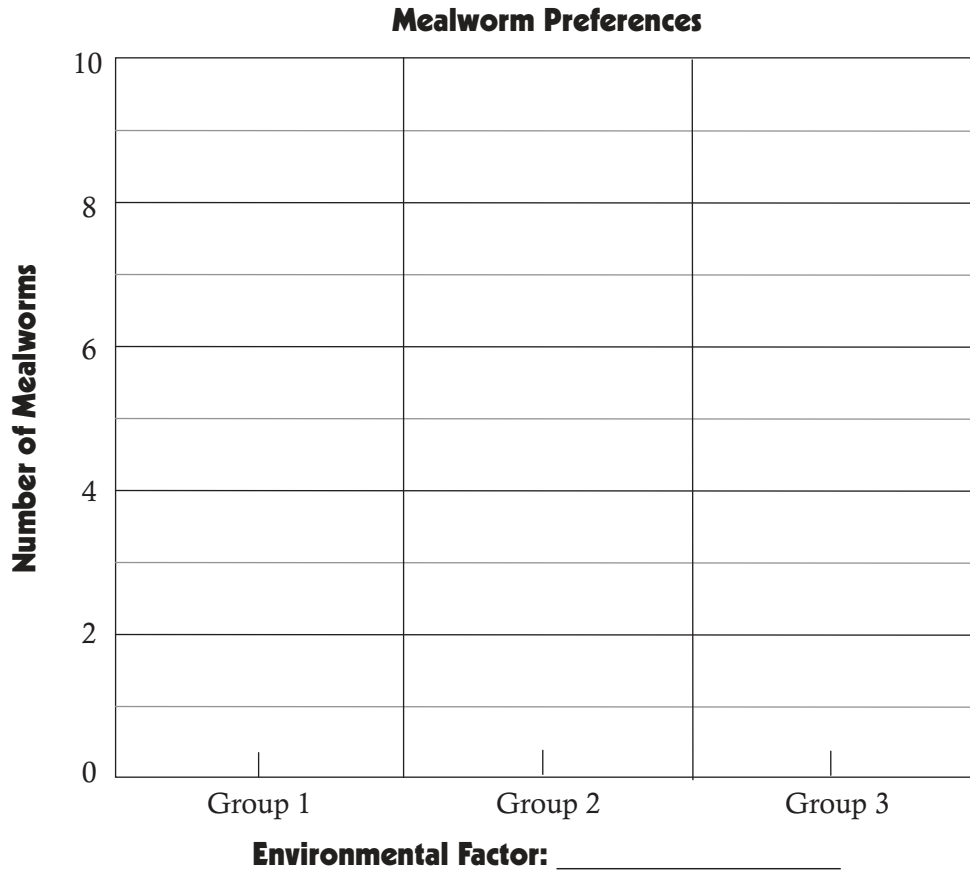
Results

	Dark	Light
Number of Mealworms		
Expressed in Fraction Form		
Mealworm Lighting Preference <i>(check preference)</i>		

Significant Surroundings Lab *(continued)*

Graph It!

Choose one environmental factor (temperature, lighting, or surface texture) your group tested. Collaborate with two additional groups to create a double bar graph comparing each group's results.



Conclusion

As an animal physiologist, you have just completed three important experiments that helped you to understand the environmental preferences of mealworms. By choosing the best environment, you are able to support the mealworm's health and well-being. Learning about environmental factors that affect animals is a crucial part of your job. It is also important to learn how to share and communicate your results.

1. Please write a short paragraph describing the mealworm behaviors you observed.

Significant Surroundings Lab *(continued)*

2. It is important for an experiment to be a fair test. You conduct a fair test by making sure that you change one factor at a time while keeping all other conditions the same. Upon reflection of the experiments you performed, was this a fair test? Explain why or why not.

3. If you had time to design more experiments to test mealworms preferences, what would you test? How would you test it? Please describe at least one additional experiment.





Build It Better

Purpose

In this lesson students investigate animal handling preferences and design a cattle corral system that is durable, efficient, and effective. Students will also discover the skills needed to be an agricultural engineer.

Time

Teacher Preparation:
45 minutes

Student Activities:
Four 40-minute sessions

Materials

For the class:

- ▶ Internet connectivity

For each group:

- ▶ Ruler
- ▶ Scissors
- ▶ Glue
- ▶ Foam or poster board
- ▶ Various construction materials including craft sticks, construction paper, chenille stems, cardboard, cereal boxes, toothpicks, fabric, and more

For each student:

- ▶ *Build It Better Design Plan* handout (pages 23-25)

Background Information

Livestock can be difficult to move and direct. Many animals will not move forward if they are fearful of something they see, hear, or smell. Removing these distractions can greatly reduce animal handling problems. If animals feel safe in their environment and are relaxed and comfortable with the handler, they often move with little or no force.



The stress caused by poor handling environments has a negative impact on animals—it lowers livestock productivity, diminishes weight gain, reduces reproductive performance, and decreases the animal's ability to fight disease. By understanding the behavior of livestock and designing environments that keep animals calm, livestock producers can greatly reduce animal stress. Significant work has been done by Colorado State University professor Temple Grandin. She has made advancements in animal handling practices by researching how livestock perceive their environment and by designing livestock facilities that help keep animals calm.

Agricultural engineers have an important role in designing livestock facilities. They work with animal specialists and apply basic science and engineering principles to design solutions to challenges in livestock production. In general, agricultural engineers may design agricultural machinery and facilities such as tractors and their implements, animal housing and handling facilities, irrigation and drainage systems, and soil conservation measures.

In this lesson, students act as agricultural engineers by investigating animal handling preferences and designing a corral system that is durable, efficient, and effective in moving cattle.

Build It Better

- ▶ *Build It Better Design Resources* handout (page 26)
- ▶ *Build It Better Design Grading Rubric* (page 27)

Procedure

1. Help students start thinking like engineers by sharing the scenario below:

Maxine has an aging German shepherd named Frankie. Maxine needs to take Frankie to the veterinarian for his annual check-up. Since Frankie has gotten older, he can no longer get into Maxine's truck independently. Unfortunately, Maxine broke her arm in a skiing accident last week and cannot lift him. It's 9:45 and Maxine needs to think of a quick, safe, and efficient way to load Frankie into the truck for his 10 o'clock appointment. Put your engineering thinking cap on and let's solve the problem!

2. Brainstorm and record student ideas for loading Frankie into the truck. Remind students to think about keeping Frankie calm and safe while accomplishing the desired goal. Tell students that agricultural engineers apply basic science and engineering principles to design solutions to challenges in agricultural production. Highlight the responsibilities and skills of an agricultural engineer:
 - ▶ They design agricultural machinery and facilities using drawings and models.
 - ▶ They use their knowledge and skills to solve real-world problems.
 - ▶ They are creative and can envision new designs such as tractors and their implements, livestock handling systems, irrigation systems, and animal housing.
 - ▶ They must understand science and engineering concepts.
3. Tell students that in today's activity they will be designing a corral system for cattle. Temple Grandin is a legend in the world of animal agriculture. She is known for her extraordinary understanding of the animal mind which has assisted her in designing animal handling systems—especially in cattle production. Temple Grandin gives credit to her autism, a condition that makes social interactions with other people challenging, for helping her understand how animals think and respond to their environment.
4. Show a video that introduces Temple Grandin and her work. There are a variety of videos available on the TempleGrandin YouTube channel (www.youtube.com/user/TempleGrandin). Grandin also improved slaughterhouse design, so you may wish to filter which video students watch.



Build It Better

Content Standards

Grade 3

English Language Arts

- Reading Informational Text 3.7
- Writing 3.7
- Speaking and Listening 3.4

Mathematics

- 3.MP.4, 3.MD.4, 3.MD.8

Grade 4

English Language Arts

- Reading Informational Text 4.7
- Writing 4.7
- Speaking and Listening 4.4

Mathematics

- 4.MP.4

Grade 5

Science

- Investigation and Experimentation 6c

English Language Arts

- Reading Informational Text 5.7
- Writing 5.7
- Speaking and Listening 5.4

Mathematics

- 5.MP.4

5. Review the *Build It Better Design Plan* handout on pages 23-25 with the class. The objective of the project is to design a model livestock corral and alley way for loading livestock onto trucks for transportation. The goal of your design is to keep the animals calm and safe. Your group will be graded on the effectiveness, efficiency, and durability of your design. As groups research and plan their design, they should record their progress on the *Build It Better Design Plan* handout. Each group must have teacher approval for their plan before starting construction. Introduce students to the available construction materials and divide students into groups.



6. Once students have completed their models, groups will present their design to the class in a three-to-five-minute presentation. Students should highlight research findings, design characteristics, modifications, and their construction procedure. You may wish to grade the models using the *Build It Better Design Grading Rubric* on page 27 or have students complete the rubric to grade their peers.
7. Conclude the lesson by discussing the reflection questions on the *Build It Better Design Plan* handout.

Variation

- ▶ Instead of creating a three-dimensional model, students can create a three dimensional sketch using an online program, such as Google SketchUp.
- ▶ Distribute graph paper and challenge students to create a scaled diagram of their design.
- ▶ If students are not yet comfortable researching topics online, review the recommended resources on page 26 prior to the lesson and print out specific documents that will help them



Build It Better

identify design characteristics. Otherwise, teachers may use an LCD projector or SMART Board™ to demonstrate how to search the Web and identify important information.

- ▶ Challenge advanced students by giving them specific information such as type of truck, age, size or gender of cattle, and the distance between the animal housing and loading area.

Extensions

- ▶ Further explore the contributions of Temple Grandin by watching the full-length film, *Temple Grandin* (2010, PG). As students watch the movie, have them record the challenges and successes she encounters as she designs facilities for animals.
- ▶ Learn more about livestock facilities by visiting a local ranch, auction yard, or feedlot. Ask your tour guide to explain how their facilities keep animals calm and safe. If appropriate, have students employ Temple Grandin's unique way of thinking by moving through the system to understand the animal's perspective.
- ▶ Invite a local rancher to your class to discuss their livestock facilities. Ask the rancher to share a diagram of their corral and identify areas that are working well, and areas that could be improved. Your county Farm Bureau may be able to connect you to a local rancher.
- ▶ Have students research the educational background and skills required to be an agricultural engineer.

ELL Adaptations

- ▶ This lesson employs group work and cooperative learning. These activities provide opportunities for students to exchange, write, and present ideas.
- ▶ Identify the origin of lesson-specific words such as corral, humane, model, durable, implement, and effective. Knowledge of Greek and Latin prefixes, suffixes, and roots can greatly enhance student understanding of engineering terms and facilitate a better understanding of English.

Build It Better Design Plan

Name: _____

Objective

Work as an agricultural engineer to design a model corral and alley way for loading cattle onto trucks for transportation. The goal of your design is to keep the animals calm and safe. Your group will be graded on the effectiveness, efficiency, and durability of your design.

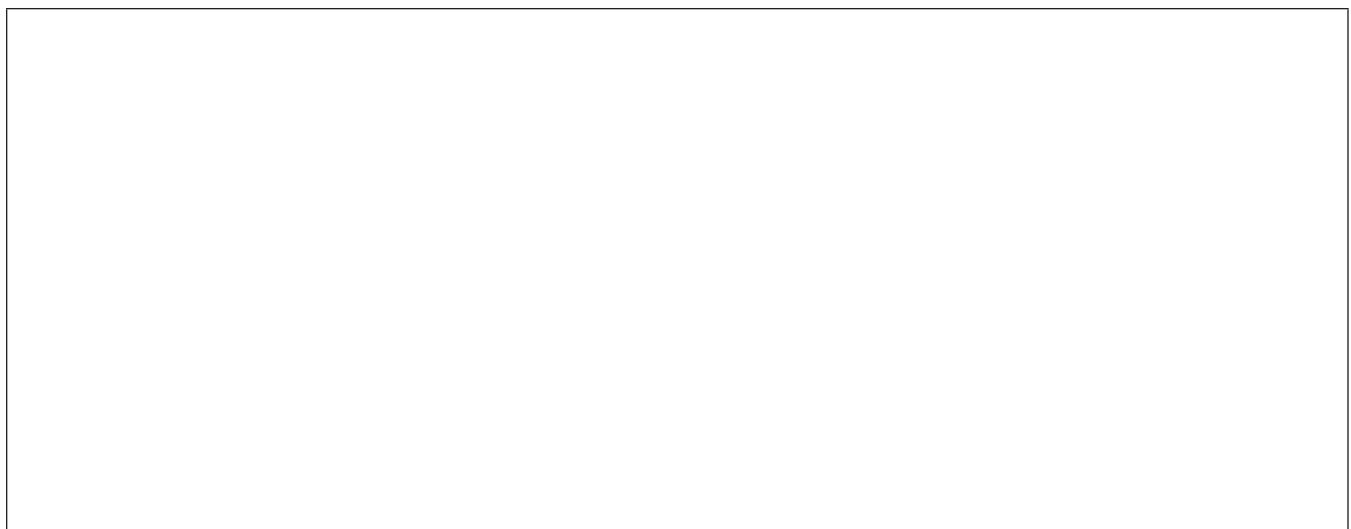
Research

Research and record at least five design characteristics that your group will include in your model. Write the reason each characteristic was included.

Design Characteristic	Reason for Inclusion
Example: <i>Curved Path for Cattle</i>	<i>Cattle prefer to return to where they came from.</i>

Design Drawing

Sketch a design that incorporates all the design characteristics listed above. Label each design characteristic. Use arrows to indicate the direction cattle will move.



Build It Better Design Plan *(continued)*

Teacher Approval

Each group’s drawing must be approved by your teacher before starting construction. Present your design drawing to your teacher. Be sure to identify and describe the design characteristics.

Once approved, have your teacher initial here: _____

Construction

Use your design drawing to construct a three-dimensional model. Label design characteristics and include measurements for all sides.

Reflection

1. List the materials required to construct your design model. You may use any of the materials provided in class or bring materials from home.
2. Describe, in detail, the procedure your group used to construct the model. The procedure must include at least ten steps.

- a. _____
- b. _____
- c. _____
- d. _____
- e. _____
- f. _____
- g. _____
- h. _____
- i. _____
- j. _____

3. List any modifications required to create an effective, efficient, and durable design.

Build It Better Design Plan *(continued)*

4. How will you motivate the cattle to move through the chute?

5. What is your favorite feature of your design? Why?

6. What aspect of your design could be improved? How?

7. Is your design effective, efficient, and durable? Provide at least one example of how your model meets each of these specifications.

Effective: Successful in producing a desired or intended result.

Efficient: Achieving maximum productivity with minimum wasted effort or expense.

Durable: Able to withstand wear, pressure, or damage.

Build It Better Design Resources

Websites

Use the following websites to research corral designs:

Grandin Livestock Handling Systems
www.grandinlivestockhandlingsystems.com

Dr. Temple Grandin
www.grandin.com

Iowa State University Beef Center
www.iowabeefcenter.org/Beef_Cattle_Handbook/Cattle-Behavior_Handling.pdf

The Ohio State University Extension Bulletin–Cattle Handling and Working Facilities
Ohioline.osu.edu/b906/index.html

Colorado State University–Sample Designs of Cattle Races and Corrals
lamar.colostate.edu/~grandin/design/blueprint/blueprint.html

Louisiana State University Ag Center
www.lsuagcenter.com/en/our_offices/departments/Biological_Ag_Engineering/Features/Extension/Building_Plans/Beef



Books

Use the following books to research corral designs:

Grandin, Temple. *Improving Animal Welfare: A Practical Approach*. CABI, 2010. This textbook aims to help those working with animals to apply practical methods for improving welfare, bridging the gap between scientific research and practical application. ISBN 978-1-845935-41-2

Grandin, Temple. *Humane Livestock Handling*. Storey Publishing, LLC, 2008. Working with the animals' natural instincts, Grandin describes low-stress methods for moving cattle on pastures, paddocks, and feedlot pens. ISBN 978-1-603420-28-0

Drake, Daniel. *Fundamentals of Beef Management*. Univ. of California Press, 2006. This handy guide was developed specifically for small-scale operations, and includes everything you need to know to get started in the beef cattle business. ISBN 978-1-879906-73-0

List additional resources used for research:

- 1.
- 2.
- 3.

Build It Better Design Grading Rubric

Evaluator's Name: _____

Designers: _____

Circle the appropriate description for the project you are evaluating.

	10 Points	8 Points	6 Points	4 Points
Information Gathering	Accurate information taken from several sources in a systematic manner. Plan is neat, detailed, and all design characteristics are labeled.	Accurate information taken from a couple of sources in a systematic manner. Plan is detailed and most design characteristics are labeled.	Accurate information taken from a couple of sources, but not systematically. Plan lacks precision but most design characteristics are labeled.	Information taken from only one source and/or information not accurate. Plan lacks precision and is inadequately labeled.
Construction	Great care taken in construction process so that the structure is neat, attractive, and follows plans accurately. Provides a complete record of planning, construction, and reflections about the process.	Construction was careful and accurate, but some details could have been refined for a more attractive product. Provides a complete record of planning, construction, and modifications.	Construction differs from the original plan and some details could have been refined for a more attractive product. Provides some detail about planning, construction, and modifications.	Construction appears careless and haphazard. Many details need refinement for a strong or attractive product. Provides very little detail about several aspects of the planning, construction, and modifications.
Design Plan Worksheet				

Comments: _____

Total points: _____

Roll of the Genes

Purpose

In this lesson students will learn about genes and how they affect important traits such as growth, reproduction, disease resistance, and behavior. Students will also discover the responsibilities of an animal geneticist.

Time

Teacher Preparation:
15 minutes

Student Activities:
Two 45-minute sessions

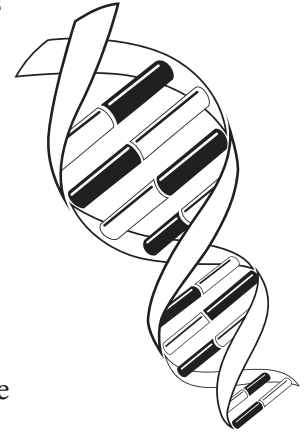
Materials

For the class:

- ▶ Document or overhead projector
- ▶ Transparency film (optional)
- ▶ *Brahman Beef Cattle* photograph (page 38)
- ▶ *Angus Beef Cattle* photograph (page 39)
- ▶ *Brangus Beef Cattle* photograph (page 40)
- ▶ Colored pencils
- ▶ White paper
- ▶ Ten four-sided dice

Background Information

Heredity is the passing on of traits from parents to offspring. Most plants and animals have two of every kind of gene, one from their mother and one from their father. Only one gene from each parent is passed to each offspring for a particular trait. For example, a gene will determine eye color. Alleles are forms of the same gene with small differences in their DNA sequence. For example, one allele will determine brown eye color and another allele will determine blue eye color. These small differences contribute to each organism's unique physical features. These physical features are called "phenotypes."



Some alleles are dominant while others are recessive. Dominant alleles overpower recessive alleles and are always expressed in offspring. Recessive alleles can only be expressed in offspring if both parents contribute a recessive allele.

One of the easiest ways to calculate the mathematical probability of inheriting a specific trait was invented by an early 20th century English geneticist named Reginald Punnett. His technique employs what we now call a Punnett square. This is a simple graphical way of discovering all of the potential combinations of two gene sets and the resulting genetic traits. It also illustrates the probability, or chances of, each combination occurring.

Understanding and being able to use a Punnett square is a basic skill for an animal geneticist. They use the Punnett square to predict the outcome of breeding two animals. By understanding how genes are passed on to offspring, scientists can help improve a wide range of economically important traits. They can also decrease the likelihood of an animal receiving an undesirable trait which may affect the health and well-being of the animal.

In this lesson, students will use a simple Punnett square to predict the outcome of fictional, and fantastical, livestock breeding experiments. They will practice determining the probability of each possible outcome and create a drawing of the offspring they create.



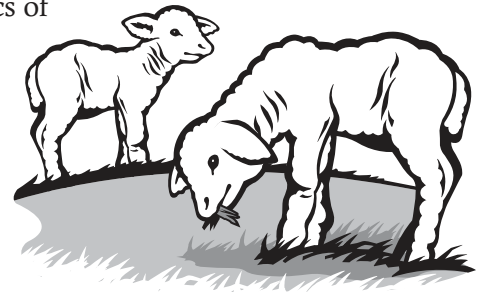
Roll of the Genes

For each student:

- ▶ *Have You Any Wool?* handout (page 32)
- ▶ *Cattle Call* handout (pages 34-35)

Procedure

1. Prior to the lesson, replicate the *Brahman, Angus, and Brangus Beef Cattle* photographs (pages 38-40) and the *Have You Any Wool?* handout on page 32 onto overhead transparencies (optional). Students should have some basic understanding of probability, and understand related terms such as chance, likely, unlikely, possible, and impossible.
2. Brainstorm physical features, such as eye color and hair, which make students look different than each other. Explain that these characteristics are called traits. A trait is a physical characteristic or feature, obvious and observable, which is inherited from one or more parent. Traits may be dominant or recessive. A dominant trait is displayed if one or both parents carry the trait. A recessive trait is displayed only when both parents carry the trait.
3. Instruct students to raise their hand if they've ever been told they look like a family member. Allow a few students to share about their personal experience. Explain that traits are passed from parents to their children through DNA. The piece of DNA that carries the trait is called a gene.
4. Tell students that traits are also passed on in the animal world. For example, livestock geneticists have been able to improve a breed's traits through selective breeding programs. For example, breeders were able to cross Brahman beef cattle (show students the *Brahman Beef Cattle* photograph) and Angus beef cattle (show students *Angus Beef Cattle* photograph). Have students describe some of the obvious physical traits of each breed. Explain that the breed created from the two breeds is called a "Brangus" (show students the *Brangus Beef Cattle* photograph). Encourage students to identify the physical traits inherited from the Brahman and the Angus breeds. Explain that geneticists purposefully developed the breed to create a superior animal. Brahman cattle are tolerant to hot climates, and outstanding mothers. Angus cattle have excellent meat quality. The Brangus has the characteristics of both breeds.
5. Display the *Have You Any Wool?* handout with a document or overhead projector. Distribute the *Have You Any Wool?* handout to students. Read the sheep's



Roll of the Genes

Content Standards

Grade 3

Science

Life Sciences 3a
Investigation and
Experimentation 5e

English Language Arts

Reading Informational Text
3.4

Mathematics

3.NF.1

Grade 4

Science

Investigation and
Experimentation 6f

English Language Arts

Reading Informational Text
4.4

Mathematics

4.NF.3b

Grade 5

Science

Investigation and
Experimentation 6g

English Language Arts

Reading Informational Text
5.4

genetic background aloud and define any unknown scientific terms. Explain that the Punnett square is a diagram that helps geneticists predict the outcome of breeding two animals.

6. Explain that the class is going to use the Punnett square to determine what color wool the sheep's offspring will have. Dominant traits are expressed with a capital letter and recessive traits are expressed with a lowercase letter. If dominant and recessive traits are combined, the dominant trait will always overpower the recessive trait. Complete the Punnett square in front of the class while explaining the process.
7. Remind students that probability is the likelihood that a particular event, or outcome, will occur. It is expressed as a fraction with the numerator being the total number of favorable outcomes, the denominator being the total number of possible outcomes. In this scenario, two quadrants have dominant genes for white wool and two quadrants have recessive genes for black wool; thus the lamb has a 2 out of 4 chance of inheriting white wool and a 2 out of 4 chance of inheriting black wool. Have every student roll a die to determine the breeding outcome. Instruct students to sketch a portrait of the lamb in the box provided at the bottom of the worksheet.
8. Tell students that now they know how to use the Punnett square to predict what animals will look like, they will practice being an animal geneticist by creating their own breed of cattle. Distribute the *Cattle Call* handout to students. Students will use the information provided about the bull and cow to determine the physical attributes of their offspring. Explain that the traits used as examples are not necessarily real cattle traits, but the traits will help students understand the main concepts of heredity. Instruct students to complete the *Cattle Call* handout. Review the handout and allow students to share their artwork.



Roll of the Genes

Variations

- ▶ Introduce genetics through an educational video on heredity. Check out the video “Heredity” on BrainPOP (www.brainpop.com) or search YouTube using the term “Punnett Square.”
- ▶ Students work on the project individually, with a partner, in small groups, or as a class.
- ▶ Students research actual phenotypes expressed in breeds of cattle. They create new variations of cattle by crossing actual breeds with the imaginary cattle featured in the *Cattle Call* handout.

Extensions

- ▶ Invite a local breeder to speak to the class about how they utilize genetics to improve their herd.
- ▶ Instruct student groups to select a cattle breed (see *Breeds of Beef Cattle* handout on page 37) to research. Have each group create a visual aid that illustrates the genetic history of their breed, including countries of origin, breed characteristics, and genetic selection over time.
- ▶ Observe pictures of Hereford and Brahman cattle, and predict what a Braford would look like. Repeat with any of the breeds listed on the *Breeds of Beef Cattle* handout.
- ▶ Have students research the educational background and skills required to be an animal geneticist.

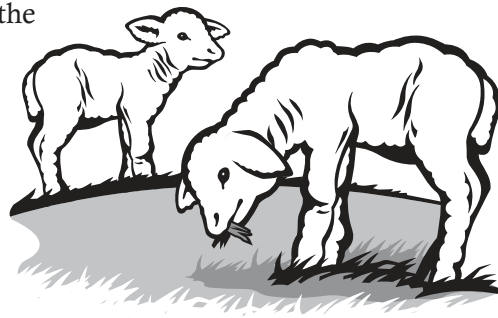
ELL Adaptations

- ▶ While leading students through the *Have You Any Wool?* handout, allow students time to think and respond to questions.
- ▶ Throughout the lesson ELL students can be partnered with students that are proficient or advanced English speakers.
- ▶ Students can define new terms like genes and alleles in their science journal or on a classroom word wall for future reference.

Have You Any Wool?

Name: _____

As an animal geneticist, you help ranchers determine the probable outcome of sheep breeding programs. A sheep rancher has two sheep he would like to breed. The male is called a ram, the female, a ewe. You decide to use a Punnett square to determine the probability of their lamb's wool color based on the genes passed on by the parents. An allele is a gene containing inherited traits from parents. The ram has white wool. An upper case W is used to represent his *dominant* white wool allele and a lower case b to represent his *recessive* black wool allele. The ewe has black wool. Two lowercase b's are used to represent her *recessive* black wool alleles. What is the probability their offspring, a lamb, will have white wool? What is the probability for black wool?



		RAM	
EWE		Roll 1	Roll 2
		Roll 4	Roll 3

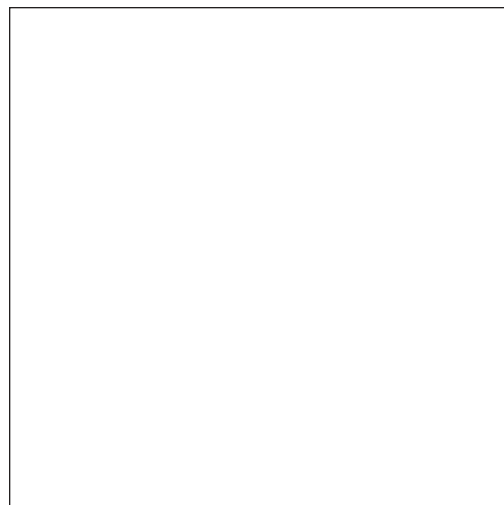
Probability of white wool:

_____ out of _____

Probability of black wool:

_____ out of _____

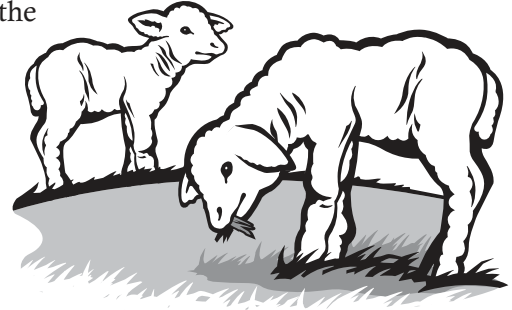
Directions: After reading the paragraph above, complete the Punnett square to determine the probability of the lamb having black or white wool. Once you know the probability of black or white wool, roll a die to represent chance. If you roll a one, select the top left hand square. If you roll a two, select the top right hand square. If you roll a three, select the bottom right hand square. If you roll a four, select the bottom left hand square. In the space provided, sketch a portrait of the newborn lamb.



Have You Any Wool?

Answer Key

As an animal geneticist, you help ranchers determine the probable outcome of sheep breeding programs. A sheep rancher has two sheep he would like to breed. The male is called a ram, the female, a ewe. You decide to use a Punnett square to determine the probability of their lamb's wool color based on the genes passed on by the parents. An allele is a gene containing inherited traits from parents. The ram has white wool. An upper case W is used to represent his *dominant* white wool allele and a lower case b to represent his *recessive* black wool allele. The ewe has black wool. Two lowercase b's are used to represent her *recessive* black wool alleles. What is the probability their offspring, a lamb, will have white wool? What is the probability for black wool?



		RAM	
		W	b
EWE	b	Wb Roll 1	bb Roll 2
	b	Wb Roll 4	bb Roll 3

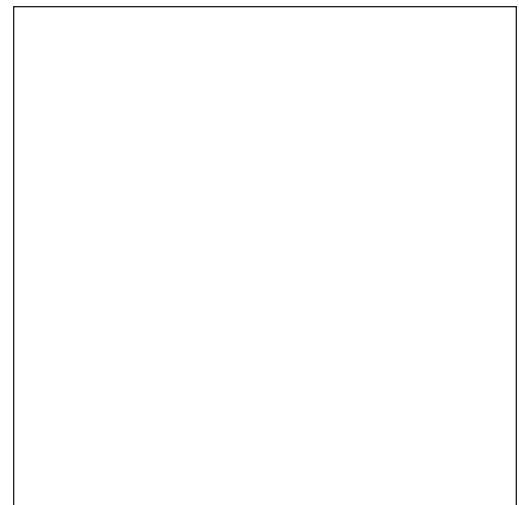
Probability of white wool:

2 out of 4

Probability of black wool:

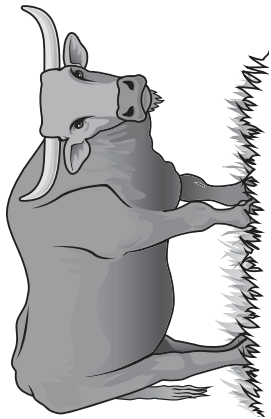
2 out of 4

Directions: After reading the paragraph above, complete the Punnett square to determine the probability of the lamb having black or white wool. Once you know the probability of black or white wool, roll a die to represent chance. If you roll a one, select the top left hand square. If you roll a two, select the top right hand square. If you roll a three, select the bottom right hand square. If you roll a four, select the bottom left hand square. In the space provided, sketch a portrait of the newborn lamb.



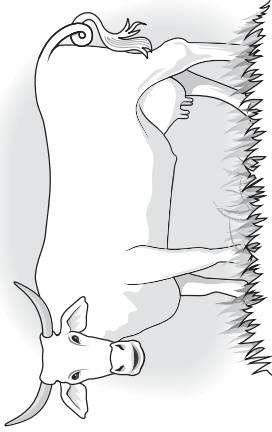
Cattle Call

Name: _____



Bull (male)

Hide: Purple (pp)
 Eye: Red (Rg)
 Horn: Long Horns (LL)
 Tail: Straight (Sc)



Cow (female)

Hide: Orange (Op)
 Eye: Red (Rg)
 Horn: Long Horns (LL)
 Tail: Curly (cc)

Directions: As an animal geneticist, predict the traits of a calf produced by a bull and a cow. Using a Punnett square will help you determine what the calf will look like. Use the traits given for the bull to fill in the top of the square and the traits given for the cow to fill in the side. Once the squares are complete, roll a die to represent chance. If you roll a one, select the top left square. If you roll a two, select the top right square. If you roll a three, select the bottom right square. If you roll a four, select the bottom left square. If you roll a five or a six, roll again. Circle the corner of each Punnett square that is selected by chance.

Calf's hide color: Dominant orange or recessive purple

	BULL	
COW		

Probability of orange hide: _____ out of _____
 Probability of purple hide: _____ out of _____

Calf's eye color: Dominant red or recessive green

	BULL	
COW		

Probability of red eyes: _____ out of _____
 Probability of green eyes: _____ out of _____

Calf's horns: Dominant long horns or recessive no horns

	BULL	
COW		

Probability of long horns: _____ out of _____
 Probability of no horns: _____ out of _____

Calf's tail: Dominant straight or recessive curly

	BULL	
COW		

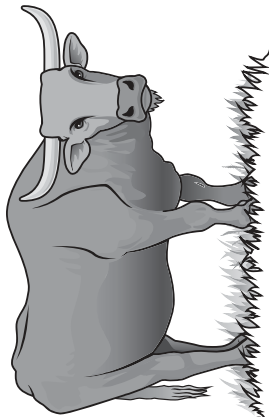
Probability of a straight tail: _____ out of _____
 Probability of a curly tail: _____ out of _____

Cattle Call *(continued)*

Add the calf's inherited traits to the illustration below.



Cattle Call Answer Key

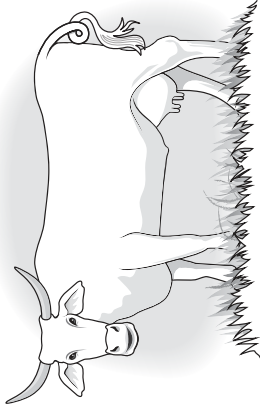


Bull (male)

Hide: Purple (pp)
 Eye: Red (Rg)
 Horn: Long Horns (LL)
 Tail: Straight (Sc)

Cow (female)

Hide: Orange (Op)
 Eye: Red (Rg)
 Horn: Long Horns (LL)
 Tail: Curly (cc)



Directions: As an animal geneticist, predict the traits of a calf produced by a bull and a cow. Using a Punnett square will help you determine what the calf will look like. Use the traits given for the bull to fill in the top of the square and the traits given for the cow to fill in the side. Once the squares are complete, roll a die to represent chance. If you roll a one, select the top left square. If you roll a two, select the top right square. If you roll a three, select the bottom right square. If you roll a four, select the bottom left square. If you roll a five or a six, roll again. Circle the corner of each Punnett square that is selected by chance.

Calf's hide color: Dominant orange or recessive purple

	BULL	p	p
COW	P	pp	pp
	O	Op	Op

Probability of orange hide:
 $\frac{2}{4}$ out of $\frac{4}{4}$

Probability of purple hide:
 $\frac{2}{4}$ out of $\frac{4}{4}$

Calf's eye color: Dominant red or recessive green

	BULL	R	g
COW	oo	Rg	gg
	aa	RR	Rg

Probability of red eyes:
 $\frac{3}{4}$ out of $\frac{4}{4}$

Probability of green eyes:
 $\frac{1}{4}$ out of $\frac{4}{4}$

Calf's horns: Dominant long horns or recessive no horns

	BULL	L	L
COW	ll	LL	LL
	ll	LL	LL

Probability of long horns:
 $\frac{4}{4}$ out of $\frac{4}{4}$

Probability of no horns:
 $\frac{0}{4}$ out of $\frac{4}{4}$

Calf's tail: Dominant straight or recessive curly

	BULL	S	c
COW	oo	Sc	cc
	oo	Sc	cc

Probability of a straight tail:
 $\frac{2}{4}$ out of $\frac{4}{4}$

Probability of a curly tail:
 $\frac{2}{4}$ out of $\frac{4}{4}$



California Foundation for
Agriculture in the Classroom

Breeds of Beef Cattle

Angus
www.angus.org

Beefmaster
www.beefmasters.org

Belmontred
www.belmontred.com.au

Belted Galo
www.beltie.org

Braford
www.brafords.org

Brahman
www.brahman.org

Brangus
www.int-brangus.org

Braunvieh
www.braunvieh.org

Charolais
www.charolaisusa.com

Dexter
www.dextercattle.org

Gelbvieh
www.gelbvieh.org

Hereford
www.hereford.org

Highland
www.highlandcattleusa.org

Limousin
www.nalf.org

Lowline
www.usa-lowline.org

Maine Anjou
www.maine-anjou.org

Santa Gertrudi
www.santagertrudis.com

Shorthorn
www.shorthorn.org

Simmental
www.simmental.org

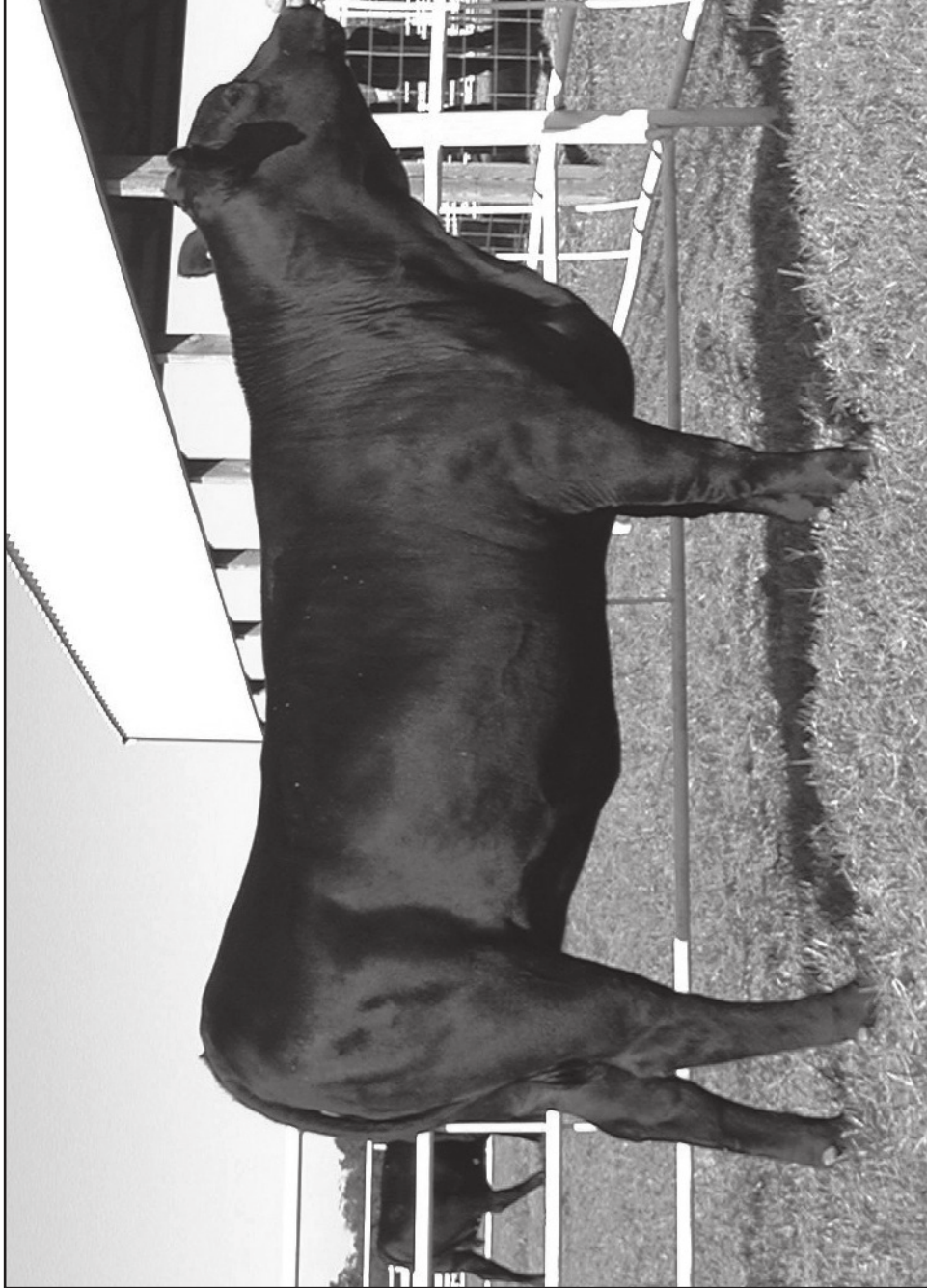
Texas Longhorn
www.tlbaa.org

Brahman Beef Cattle



Used with permission from American Brahman Breeders Association
Download a color photo at www.LearnAboutAg.org/stem

Angus Beef Cattle



Used with permission from Gul Livestock, LLC
Download a color photo at www.LearnAboutAg.org/stem

Brangus Beef Cattle



Used with permission from The Oaks Farm
Download a color photo at www.LearnAboutAg.org/stem



Got Guts?

Purpose

In this lesson students will investigate the different digestive systems of livestock and learn how animals have unique nutritional needs based on these structures. Students will also discover the responsibilities of an animal nutritionist.

Time

Teacher Preparation:
45 minutes

Student Activities:
Two 50-minute sessions

Materials

For the teacher:

- ▶ Document or overhead projector
- ▶ Transparency film (optional)
- ▶ *Animal Appetites* handout (page 46)
- ▶ *Got Guts? Teacher Review* (page 51)

For the class:

- ▶ *Got Guts? Pig Descriptions* (page 48)
- ▶ *Got Guts? Cow Descriptions* (page 50)

Background Information

There are two basic digestive systems, monogastric and ruminant. Although both systems break down food into smaller components so it is easily absorbed into the blood stream, they have significant differences.

A monogastric organism has a simple single-chambered stomach. Humans have a monogastric digestive system. Examples of other monogastric organisms include omnivores such as rats and pigs, carnivores such as dogs and cats, and herbivores such as horses and rabbits.

A ruminant is a grazing or browsing animal that chews cud. There are many different species of ruminant animals, including cattle, sheep, goats, buffalo, deer, and elk. These animals all have a similar digestive system.

Plant-based foods, such as grasses, herbs, and twigs, initially enter the first stomach, known as the rumen, where they are broken down by bacteria. Next, they regurgitate the partially digested food and chew it again in the form of cud. The word “ruminant” means “to chew over again.”



Most ruminant animals have no upper front teeth. In place of teeth, they have a hardened gum, which they use to crush food. Ruminants eat rapidly and do not chew their food completely before swallowing it, but can chew their cud for hours. Dairy cows spend almost eight hours a day chewing their cud.

Ruminants have four different chambers in their stomach, and these chambers have specific functions. In a large dairy cow, the rumen has the capacity to store and process up to 50 gallons of food at a time. Food remains in the rumen until it has been broken down and can proceed to the next chamber. Good bacteria in the rumen help the cow digest her food and provide her with protein and energy. This is where cud comes from. The reticulum works with the rumen to mix and bring the undigested feed back up the esophagus in the form of cud, to be rechewed. The cud chewing physically breaks down the fibrous material and increases the surface area of the feed. When the cud is swallowed, the increased surface area provides space for bacteria



Got Guts?

For each group:

- ▶ *Got Guts? Pig Labels* or *Cow Labels* (pages 47 and 49)
- ▶ *Cow Digestive Tract* or *Pig Digestive Tract* handout (pages 52 and 53)
- ▶ Foam board
- ▶ Modeling materials: balloons, tubing, hoses, straws, string, rope, empty soft drink bottles, chenille stems, milk jugs, or food containers
- ▶ Scissors
- ▶ Tape or glue

For each student:

- ▶ Sticky note

to attach and continue the digestion process. Once the particle size is reduced sufficiently, the undigested feed particles leave the rumen with liquid and flow into the omasum. The omasum has many folds which regulate flow of partially digested food to the fourth stomach compartment, the abomasum. The abomasum is similar to a human stomach, where the pH is approximately two—very acidic. This acidic environment prepares the nutrients that are present for absorption in the small intestine. See the *Cow Digestive Tract* handout on page 52 for more information.

Many of the plants that grow on earth cannot be used directly by humans as food. More than 50 percent of the plant matter in cereal crops is inedible to humans. Because of the microorganisms in the rumen, ruminants can convert otherwise unusable plant materials into nutritious food (e.g., milk and meat) and fiber (e.g., wool).

In this lesson, students will investigate the digestive process and use household materials to construct models of both monogastric and ruminant digestive systems.

Procedure

1. Prior to the lesson, replicate the *Animal Appetites* handout on page 46 onto an overhead transparency (optional). Cut out one set of the *Got Guts? Descriptions* on pages 48 and 50. Draw a large outline of either a cow or a pig on each group's piece of foam board.
2. Read the story, *Animal Appetites*, on page 46. After reading the story out loud, solicit student responses to the included questions. Tell students that today they are going to act as animal nutritionists. Animal nutritionists must have an extensive knowledge of how animals digest food. They use their knowledge to formulate diets for animals. The diets they create must be nutritionally sound, good-tasting, and economical for the ages and types of animals that will use them.
3. Write the questions: "What do cattle eat?" and "What do pigs eat?" on the board. Have students write their ideas on a sticky note and place their sticky note under the corresponding question. Review student ideas as a class, rearranging sticky notes to group, sort, and identify themes or ideas. Help students understand that animals eat different things due to animal nutritional needs, preferences, and their unique digestive tracts.



Got Guts?

Content Standards

Grade 3

Science

Life Sciences 3a

English Language Arts

Reading Informational Text

3.7

Writing 3.7

Language 3.6

Health Education

Growth and Development

1.3.G

Grade 4

Science

Life Sciences 3d

English Language Arts

Reading Informational Text

4.7

Writing 4.7

Language 4.6

Grade 5

Science

Life Sciences 2c

English Language Arts

Reading Informational Text

5.7

Writing 5.7

Language 5.6

4. Introduce the term “digestive tract.” Briefly review the human digestive system, and the roles of teeth and the mouth, esophagus, stomach, small intestine, large intestine, and colon in the function of digesting food. Allow students to identify the parts they know, and if possible, the related function. Highlight the following features:
- ▶ Digestion begins in the mouth. As the teeth tear and chop food, saliva moistens it for easy swallowing.
 - ▶ From the throat, food travels down a muscular tube in the chest called the esophagus. Waves of muscle contractions force food down through the esophagus to the stomach.
 - ▶ The stomach muscles churn and mix the food with acids and enzymes, breaking it into smaller, more digestible pieces.
 - ▶ Digestion continues in the small intestine, a tube-like structure that absorbs nutrients into the bloodstream.
 - ▶ The large intestine’s main function is to remove water and minerals from the undigested matter and form solid waste that can be excreted.
 - ▶ The colon is part of the large intestine. Bacteria in the colon help to digest the remaining food products.
5. Tell students that today they will use household materials to construct models of both monogastric and ruminant digestive systems. Divide the class into groups of five students. Assign each group a cow or pig digestive tract. Give each group the *Pig Digestive Tract* or *Cow Digestive Tract* handout. Distribute foam board, modeling materials (including balloons, tubes, hoses, straws, string, rope, and empty soft drink bottles, chenille stems, milk jugs, and food containers), and corresponding *Got Guts? Labels*. Instruct students to research their assigned animal, using classroom and Web resources, and then create a model of the animal’s digestive tract on the foam board using the labels and materials provided.



Got Guts?

6. Once students have completed their models, display them around the room. Gather students in a location where both cow and pig digestive tracts are visible. Distribute the *Got Guts? Descriptions* (both pig and cow) to students. Lead students in a review of each digestive tract, using the *Got Guts? Teacher Review* as needed. Throughout the review, have students place the correct description of each organ on the correct model.
7. Summarize student learning with a classroom discussion.
 - ▶ Monogastric and ruminant digestive systems are different. Monogastric systems have one true stomach, while ruminants have a multi-chambered stomach.
 - ▶ Animals prefer foods that can be easily digested and used by their body. Cattle have ruminant digestive tracts with large microbial populations that allow them to eat complex plant materials. Pigs and humans have monogastric digestive tracts.
 - ▶ Animal nutritionists use their knowledge about animals and their digestive tracts to formulate diets that are nutritionally sound, good-tasting, and economical.
 - ▶ The proper nutrition of livestock animals is a key component of a successful production system. Just like humans, animals that consume the nutrients they need will stay healthy and grow stronger.

Variations

- ▶ During the anticipatory set, solicit student responses using a text message poll such as www.polleverywhere.com or www.smspoll.net. Summarize student responses by creating a wordle (www.wordle.net).
- ▶ Have students choose a livestock animal to research and design a digestive model. Compare the digestive systems of a variety of animals including llamas, sheep, goats, cattle, horses, and pigs.

Extensions

- ▶ Use diagrams to compare the human, cow, and pig digestive systems. Challenge students to consider which animal humans are most similar to and form an expository response.



Got Guts?

- ▶ Compare the teeth of different animals and discuss how they are designed to break down specific foods. Introduce the terms carnivore, herbivore, and omnivore. Sort the teeth based on the animal's primary food sources and observe similar characteristics.
- ▶ Research the length of animal intestines. Use rope to model and compare the different lengths. Discuss why these differences might exist.
- ▶ Students research the educational background and skills required to be an animal nutritionist.

ELL Adaptations

- ▶ Students create a diagram of the selected digestive system before working on model. Graphic organizers are a means of introducing and assessing concepts in a manner that encourages meaningful learning.
- ▶ The activities in this lesson employ group work and cooperative learning. These activities provide opportunities for students to exchange, write, and present ideas. Students use a variety of skills that work together to increase understanding and retention.

Animal Appetites

The following narrative was written by Alex, a 5th grader who raises livestock for 4-H.

This morning I woke up early because it was my turn to feed the animals my sister and I are raising for our 4-H projects. It's a lot of hard work, but I really like caring for Daisy, my heifer, and Lucky, my sister's pig.

When I walked up to Daisy's corral, I noticed right away that her trough was empty. She has an impressive appetite. First I cleaned out Daisy's pen and made sure she had fresh, clean water. I gave her a big scoop of food and a handful of hay. I sat back to watch. At first, Daisy ate her food rapidly—it was gone in minutes! But once her food was gone, she continued to chew... and chew... and chew. I watched for 30 minutes, and the whole time Daisy never stopped chewing! I know my jaw would get sore if I chewed as much as Daisy did. I didn't have time to watch Daisy chew all day, so I decided it was time to feed my sister's pig, Lucky.

Lucky was hungry too. I gave him a big scoop of food in his bowl. Lucky, even though he ate last night, wolfed down his food like he was starving. In fact, he hardly chewed at all. It only took him a few minutes to finish his meal. I looked over at Daisy. Guess what she was doing? STILL chewing!

This really got me thinking...

Why do Lucky and Daisy eat different kinds of food?

Why do they eat their food differently?

Who decides what they should eat?

Do you know the answers to any of these questions?

Do you have questions about what animals eat?

Got Guts? Pig Labels

Teeth

Esophagus

Stomach

Small Intestine

Large Intestine

Got Guts? Pig Descriptions

Tear and chop food.

Muscle contractions force food through this tube and into the stomach.

Muscles mix the food with acids and enzymes, breaking it into smaller, more digestible pieces.

A tube-like structure that absorbs nutrients into the bloodstream.

Removes water and minerals from the undigested matter and forms solid waste that can be excreted.

Got Guts? Cow Labels

Teeth

Esophagus

Rumen

Reticulum

Omasum

Abomasum

Small Intestine

Large Intestine

Got Guts? Cow Descriptions

Tear and chop food.

Muscle contractions force food through this tube and into the stomach.

Good bacteria help the cow digest her food and provide her with protein and energy.

Brings the undigested feed back up the esophagus in the form of cud, to be re-chewed.

Folds regulate flow of partially digested food to the fourth chamber.

Prepares the nutrients that are present for absorption in the small intestine.

A tube-like structure that absorbs nutrients into the bloodstream.

Removes water and minerals from the undigested matter and forms solid waste that can be excreted.

Got Guts? Teacher Review

Teeth (Pig and Cow)

This part is the most distinctive and long-lasting features of mammal species. To an animal, these are the tools that help them *tear and chew food*.

Cattle have flat teeth and enjoy eating grasses and grains. Pigs have a variety of teeth. They are omnivores and enjoy eating plants and animals.

Students place the description, “tear and chew food,” near the teeth of both pig and cow models.

Esophagus (Pig and Cow)

This is the route food takes to get to the stomach, or rumen. *Muscle contractions force food through this tube and into the stomach.*

Students place the description, “muscle contractions force food through this tube and into the stomach,” near the esophagus of both pig and cow models.

Stomach (Pig)

Species with a monogastric digestive system have this organ. This is where *muscles mix the food with acids and enzymes, breaking it into smaller, digestible pieces.*

Students place the description, “muscles mix the food with acids and enzymes, breaking it into smaller, digestible pieces,” near the stomach of the pig model.

Rumen (Cow)

Cattle have one stomach with four chambers. This is the first chamber where *good bacteria help the cow digest her food and provide her with protein and energy.*

Students place the description, “good bacteria help the cow digest her food and provide her with protein and energy,” near the rumen of the cow model.

Reticulum (Cow)

This chamber of the stomach sorts particles entering or leaving the rumen. This organ *brings the undigested feed back up the esophagus in the form of cud, to be rechewed.*

Students place the description, “brings the undigested feed back up the esophagus in the form of cud, to be rechewed,” near the reticulum of the cow model.

Omasum (Cow)

This is a small chamber. Its *folds regulate flow of partially digested food to the fourth chamber.*

Students place the description, “folds regulate flow of partially digested food to the fourth chamber,” near the omasum of the cow model.

Abomasum (Cow)

This chamber is most like the stomach of a monogastric animal. It *prepares the nutrients that are present for absorption in the small intestine,* it contains strong acids and digestive enzymes.

Students place the description, “prepares the nutrients that are present for absorption in the small intestine,” near the abomasum of the cow model.

Small Intestine (Pig and Cow)

In both species, food travels through *a tube-like structure that absorbs nutrients into the bloodstream.*

The small intestine of a steer is 20 times the animal’s length. The small intestine of pig is approximately 15-20 meters.

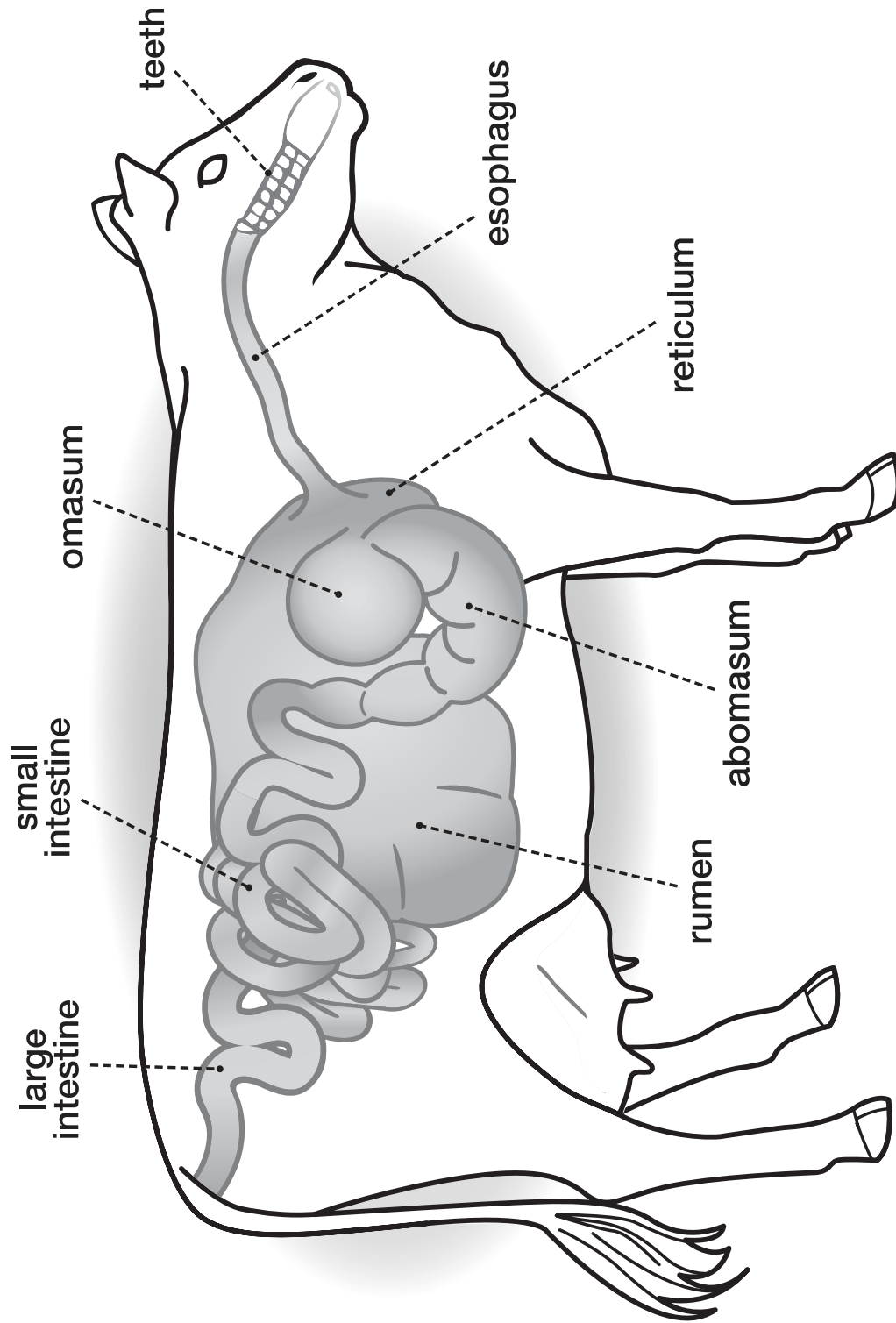
Students place the description, “a tube-like structure that absorbs nutrients into the bloodstream,” near the small intestine of both pig and cow models.

Large Intestine (Pig and Cow)

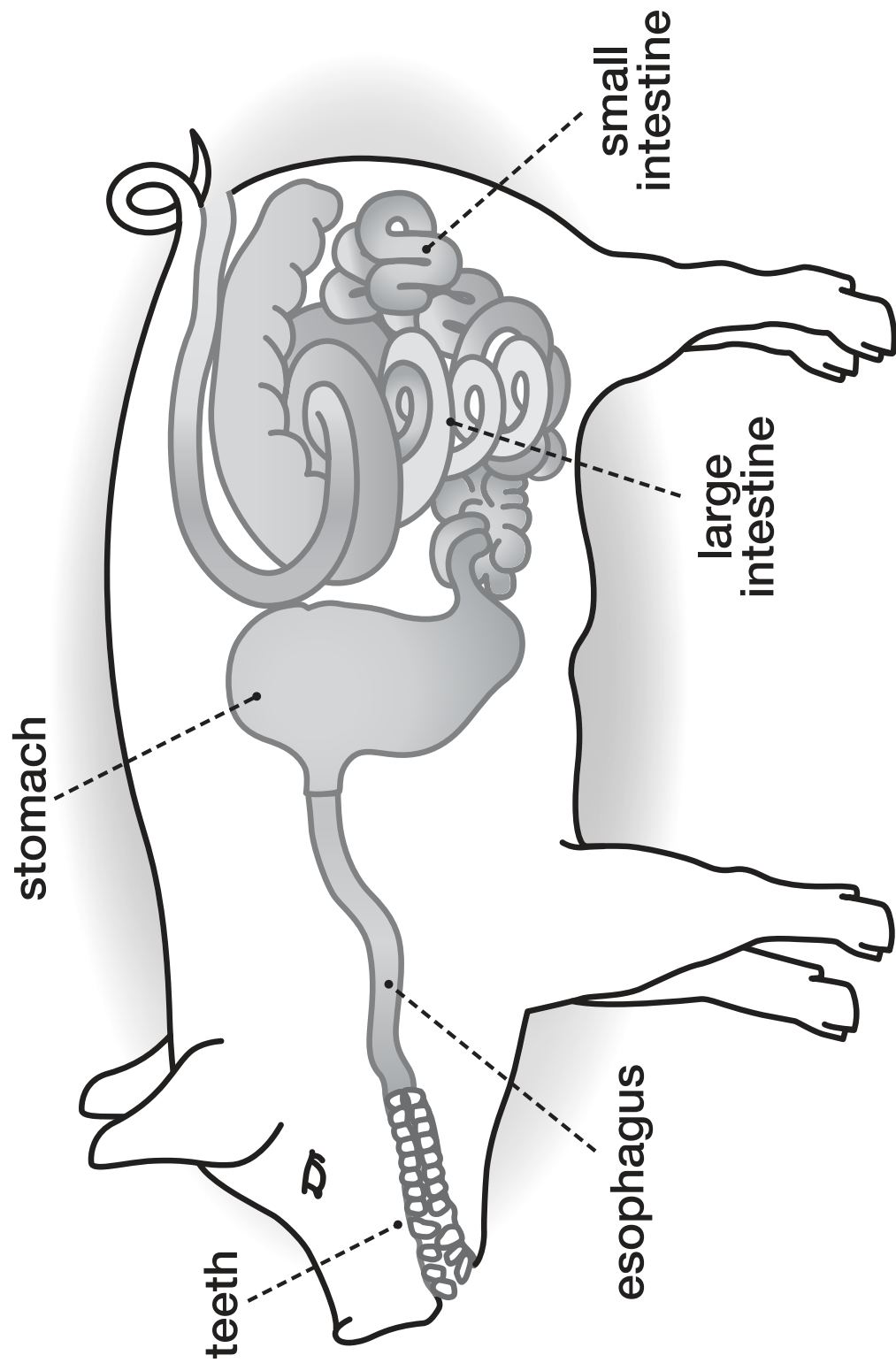
Despite its name, this structure is actually shorter than the small intestine. It *removes water and minerals from the undigested matter and forms solid waste that can be excreted.* This is the final structure food moves through before the animal defecates.

Students place the description, “removes water and minerals from the undigested matter and forms solid waste that can be excreted,” near the large intestine of both pig and cow models.

Cow Digestive Tract



Pig Digestive Tract



Homes on the Range

Purpose

In this lesson students will design a board game that reinforces how California rangelands provide habitat for livestock and wildlife while benefiting humans, animals, and plants. Students will also learn about the responsibilities of a range manager.

Time

Teacher Preparation:
20 minutes

Student Activities:
Three 50-minute sessions

Materials

For the class:

- ▶ Document or overhead projector
- ▶ Transparency film (optional)

For each group:

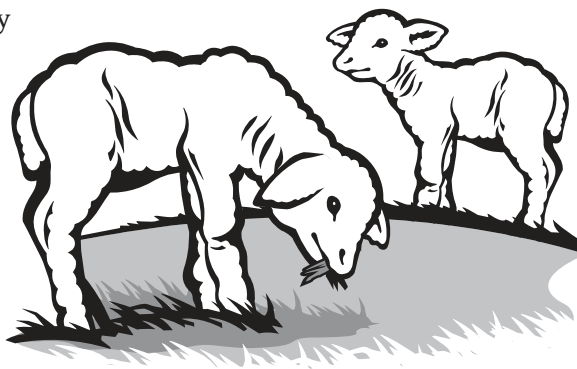
- ▶ *Rangeland Rescue Game Instructions* (page 61)
- ▶ *Rangeland Rescue Cards* (page 62)
- ▶ *Rangeland Rescue Game Board Spaces* (page 63)
- ▶ *Range Fact Cards* (pages 64-65)
- ▶ Six-sided die
- ▶ File folder

Background Information

Rangelands are vast natural landscapes that include grasslands, shrublands, woodlands, forests, tundra, wetlands, and deserts. Rangelands do not include barren desert, farmland, or land covered by bare soil, solid rock, concrete, or glaciers. Rangelands are uncultivated lands that will provide the necessities of life for grazing and browsing animals. Rangelands are distinguished from pasture lands because they grow naturally occurring vegetation, rather than plants cultivated by humans with irrigation, fertilizers, and other additions. From the wide open spaces of northern California to the vast plains of Africa, rangelands are found all over the world, encompassing more than half of the Earth's land surface.

Rangelands also provide important habitat for domestic livestock, including cattle, sheep, goats, and horses. These animals graze the land, feeding on plants, such as grasses. Grazing is important in agriculture, because domestic livestock convert grass and other forage into meat, milk, and other products.

There are many benefits to livestock grazing, including reducing fire hazards, promoting plant life, and encouraging wildlife species. Properly managed livestock grazing helps reduce fire hazards by controlling the amount and distribution of grasses and other potential fuel. Additionally, livestock grazing controls the growth of non-native grasses and herbs so that desirable plants (wildflowers and native grasses) can regenerate and coexist with them. Many species, including several threatened species, benefit from the vegetation management performed by livestock.



Rangelands are an important resource. They preserve open space and provide recreational uses, natural beauty, wildlife habitat, water purification, and clean air. Approximately 70 percent of the planet and 50 percent of the United States is rangeland. In California, the health and productivity of rangelands are very important. California supports nearly 63 million acres of rangeland.

Homes on the Range

- ▶ Colored paper
- ▶ Crayons, colored pencils, or markers
- ▶ Index cards

For each student:

- ▶ *Homes on the Range* t-chart handout (page 59)
- ▶ *Rangeland Rescue Game Design* handout (page 60)
- ▶ *Rangeland Rescue Game Design Grading Rubric* (page 66)
- ▶ Scissors

Range managers care for our country's vast rangelands. They maintain plants for forage; wildlife for aesthetics and hunting; livestock for meat, milk, and fiber production; and clean water. In this lesson, students will learn the basics about California rangelands and use their acquired knowledge and research skills to design an educational game.

Procedure

1. Prior to the lesson, replicate the *Homes on the Range* t-chart handout on page 59 onto an overhead transparency (optional).
2. Distribute the *Homes on the Range* t-chart handout on page 59 to students. Lead a discussion with students to build background information about California rangelands. Demonstrate how students can use the graphic organizer to record notes. Classroom discussion should include the following:
 - ▶ What are rangelands? Rangelands are vast natural landscapes that include grasslands, shrublands, woodlands, forests, tundra, wetlands, and deserts. It is land that can be used for grazing, foraging, wildlife habitat, aesthetics, hunting, and a clean water supply.
 - ▶ Who uses rangeland? Ranchers, hunters, hikers, scientists, wildlife, and livestock. Ask students to share ways they have personally used rangeland, emphasizing the value of rangeland to humans, animals, and plants.
 - ▶ How can grazing animals improve rangeland? Grazing animals...
 - a. Reduce the amount of fuel (grasses and shrubs) for wildfires. Land that is grazed is less likely to experience severe fires.
 - b. Increase aeration of the soil, facilitating better water absorption. Their hooves break up hard ground, adding beneficial air to the soil.
 - c. Control the growth of the non-native grasses and plants so that other desirable plants (wildflowers and native grasses) can thrive.
 - d. Increase the diversity of habitats available to wildlife species. Many species, including several threatened species, benefit from livestock controlling the growth of invasive plants.



Homes on the Range

Content Standards

Grade 3

Science

Life Sciences 3b, 3c

English Language Arts

Reading Informational Text

3.7

Writing 3.7

Mathematics

3.MP.1, 3.MP.7

Grade 4

Science

Life Sciences 2a, 3a

English Language Arts

Writing 4.7

Language 4.6

Math

4.MP.1, 4.MP.7

Grade 5

English Language Arts

Reading Informational Text

5.7

Writing 5.7

Language 5.6

Math

5.MP.1, 5.MP.7

- ▶ What role does a range manager have in the health of our land? The range manager makes decisions about how to carefully use and manage rangeland resources (plants, animals, soil, and water) to meet the needs and desires of society. When managed properly, California rangelands provide habitat for livestock and wildlife while benefiting humans, animals, and plants.

- ▶ What does a range manager do? A range manager may work with ranchers, scientists, and others to monitor plant growth, create agreements among rangeland users, develop conservation plans to meet land goals, manage private livestock operations, and develop methods to protect the range from fire, unwanted wildlife, and poisonous plants.



3. Introduce students to the game *Rangeland Rescue*. Explain that in this activity, students will take on the role of range managers to help a game board manufacturer create a realistic board game about California rangelands. The manufacturer has provided instructions and game board spaces. Students must use these resources to design their game board. Review the *Rangeland Rescue Game Instructions* out loud as a class. Tell students that this handout is their instructions for playing the game.
4. Distribute and review the *Rangeland Rescue Game Design* handout (page 60). Tell students that this handout is their instructions for designing the game. Show students an example of a game board, which can viewed online at www.LearnAboutAg.org/stem (optional). Divide the class into groups of four. Distribute the necessary materials.
5. Once game boards are complete, each student will evaluate another group's game board, using the *Rangeland Rescue Game Design Grading Rubric* on page 66. Students should play the game completely prior to filling out the rubric. The teacher will review the completed rubrics and average the student-determined evaluation scores for grading.
6. Debrief the activity to highlight significant discoveries. Use the *Range Fact Cards* to guide discussion and quiz students on the

Homes on the Range

information they learned about rangelands and range managers. Questions for the class may include:

- ▶ What was difficult about this activity? What was easy?
- ▶ Which *Range Fact Card* surprised you? Why?
- ▶ What skills are important for a range manager to have?
- ▶ Why is rangeland important?
- ▶ What would life be like without California rangelands?

Variations

- ▶ Have students use library, classroom, and Web resources to design their own *Range Fact Cards*. Each *Range Fact Card* must feature a question about California rangelands. Questions may be true/false, multiple choice, or short answer. Students should print questions and answers neatly on index cards for use in the game.
- ▶ Use an electronic presentation to introduce the topic. A presentation on California rangelands can be downloaded from www.LearnAboutAg.org/stem.
- ▶ Distribute the *Homes on the Range* t-chart electronically and have students fill them out on their tablet computer.

Extensions

- ▶ California Foundation for Agriculture in the Classroom's *Imagine this... Story Writing Contest* features several winning stories about livestock living on the range. Read "The Guard Llama: To Protect and Serve" (2010) by eighth-grader, Matt Wright, or "Summer Range" (2008) by sixth-grader, Braden Whitehouse. Inspired students can even write and submit their own stories about California rangelands. Visit www.LearnAboutAg.org/imaginethis for more information.
- ▶ Design product packaging and a commercial for the game. Include the box, instructions, and optional add-on packs. Create a video of actual game play to help build interest.
- ▶ Have students explore the educational background and skills required to be a range manager.

Homes on the Range

ELL Adaptations

- ▶ Give students a copy of the lesson's background information, which provides additional information about rangelands and range managers. Lead students in highlighting and annotating the text to identify important information.
- ▶ Use games such as Pictionary® or bingo to reinforce challenging new vocabulary words.
- ▶ The “Think-Pair-Share” technique increases student engagement and is an effective way to encourage English language learners to express new concepts in English. Give students time to write a response to a question on paper, additional time to discuss their ideas with their neighbor, and then solicit responses from the entire class.

Homes on the Range

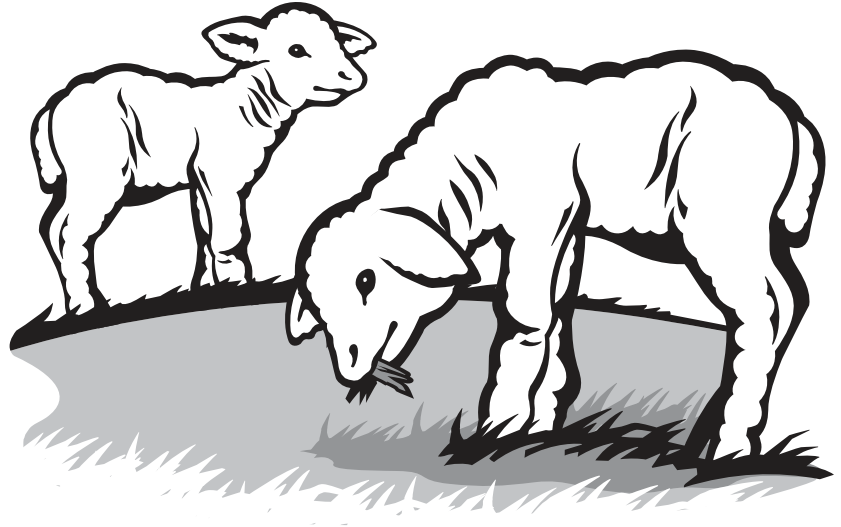
Name: _____

Topic = Rangeland	
What are rangelands?	<ol style="list-style-type: none">1.2.3.4.5.
Who uses rangelands?	<ol style="list-style-type: none">1.2.3.4.5.6.
How can grazing animals improve rangeland?	<ol style="list-style-type: none">1.2.3.4.
What role does a range manager have in the health of our land?	
What does a range manager do?	<ol style="list-style-type: none">1.2.3.4.5.

Rangeland Rescue Game Design

Materials

- ▶ File folder
- ▶ Colored paper
- ▶ Crayons, colored pencils, or markers
- ▶ Index cards
- ▶ Six-sided die
- ▶ *Rangeland Rescue Cards*
- ▶ *Range Fact Cards*
- ▶ *Rangeland Rescue Game Board Spaces*



Objective

You are a range manager working with a game board manufacturer to create a fun, easy-to-use, board game that teaches others about California rangelands.

- ▶ Prepare *Rangeland Rescue Cards*. Carefully cut out “Disaster,” “Invasive,” and “Predator” *Rangeland Rescue Cards*.
- ▶ Prepare *Range Fact Cards*. Carefully cut out *Range Fact Cards*.
- ▶ Design the path. Cut out and organize the *Rangeland Rescue Game Board Spaces* in a path. Make sure to add start and finishing spaces. Game designers must use all board spaces provided.
- ▶ Decorate the game board. Decorate the game board to reflect your theme: California rangelands.
- ▶ Make the game pieces. Identify designs that will represent California rangelands. Create one game piece for each player. The game piece must be free-standing.
- ▶ Test and retest. Test your prototype design in your group and with your classmates. Use their feedback to improve your design.

Rangeland Rescue Game Instructions

Materials

- ▶ Game piece for each player
- ▶ *Range Fact Cards*
- ▶ *Rangeland Rescue Cards*
- ▶ *Rangeland Rescue Game Board*
- ▶ Six-sided die



Players

- ▶ A game for two to four players.

Objective

- ▶ The first range manager who manages their land best (by getting to the end of the game board first) wins!

Set up

- ▶ Shuffle the *Range Fact Cards*. Shuffle the *Rangeland Rescue Cards*. Place both stacks face down near the board.
- ▶ Select a game piece and place it on “Start.”
- ▶ Roll the die to see who goes first. Play passes to the left.






















Game Play

- ▶ Roll the die and move the number of spaces shown.
- ▶ If you land on a space with livestock on it, another player will ask you a question from a *Range Fact Card*. If you answer correctly, draw a *Rangeland Rescue Card*. If answered incorrectly, remain on the same space until your next turn.

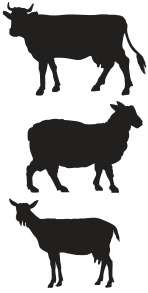





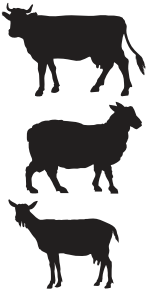

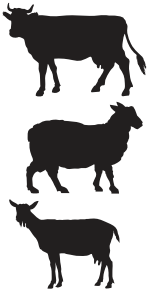



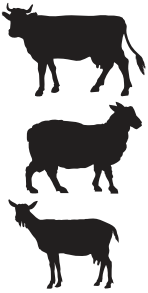

Rangeland Rescue Cards

- ▶ Keep *Rangeland Rescue Cards* for use when a range challenge arises.

Rangeland Rescue Cards

 <p>Rangeland Rescue PREDATOR Prevention</p>	 <p>Rangeland Rescue DISASTER Prevention</p>	 <p>Rangeland Rescue INVASIVE Prevention</p>
 <p>Rangeland Rescue PREDATOR Prevention</p>	 <p>Rangeland Rescue DISASTER Prevention</p>	 <p>Rangeland Rescue INVASIVE Prevention</p>
 <p>Rangeland Rescue PREDATOR Prevention</p>	 <p>Rangeland Rescue DISASTER Prevention</p>	 <p>Rangeland Rescue INVASIVE Prevention</p>
 <p>Rangeland Rescue PREDATOR Prevention</p>	 <p>Rangeland Rescue DISASTER Prevention</p>	 <p>Rangeland Rescue INVASIVE Prevention</p>
 <p>Rangeland Rescue PREDATOR Prevention</p>	 <p>Rangeland Rescue DISASTER Prevention</p>	 <p>Rangeland Rescue INVASIVE Prevention</p>
 <p>Rangeland Rescue PREDATOR Prevention</p>	 <p>Rangeland Rescue DISASTER Prevention</p>	 <p>Rangeland Rescue INVASIVE Prevention</p>
 <p>Rangeland Rescue PREDATOR Prevention</p>	 <p>Rangeland Rescue DISASTER Prevention</p>	 <p>Rangeland Rescue INVASIVE Prevention</p>

Rangeland Rescue Game Board Spaces

					
<p>PREDATOR A virus has attacked your cattle. Move back 2 spaces to develop a vaccine that will save your livestock, unless you have a <i>Predator Prevention</i> card.</p>	<p>PREDATOR Cattle rustlers try to steal your cattle. Move back 5 spaces to wait for the sheriff to arrive, unless you have a <i>Predator Prevention</i> card.</p>	<p>PREDATOR A pack of wolves is circling your sheep. Go back 2 spaces to chase them away, unless you have a <i>Predator Prevention</i> card.</p>	<p>DISASTER Heavy rains flood your barn. Move back 2 spaces to repair the damage, unless you have a <i>Disaster Prevention</i> card.</p>	<p>DISASTER A drought has left your land dry and barren. Move back 1 space to purchase feed for your livestock, unless you have a <i>Disaster Prevention</i> card.</p>	<p>DISASTER A fire destroys your rangeland. Return to start to control the fire, unless you have a <i>Disaster Prevention</i> card.</p>
<p>INVASIVE Invasive plants are growing on your grazing land. Go back 1 space to pull them out, unless you have an <i>Invasive Prevention</i> card.</p>	<p>INVASIVE Poison oak is growing on your land. You get an itchy rash. Go back 2 spaces until the itching stops, unless you have an <i>Invasive Prevention</i> card.</p>	<p>INVASIVE Ground squirrels have dug holes in your land. A steer injures its leg. Go back 3 spaces to repair the holes, unless you have an <i>Invasive Prevention</i> card.</p>	<p>INVASIVE The invasive weed cheatgrass has taken root on your property. Go back 2 spaces until you remove it, unless you have an <i>Invasive Prevention</i> card.</p>		
					
<p>A fire is easily contained because your livestock have controlled shrub growth. Move ahead 1 space.</p>	<p>You spot a bald eagle, a threatened species, on your property. Move ahead 2 spaces.</p>	<p>A neighbor has traded you a ton of hay for the use of your tractor. Move ahead 2 spaces.</p>	<p>Your livestock help control poison oak in an area used for recreation. Move ahead 2 spaces.</p>	<p>Your water supply is abundant. Move ahead 3 spaces.</p>	<p>Your livestock are content. Move ahead 1 space.</p>

Range Fact Cards

<p>Range Fact</p> <p>Wildfires can threaten grazing land, structures, and livestock herds.</p> <p>True</p>	<p>Range Fact</p> <p>The management of rangeland is not related to water quality.</p> <p>False</p> <p><i>The proper management of rangeland can protect water flow and water quality.</i></p>	<p>Range Fact</p> <p>Wildlife is able to forage on well-managed rangeland.</p> <p>True</p>	<p>Range Fact</p> <p>Grazing goats can reduce the threat of wildfire on rangeland.</p> <p>True</p>
<p>Range Fact</p> <p>Rangelands provide permanent habitat for wildlife and improve water quality.</p> <p>True</p>	<p>Range Fact</p> <p>Rangeland only supports livestock animals.</p> <p>False</p> <p><i>Rangeland supports a diversity of living organisms that rely on each other for survival.</i></p>	<p>Range Fact</p> <p>Range managers only work for environmental groups.</p> <p>False</p> <p><i>Rangeland managers work for government agencies, universities, private companies, environmental groups, and can be self-employed.</i></p>	<p>Range Fact</p> <p>Some range managers are researchers, teachers, and extension agents with colleges and universities.</p> <p>True</p>
<p>Range Fact</p> <p>Livestock grazing is one way to reduce the threat of wildfire.</p> <p>True</p>	<p>Range Fact</p> <p>Rangeland provides homes for plants, animals, and people.</p> <p>True</p>	<p>Range Fact</p> <p>Sheep, goats, and cattle prefer eating the same rangeland plants.</p> <p>False</p> <p><i>Goats prefer woody plants, cattle prefer grasses, and sheep will eat both.</i></p>	<p>Range Fact</p> <p>Forage that has been cut down in summer months will not return in fall and spring months.</p> <p>False</p> <p><i>Livestock may reduce forage in the summer but forage will return in the fall and spring.</i></p>

Range Fact Cards

<p>Range Fact</p> <p>Mammoths foraged California rangelands in 1849.</p> <p>False</p> <p><i>Mammoths foraged California rangelands 10,000 years ago, not 1849.</i></p>	<p>Range Fact</p> <p>Rangeland and pasture land are the same type of land.</p> <p>False</p> <p><i>Rangeland contains natural vegetation where pasture land is established or planted by humans.</i></p>	<p>Range Fact</p> <p>Machines are used by land managers to remove vegetation.</p> <p>True</p>	<p>Range Fact</p> <p>Cattle, sheep, llamas, and horses are all examples of livestock raised on the range.</p> <p>True</p>
<p>Range Fact</p> <p>Grasses are the only type of plant that grow on rangeland.</p> <p>False</p> <p><i>Grasses, trees, shrubs, orbs, wildflowers, and other plants grow on rangelands.</i></p>	<p>Range Fact</p> <p>Native American communities have managed and tended California rangeland.</p> <p>True</p>	<p>Range Fact</p> <p>Grazing livestock are carnivores, they eat mainly meat.</p> <p>False</p> <p><i>Grazing livestock are herbivores, designed for eating only plant materials.</i></p>	<p>Range Fact</p> <p>Livestock have taste preferences</p> <p>True</p>
<p>Range Fact</p> <p>Rangeland and livestock operations provide us with butter, cheese, milk, lamb and beef.</p> <p>True</p>	<p>Range Fact</p> <p>Rangeland is not a good habitat for threatened species.</p> <p>False</p> <p><i>More than half of the species considered "endangered" or "threatened" live on rangelands.</i></p>	<p>Range Fact</p> <p>The amount of rangeland in California is increasing.</p> <p>False</p> <p><i>As California's population grows, more rangeland is being converted to homes, businesses, and other infrastructure.</i></p>	<p>Range Fact</p> <p>Virtually all of the water consumed by California residents flows through rangeland.</p> <p>True</p>

Rangeland Rescue Game Design Grading Rubric

Evaluator's Name: _____

Designers: _____

Circle the appropriate description for the project you are evaluating.

	10 Points	8 Points	6 Points	4 Points	2 Points
Game Board	Game board is neat, colorful, and creative.	Game board is colorful and creative, but lacks precision.	Game board is creative, but lacks color and precision.	Game board has little creativity, color, and attention to detail.	Game board has no color and no extra efforts were made at creativity.
Path	Path is clear, easy to follow, and challenging.	Path is a little confusing, but is still challenging.	Path is somewhat confusing or design caused players to get "stuck" once or twice.	Path is somewhat confusing or design caused players to get "stuck" often.	Path is very confusing and difficult to follow.
Game Pieces	Game pieces are neat, colorful, creative, and free-standing.	Game pieces are colorful, creative, and free-standing.	Game pieces are colorful and creative. They are not free-standing.	Game pieces are colorful. They are not free-standing.	Game pieces have little color and creativity. They are not free-standing.

Comments: _____

Total points: _____

Answers to Commonly Asked Questions

Why is animal nutrition important in livestock production?

Animal nutrition includes not only the nutritional value of the feed, but also the format, frequency, and how it is delivered. Animal nutritional needs vary, depending on species as well as life stage. Water is crucial to an animal's nutrition program, both in terms of quality and quantity.

An animal's diet provides the building blocks necessary for robust animal health and the related production of meat, milk, or other harvestable items, such as wool or leather. Therefore, the quality of the animal's diet directly impacts the quality and quantity of products produced. The product has a specific value in the marketplace. If the value of the product remains the same, the more money a rancher invests in feeding an animal to produce the desired product means the smaller their profit margin (or none at all). While some might assume that less money spent on feed will equal the greatest benefit to the farmer, some high-quality feed ingredients—which may be expensive—may also increase the quantity and quality of the product. Thus, there is a careful balance between spending too much money on feed and exceeding the marketplace value, and spending too little on feed and sacrificing quality or yield. Animal nutritionists have to consider the optimal diet for the animal so that it maximizes animal health, product yield and quality, while taking into account the farmer's profit margin.

What is animal welfare?

Animal welfare is the physical and psychological well-being of animals. An animal that is healthy, comfortable, well-nourished, safe, able to express natural behaviors, and is not suffering from pain, fear, or stress is in a good state of welfare. Good animal welfare requires disease prevention, veterinary treatment, appropriate shelter, management, nutrition, humane handling, and humane death.

Why are antibiotics used in livestock production?

Antibiotics are used in livestock production primarily for disease treatment and disease prevention. Just like humans, at certain times in their lives animals are more susceptible to bacterial infections. As in human medicine, antibiotics are used to effectively treat those infections. In livestock production, antibiotics can also be used to prevent disease. The animal's environment and the management practices of the farmer can also reduce the bacteria an animal is

Answers to Commonly Asked Questions

exposed to. Most livestock antibiotics are indicated for the treatment or prevention of specific diseases, rather than to simply promote weight gain. Preventing disease, however, can have the added effect of faster growth.

What types of regulations govern animal welfare?

Both federal and state governments have laws and regulations to protect animals and govern animal welfare. The federal Animal Welfare Act regulates the humane treatment of animals used in research, exhibition, transport, and by dealers; farm animals are regulated under this Act only when used in biomedical research, testing, teaching, and exhibition. Farm animals used for food and fiber or for food and fiber research are not regulated under the AWA. Although not a government regulation, the Federation of Animal Science Societies' Guide for the Care and Use of Agricultural Animals in Research and Teaching serves as a primary reference document for meeting the needs and requirements of agricultural animals used in research and teaching.

Horses receive protection under the federal Slaughter Horse Transport Program and the federal Horse Protection Act. The federal Humane Methods of Slaughter Act requires the proper treatment and humane handling of livestock at slaughter. In addition, many farmers use animal welfare voluntary third-party animal welfare audits to assure consumers that food animals are being raised under humane conditions. Many welfare assurance programs are offered and/or required by producer organizations, animal protection groups, retailers, processors, and distributors. Each program's focus and impact varies, including which aspect of animal welfare the program emphasizes.

What are the correct terms for different livestock animals?

Livestock is called by different names, depending on if the animal is young or old, castrated or intact, or has given birth. The chart on page 69 provides a general overview of animal nomenclature.

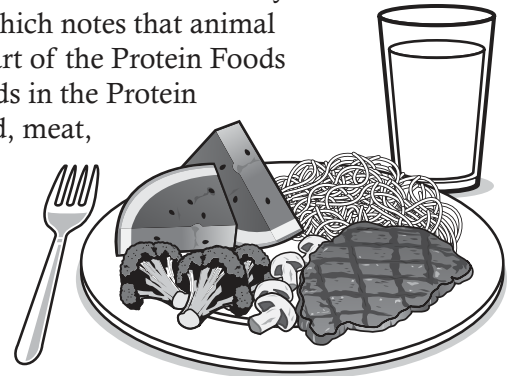
Answers to Commonly Asked Questions

	Male				Female	
	Newborn	Young	Adult	Castrated	Young	Adult
Swine	Piglet	Boar pig	Boar	Barrow	Gilt	Sow
Cattle	Calf	Bull calf	Bull	Steer	Heifer	Cow
Sheep	Lamb	Ram lamb	Ram	Wether	Ewe lamb	Ewe
Goats	Kid	Buckling	Billy/Buck	Wether	Doeling	Nanny/Doe
Horse	Foal	Colt	Stallion	Gelding	Filly	Mare
Turkeys	Poult	Jake	Tom	-----	Jenny	Hen
Ducks	Duckling	-----	Drake	-----	-----	Duck/Hen
Chickens	Chick	Cockerel	Cock/Rooster	Capon	Pullet	Hen

What are the health benefits of eating animal products?

The U.S. Department of Agriculture and Department of Health and Human Services jointly issued the 2010 Dietary Guidelines for Americans, which notes that animal products are an important part of the Protein Foods group and Dairy group. Foods in the Protein

Foods group, such as seafood, meat, poultry, and eggs, provide nutrients that are vital for health and maintenance of children's bodies. For example, all kids need protein to help them grow. Protein is an important part of the diet because it functions as a building block for bones, muscles, cartilage, skin, and blood.



Consuming foods in the Dairy group provides health benefits like building and maintaining strong, dense bones. Children should include low-fat and fat-free foods or beverages from the Dairy group in meals and snacks every day. Milk, cheese and yogurt are dairy products that provide calcium, potassium, vitamins, and protein that help the body grow and develop. People who consume dairy products have healthier bones and teeth. It is especially important for young children to consume dairy products because their bones are still developing.

Answers to Commonly Asked Questions

Eating too much of any food can have a negative effect on your health. If you have health concerns, talk to your doctor about your dietary options.

What are animal by-products?

Animals play very important roles in our lives. They are raised for food and they provide products important to everyday life. Animal by-products are the parts of slaughtered animals that humans do not directly consume. These parts may be further processed into human and non-human foodstuffs, fats, and other material that can be sold to make commercial products such as cosmetics, paint, cleaners, polishes, glue, soap, and ink. Meat production is more efficient when all parts of the animal are used.

How can people be assured that the meat and milk they consume is safe?

Personnel from the United States Department of Agriculture's Food Safety and Inspection Service (USDA-FSIS), the Food and Drug Administration, and other government agencies at the state and federal level interact regularly with research scientists, technical experts, farmers, ranchers, and the general public to discuss and enhance food safety. They establish guidelines and standards for food processors, handlers, and others involved in food production and distribution. The United States' food supply is among the safest in the world; government and private industry together work hard to maintain this position. By practicing safe food handling and storage at home, consumers also play a significant role in ensuring the safety of the food they eat.



California Foundation for
Agriculture in the Classroom

Agricultural Organizations

General

American Farm Bureau Foundation for Agriculture

600 Maryland Avenue SW, Suite 1000W
Washington, DC 20024
Phone: (202) 406-3700
Toll free: (800) 443-8456
Fax: (202) 314-5121
E-mail: curtism@fb.org
Website: www.agfoundation.org
Website: www.myamericanfarm.org

California Foundation for Agriculture in the Classroom

2300 River Plaza Drive
Sacramento, CA 95833-3293
Phone: (916) 561-5625
Toll free: (800) 700-AITC
Fax: (916) 561-5697
E-mail: info@LearnAboutAg.org
Website: www.LearnAboutAg.org

National 4-H Cooperative Curriculum System, Inc.

405 Coffey Hall, 1420 Eckles Avenue
St. Paul, MN 55108-6068
Phone: (612) 624-4900
Toll free: (800) 876-8636
E-mail: shopext@umn.edu
Website: www.n4hccs.org
Website: www.4-hmall.org

Beef

California Beef Council

4640 Northgate Boulevard, Suite 115
Sacramento, CA 95834
Phone: (916) 925-2333
Fax: (916) 925-8155
E-mail: askus@calbeef.org
Website: www.calbeef.org
Website: www.teachfree.com
Website: www.beefnutrition.org
Website: www.zip4tweens.com

Kern County CattleWomen

22474 Walser Road
Caliente, CA 93518
Phone: (661) 867-2906
E-mail: kcteachersag@aol.com

Cowboys

Sons of the San Joaquin

491 Herndon Avenue #253
Clovis, CA 93612
Toll free: (888) THE SONS
Website: www.thesons.com

Dairy

Hilmar Cheese Company Visitor Center

9001 North Lander Avenue
Hilmar, CA 95324
Phone: (209) 656-1196
Toll free: (800) 577-5772
Fax: (209) 656-1116
E-mail: dskidmore@hilmarcheese.com
Website: www.hilmarcheese.com



California Foundation for
Agriculture in the Classroom

Agricultural Organizations

Dairy Council of California

1101 National Drive, Suite B
Sacramento, CA 95834
Phone: (916) 263-3560
Fax: (916) 263-3566
E-mail: info@dairycouncilofca.org
Website: www.dairycouncilofca.org
Website: www.mealsmatter.org

California Milk Advisory Board

400 Oyster Point, Suite 211
South San Francisco, CA 94080
Phone: (650) 871-6455
Toll free: (800) 871-3444
Fax: (650) 583-7328
Website: www.RealCaliforniaMilk.com

Eggs

American Egg Board

1460 Renaissance Drive
Park Ridge, IL 60068
Phone: (847) 296-7043
Fax: (847) 296-7007
E-mail: aeb@aeb.org
Website: www.aeb.org
Website: www.incredibleegg.org

Association of California Egg Farmers

1521 I Street
Sacramento, CA 95814
Phone: (916) 928-3900
Fax: (916) 567-0505

Fairs

Western Fairs Association

1776 Tribute Road, Suite 210
Sacramento, CA 95815-4495
Website: www.WesternFairs.org

Horses

American Quarter Horse Association

Post Office Box 200
Amarillo, TX 79168
Phone: (806) 378-4707
Fax: (806) 349-6403
E-mail: cmartin@aqha.org
Website: www.aqha.com

Tennessee Walking Horse Breeders' and Exhibitors' Association

Post Office Box 250
Lewisburg, TN 37091-0286
Phone: (931) 359-1574
Fax: (931) 359-7530
E-mail: ccoffey@twhbea.com
Website: www.twhbea.com

Pork

California Pork Producers Association

1225 H Street, Suite 106
Sacramento, CA 95814
Phone: (916) 447-8950
Fax: (916) 443-1506
Website: www.calpork.com

National Pork Board

1776 NW 114th Street
Clive, IA 50325
Phone: (515) 223-2600
Fax: (515) 309-6127
E-mail: info@pork.org
Website: www.otherwhitemeat.com
Website: www.pork.org
Website: www.porkstore.pork.org



California Foundation for
Agriculture in the Classroom

Agricultural Organizations

Poultry

California Poultry Federation

4640 Spyres Way, Suite 4

Modesto, CA 95356

Phone: (209) 576-6355

Fax: (209) 576-6119

E-mail: califpoultry@cs.com

Website: www.CPIF.org

Rodeo

Grand National Rodeo

2600 Geneva Avenue

Daly City, CA 94014

Phone: (415) 404-4100

Website: www.cowpalace.com

Sheep

American Sheep Industry Association

9785 Maroon Circle, Suite 360

Englewood, CO 80112

Phone: (303) 771-3500

Fax: (303) 771-8200

E-mail: info@sheepusa.org

Website: www.sheepusa.org

California Woolgrowers Association

1225 H Street, Suite 101

Sacramento, California 95814-1910

Phone: (916) 444-8122

Fax: (916) 443-1506

E-mail: info@woolgrowers.org

Website: www.woolgrowers.org

Pendleton Woolen Mills

Education and Testing Department

Post Office Box 3030

Portland, OR 97208-3030

Fax: (503) 535-5794

E-mail: education@pendleton-usa.com

Website: www.pendleton-usa.com



California Foundation for
Agriculture in the Classroom

Teacher Resources and References

Alltech

Dig in!

The Dig in! resource pack contains 48 lesson plans which are intrinsically linked to science, geography, and SPHE (Social, Personal and Health Education) curricula. The lessons address the subjects of farming, cattle, sheep, pigs, poultry, fruits and vegetables, cereals and grasses, and healthy eating. The lessons also cover environmental subjects, including the hedgerow, air, trees, water, and soil.

Alltech

4041 North Fresno Street, Suite #104

Fresno, CA 93726

Phone: (559) 226-0405

E-mail: taner@alltech.com

Website: www.alltech.com/kidzone

American Egg Board Materials

Cel-egg-brate with Seasons

This seasonal brochure features eight kid-friendly recipes, colorful illustrations, and safety and measuring tips to entice kids to experiment in the kitchen.

Eggs 101: A Video Project

This 29-minute, comprehensive egg production education program teaches young consumers about the animal care practices of the egg industry. A teacher's guide PDF with supplemental reviews and exercises is also available. www.aeb.org/egg-industry/egg-facts-101

From the Inside Out!

This poster shows you the parts of the egg and gives you nutrition facts.

It's All in An Egg!

This poster shows that eggs are packed with numerous nutrients that play a healthful role in the body. Download from www.encteacher.org/Egg_Education_Materials.html

Shelly and Shelldon's Eggcellent Adventure

This 16-page, full-color guide for primary students includes coloring pages, a word search, craft ideas, an egg quiz, experiments, recipes, and more.

American Egg Board

1460 Renaissance Drive

Park Ridge, IL 60068

Phone: (847) 296-7043

Fax: (847) 296-7007

E-mail: aeb@aeb.org

Website: www.aeb.org

Website: www.incredibleegg.org

American Farm Bureau Foundation for Agriculture

Beef Ag Mag

Classroom sets of 30 agriculture magazines are provided in a set that explores the production of beef. Topics include nutrition, environmental issues, grazing lands, food safety, history, breeds, anatomy, and vocabulary. A teacher's guide is also available.

Addressing Early Misconceptions About Agriculture

This kit tackles five basic questions that are most often misunderstood by children and the adults they live with. Includes topics such as "Who makes chocolate milk?" and "Find the bull." The kit includes a teacher's guide that will provide set-up and teaching instructions.

Career Ag Mag

Classroom sets of 30 agriculture magazines are provided in a set focused on a wide array of careers in agriculture.

Dairy Ag Mag

Classroom sets of 30 agriculture magazines are provided in a set. Topics covered include nutrition, processing, homogenization, breeds, and careers. A teacher's guide is also available.



California Foundation for
Agriculture in the Classroom

Teacher Resources and References

Pigs and Pork in the Story of Agriculture: Educator's Guide

This guide accompanies the book "Pigs and Pork in the Story of Agriculture." Activities help students identify the five sub concepts of pigs and pork in agriculture: production, processing, distribution, marketing, and consumerism.

Food and Farm Facts Booklet

This 29-page booklet contains realistic illustrations of farmers, consumers, livestock, and crops. It features charts and graphs with facts about today's agricultural system, food consumption and safety, biotechnology, international trade, historical highlights, and agricultural terminology. New sections on aquaculture, silviculture, nursery and greenhouse, and the farmers' share of the retail food dollar are included. A one-sided poster map (38" x 27") is included with each booklet. Condensed, pocket-sized booklet is also available.

Ten Things Kids Want to Know About Farming

This 22-minute educational video or DVD takes students on a series of field trips to farm and ranch locations throughout the United States, offering them a firsthand view of how the food and clothing we use every day is produced.

American Farm Bureau Foundation for Agriculture
600 Maryland Avenue SW, Suite 1000W
Washington, DC 20024
Phone: (202) 406-3700
Toll free: (800) 443-8456
Fax: (202) 314-5121
E-mail: curtism@fb.org
Website: www.agfoundation.org
Website: www.myamericanfarm.org

American Sheep Industry Association

American Sheep Industry Association

Educational materials concerning the sheep, lamb, and wool industry.

American Sheep Industry Association
9785 Maroon Circle, Suite 360
Englewood, CO 80112
Phone: (303) 771-3500
Fax: (303) 771-8200
E-mail: info@sheepusa.org
Website: www.sheepusa.org

American Quarterhorse Association

American Quarter Horse Materials

Booklets and posters with general information, anatomy, and history of the American Quarter Horse are available.

Junior Master Horseman Curriculum

Junior Master Horseman is a non-breed specific equine curriculum that uses a variety of activities that reinforce the lessons on an interactive website. There are comprehension checks after each of the eight chapters. For more details on this curriculum, visit JuniorMasterHorseman.com.

American Quarter Horse Association
Post Office Box 200
Amarillo, TX 79168
Phone: (806) 378-4707
Fax: (806) 349-6403
E-mail: cmartin@aqha.org
Website: www.aqha.com



California Foundation for
Agriculture in the Classroom

Teacher Resources and References

Cabot Vermont

Cows, Calcium and Cheese

An “udderly” fun-filled school program teaches students about life on the farm, explores varied careers in agriculture, and considers nutrition concepts, such as how calcium is linked to health. Two free posters, a CD-ROM, and an activity guide are included—both chock-full of resources. Assessment tool samples help educators address education standards.

Cabot Vermont
1 Home Farm Way
Montpelier, VT 05602
Phone: (802) 229-9361
Toll free: (888) 792-2268
Fax: (802) 371-1200
Website: www.cabotcheese.com

California Beef Council

Basics About Beef

This colorful, 24-page booklet for consumer science students covers the nutritional benefits of beef as well as all aspects of buying, storing, preparing, and serving beef. The 8 ½" x 11" booklet also contains word puzzles which offer an interesting way to reinforce and review the information found in the booklet. Answers to games and puzzles are available in the download section of www.teachfree.com.

Beef Ag Mag

A four-page agricultural newspaper for kids. This newspaper talks about cattle and the environment, beef statistics, nutritional information, food safety, branding, beef vocabulary, beef breeds, and more.

Beefman

With this activity booklet about beef, kids can have fun doing word finds, crossword puzzles, and more while learning about beef.

Caretakers All

This environmental education teaching kit was developed to help teach students the principles of environmental stewardship, animal husbandry and, ultimately, good “caretaking.” The kit includes a 21-page teacher’s guide consisting of six lessons, a CD containing reproducible photos and activity sheets for each lesson, and more. This resource is aligned with California Content Standards.

Celebrate America

This social studies supplement provides students the opportunity to explore the foods and traditions of their own individual cultural backgrounds and gather information about how and when their families came to America. The kit includes a video, leader’s guide containing activity masters, and a full-color poster. This resource is aligned with California Content Standards.

Safe Food Journey

This is a colorful, poster-size illustration of the safe food journey that our food takes from the farm to our tables. The reverse side contains a teacher’s guide and six reproducible student activities.

Things We Can Learn From a Cow and a Worm

Colorful education poster with accompanying activities demonstrates the positive role ruminants, especially cattle, play in our environment. A teacher’s guide and reproducible master are printed on the reverse side. This resource is aligned with California Content Standards.



California Foundation for
Agriculture in the Classroom

Teacher Resources and References

Wow That Cow

An informational tri-fold brochure designed for kids to understand the many significant contributions cattle provide for humans and the environment. Also includes by-products information and nutritional information about beef.

California Beef Council
4640 Northgate Boulevard, Suite 115
Sacramento, CA 95834
Phone: (916) 925-2333
Fax: (916) 925-8155
E-mail: askus@calbeef.org
Website: www.calbeef.org
Website: www.teachfree.com
Website: www.beefnutrition.org
Website: www.zip4tweens.com

California Foundation for Agriculture in the Classroom

Beef Fact and Activity Sheet

This California-specific fact sheet includes information on beef production, history, and economic value. The activity sheet provides lesson ideas and interesting facts on beef.

Dairy Fact and Activity Sheet

This California-specific fact sheet includes information on dairy production, history, nutrition, and economic value. The activity sheet provides specific lesson ideas and interesting facts on the dairy industry.

Egg Fact and Activity Sheet

This California-specific fact sheet includes information on egg production, history, and economic value. The activity sheet provides lesson ideas and interesting facts about eggs.

Milk Matters: Discovering Dairy

Students discover the many different aspects of life on a dairy farm. From investigating the historical significance of dairy breeds to conquering mathematical business challenges, students will understand why milk matters. This five-lesson unit meets the California State Content Standards in each academic area.

Presidential Turkey Activity Guide

This four-page guide introduces students to the history of our nation's Presidential Turkey tradition and engages them with activities about the popular poultry. English language arts, history-social science, math, science, and health education are incorporated. Aligned to the Content Standards for California Public Schools.

California Foundation for Agriculture
in the Classroom
2300 River Plaza Drive
Sacramento, CA 95833-3293
Phone: (916) 561-5625
Toll free: (800) 700-AITC
Fax: (916) 561-5697
E-mail: info@LearnAboutAg.org
Website: www.LearnAboutAg.org

Dairy Council of California

Dairy Detectives

This interactive CD-ROM helps students learn about nutrition, dairy cows, and the production of dairy products with activities that support core curriculum.

Dairy Council of California
1101 National Drive, Suite B
Sacramento, CA 95834
Phone: (916) 263-3560
Fax: (916) 263-3566
E-mail: info@dairycouncilofca.org
Website: www.dairycouncilofca.org
Website: www.mealsmatter.org



California Foundation for
Agriculture in the Classroom

Teacher Resources and References

Hilmar Cheese Company

Cow to Calcium Virtual Tour

Join “Daisy” as she takes you on a virtual tour from “Cow to Calcium.” Education section of website features virtual tour (with animated graphics) and printable activity pages.

View www.hilmarcheese.com/CowTour.cms.

Daisy Dairy ABC’s All aBout Cheese

This student activity booklet, aligned to the state content standards, provides information on cows, cheese production, recycling, and careers in agriculture.

Hilmar Cheese Company Visitor Center
9001 North Lander Avenue
Hilmar, CA 95324
Phone: (209) 656-1196
Toll free: (800) 577-5772
Fax: (209) 656-1116
E-mail: dskidmore@hilmarcheese.com
Website: www.hilmarcheese.com

Illinois Agriculture in the Classroom

Ag Bag Lessons

This series focuses on 10 different commodities. Each unit encourages the use of a particular literature book that relates to the topic and includes activities and lesson ideas. Commodities include corn, apples, horses, sheep, pork, pumpkins, dairy, farm safety, pizza, and soybeans.

A Hog Ate My Homework: Activity Book

Designed to complement the book “A Hog Ate My Homework,” by Gary Metivier, this resource includes lesson plans and activities intended to be used in the classroom as supplemental learning material. Activities reinforce science, health and nutrition, reading, math, social studies, and writing skills. An answer sheet for each activity is also included.

Illinois Agriculture in the Classroom
1701 Towanda Avenue
Bloomington, IL 61702
Phone: (309) 557-3334
Fax: (309) 557-2098
E-mail: aitc@ilfb.org
Website: www.aginthe classroom.org

Iowa Turkey Federation

Turkey Production

This 15-minute video (VHS or DVD) shows how turkeys grow in the egg, hatch, and are raised.

Iowa Turkey Federation
Post Office Box 825
Ames, IA 50010
Phone: (515) 232-7492
Fax: (515) 232-2825
E-mail: info@iowaturkey.org
Website: www.iowaturkey.com

Kern County CattleWomen

Cattle Country

This four-page, full-color pamphlet is designed to teach children about life on a cattle ranch, beef nutrition, and everyday by-products. The pamphlet uses kid-friendly activities such as “I Spy,” word searches, crosswords, drawing, and other fun activities.



California Foundation for
Agriculture in the Classroom

Teacher Resources and References

Life on a Cattle Ranch: A Child's Perspective

In this 11-minute video, California ranch children tell their story. Students will learn about youth responsibilities, the various ways ranchers care for their animals, and the adventure of participating in a cattle drive. Includes a "Guide to Ranch Life" agricultural magazine for students.

Kern County CattleWomen
22474 Walser Road
Caliente, CA 93518
Phone: (661) 867-2906
E-mail: kcteachersag@aol.com

National 4-H Cooperative Curriculum System, Inc.

Dairy Cattle Youth Activity Guide Set

This set includes three dairy cattle activity guides and a helper's guide. Youth build their dairy knowledge and skills as they complete the hands-on activities included in this series.

Dairy Goat Youth Activity Guide Set

This set includes three dairy goat activity guides and a helper's guide. Whether it's exploring goat management, selection, health, reproduction, showing, judging products, or careers, youth will expand their dairy goat knowledge and skills. Participants will also practice the life skills of record keeping, decision making, leadership, communication, planning and organizing, and more.

Embryology Helper's Guides

Guides titled "Experiments in Poultry Science" and "Hatching Classroom Projects" are designed to provide educators with background information and experimental activities related to life science. Correlated to the National Science Education Standards.

Meat Goat Youth Activity Guide Set

This set includes three meat goat activity guides and a helper's guide. The series engages youth in activities related to breeds, health care, grooming, production, reproduction, management, showmanship, marketing, and careers.

Poultry Youth Activity Guide Set

This set includes three poultry activity guides and a helper's guide. Each guide introduces students to a variety of poultry facts and knowledge, including poultry anatomy, eggs, feathers, careers, and more.

Sheep Youth Activity Guide Set

This set includes three sheep activity guides and a helper's guide. Youth and volunteers will enjoy these experimentally based project materials as they explore age-appropriate content, including activities related to breeds, health, nutrition, production, management, and beyond the show ring.

Swine Youth Activity Guide Set

This set includes three swine activity guides and a helper's guide. Each guide introduces students to age-appropriate content, including activities related to breeds, health, nutrition, production, management, and beyond the show ring.

Veterinary Science Youth Activity Guide Set

This series will lead youth through an exploration of the exciting world of veterinary science. Students will practice science skills and discover vet science-related careers. Includes three vet science activity guides and a helper's guide.

National 4-H Cooperative Curriculum System, Inc.
405 Coffey Hall, 1420 Eckles Avenue
St. Paul, MN 55108-6068
Phone: (612) 624-4900
Toll free: (800) 876-8636
E-mail: shopext@umn.edu
Website: www.n4hccs.org/afterschoolag
Website: www.4-hmall.org



Teacher Resources and References

National Farm-City Council

It's a PUZZLEment!

This classroom activity kit focuses on products made from cotton, wool, and leather. Includes background information and classroom-ready handouts. Lessons are aligned to national standards.

National Farm-City Council
Post Office Box 6825
Reading, PA 19610
Phone: (877) 611-8161
E-mail: contact@farmcity.org
Website: www.farmcity.org

National Institute of Food and Agriculture

Living Science

This set of full-color 8½" x 11" posters depicts 40 science-related careers in food, agriculture, and natural resources. On the back, each includes information on the types of jobs available in those career areas and how high school students can prepare for those jobs.

National Institute of Food and Agriculture
1400 Independence Avenue SW, Mail Stop 2215
Washington, DC 20250-2215
Phone: (202) 720-2727
Fax: (202) 690-0062
E-mail: rali@nifa.usda.gov
Website: www.nifa.usda.gov
Website: www.agclassroom.org

National Pork Board

The Amazing Pig

This DVD takes viewers on a journey to a modern hog farm. Introducing students to pork production helps them understand how pigs are fed and cared for and the contributions pork products make in our society.

Food Fun for Kids

Colorful neon bookmarks have a pork nutrition puzzle on one side and an easy pork recipe for kids on the other side.

Producers, Pigs & Pork Teacher's Resource Guide

A set of five lessons that address our food supply system, with a focus on pork production. This guide includes a variety of lessons and activities which enhance standards and skills.

Producers, Pigs, and Pork Storybook

This storybook is an illustrated adventure about a boy's visit to a modern swine production facility. Contains facts and color photos. A teacher's resource guide is also available.

National Pork Board
1776 NW 114th Street
Clive, IA 50325
Phone: (515) 223-2600
Fax: (515) 309-6127
E-mail: info@pork.org
Website: www.otherwhitemeat.com
Website: www.pork.org
Website: www.porkstore.pork.org



California Foundation for
Agriculture in the Classroom

Teacher Resources and References

Nebraska Foundation for Agricultural Awareness

A Peek at Pork

This packet contains “The Amazing Pig” DVD and teacher’s guide with lessons about mapping, the food chain, pork products, food processing, and nutrition.

Livestock Cards

This full-color set of six cards provides illustrations about livestock, including beef cattle, sheep, dairy cattle, poultry, swine, and a vocabulary card. The back side of the card has basic information about each species.

Nebraska Foundation for Agricultural Awareness
5225 South 16th Street
Lincoln, NE 68512
Phone: (402) 421-4408
E-mail: ellenh@nefb.org
Website: www.agclassroom.org/ne

Pendleton Woolen Mills

Wool Packet

Packet includes wool chart and booklet about wool production. A video describing the story of Pendleton is also available.

Pendleton Woolen Mills
Education and Testing Department
Post Office Box 3030
Portland, OR 97208-3030
Fax: (503) 535-5794
E-mail: education@pendleton-usa.com
Website: www.pendleton-usa.com

Sons of the San Joaquin

Sons of the San Joaquin

This musical group has a passion for educating others about cowboys and cattle. “The Sons Sing for the Young and the Young at Heart” is a collection of music which has accompanying educational materials. School visits are also available.

Sons of the San Joaquin
491 Herndon Avenue #253
Clovis, CA 93612
Toll free: (888) THE SONS
Website: www.thesons.com

Pennsylvania Dairy Promotion Board

Discover Dairy

Each lesson plan in this dairy-related series includes a four-minute video clip, complete lesson plan, guided reading pamphlet, and assessment worksheet. The website features supplemental materials including interactive games for students. Copies of the videos, in DVD format, are available by request.

Pennsylvania Dairy Promotion Program
2301 N. Cameron Street, Room 311
Harrisburg, PA 17110
Phone: (717) 787-6903
Fax: (717) 783-2344
E-mail: lperrin@milk4u.org
Website: www.discoverdairy.com



California Foundation for
Agriculture in the Classroom

Teacher Resources and References

The Great American Animal Entertainment Company

Animal Adventures at the Farm

This educational animal coloring and activity book describes many different animals one could find on a farm. Non-traditional farm animals such as wallabies and llamas are also described.

The Great American Animal
Entertainment Company
Post Office Box 2304
Grants Pass, OR 97528
Phone: (541) 512-1100
Fax: (541) 512-1800
E-mail: info@greatamericanpettingzoo.com
Website: greatamericanpettingzoo.com

Smithsonian National Zoological Park

Smithsonian National Zoological Park

The National Zoo has a live and virtual kids farm. Enjoy viewing this interactive Kids' Farm website geared for young students. Learn some specifics about farm animals such as chickens, sheep, and goats.

Smithsonian National Zoological Park
3001 Connecticut Avenue NW
Washington, DC 20008
Phone: (202) 633-4800
E-mail: education@fonz.org
Website: nationalzoo.si.edu/Animals/KidsFarm

University of California Cooperative Extension

Our Rangelands

This curriculum introduces rangelands, their functions, why they are important, and how to protect them. Each of the five thematic units feature multiple lesson plans for classroom use. Lessons include "What Comes from the Range?," "We Are All Water Stewards," "Let's Make Mudshakes," and more.

University of California Cooperative Extension
Sonoma County, Division of Agriculture and
Natural Resources
133 Aviation Boulevard, Suite 109
Santa Rosa, CA 95403-2894
Phone: (707) 565-2621
Fax: (707) 565-2623
E-mail: slarson@ucdavis.edu
Website: http://cesonoma.ucdavis.edu/Livestock_and_Range_Management/Our_Rangelands_Curriculum/

Related Websites

This list is offered as an informational resource only. It contains websites established by various entities and at the time of printing included information related to animal agriculture and agriculture-related careers. The list is not considered to be all-inclusive. The entities or contents of the sites on this list are not endorsed by the California Foundation for Agriculture in the Classroom or by the authors of *“Steer” Toward STEM: Careers in Animal Agriculture*.

Agripedia

www.ca.uky.edu/agripedia

Alltech

www.alltech.com/kidzone

American Beefalo International

www.americanbeefalo.org

American Egg Board

www.aeb.org

American Farm Bureau Foundation for Agriculture

www.myamericanfarm.org

www.agricultureslastingheritage.org

American Horse Council

www.horsecouncil.org

American Quarter Horse Association

www.aqha.com

American Sheep Industry Association

www.sheepusa.org

American Society of Agricultural and Biological Engineers

www.asabe.org

American Society of Animal Science

www.animalsmart.org

Beef Checkoff for Educators

www.teachfree.com

Beef for Foodservice Professionals

www.beeffoodservice.com



California Foundation for
Agriculture in the Classroom

Related Websites

Beefnutrition.org

www.beefnutrition.org

Cabot Vermont

www.cabotcheese.com

California Beef Council

www.calbeef.org

California Department of Food and Agriculture, Kids' Page

www.cdffa.ca.gov/kids/

California Milk Advisory Board

www.RealCaliforniaMilk.com

California Poultry Federation

www.cpi.org

California State Fair

www.bigfun.org

California Thoroughbred Breeders Association

www.ctba.com

Centennial Farm

www.ocfair.com/farm

Center for Food Integrity

www.bestfoodfacts.org

Certified Angus Beef

www.certifiedangusbeef.com

Colusa Farm Show

www.thefarmshow.com

COSI Columbus

www.cosi.org/online-activities

Council for Agricultural Science and Technology

www.cast-science.org

Dairy America

www.dairyamerica.com



California Foundation for
Agriculture in the Classroom

Related Websites

Dairy Council of California

www.dairycouncilofca.org

Egg Nutrition Center

www.eggnutritioncenter.org

Fight BAC!

www.fightbac.org

Florida Department of Agriculture and Consumer Services

www.florida-agriculture.com/kids/education/planetag

Food Safety and Inspection Service

www.fsis.usda.gov/OA/foodsafetymobile/mobilegame.swf

Fur Commission USA

www.furcommission.com

Gateway to Government Food Safety Information

www.foodsafety.gov

Handweavers Guild of America, Inc.

www.weavespindye.org

Hilmar Cheese Company

www.hilmarcheese.com

International Food Information Council

www.foodinsight.org

Iowa Turkey Federation

www.iowaturkey.com

Moo Milk

www.moomilk.com

National Cattlemen's Beef Association

www.beef.org

National Dairy Council

www.nationaldairycouncil.org



California Foundation for
Agriculture in the Classroom

Related Websites

National Pork Board

www.porkbeinspired.com

National Turkey Federation

www.eatturkey.com

NSF International

www.scrubclub.org

Pacific Coast Quarter Horse Association

www.pcqha.com

Pendleton Woolen Mills

www.pendleton-usa.com

Pennsylvania Dairy Promotion Program

www.discoverdairy.com

Pork Checkoff

www.pork.org

Purina Mills Dairy

dairy.purinamills.com

Real California Cheese

www.realcaliforniacheese.com

Sci4Kids

www.ars.usda.gov/is/kids

Sloan Career Cornerstone Center

www.careercornerstone.org

Tennessee Walking Horse Breeders' and Exhibition Association

www.twhbea.com

The Incredible Edible Egg

www.incredibleegg.org

USDA Higher Education Programs

www.agriculture.purdue.edu/USDA/careers

Related Literature

Anderson, Susan and JoAnne Buggy. *Pigs and Pork in the Story of Agriculture*. Northwest Arm Press, 2009. This colorful book introduces elementary students to the five stages of pigs and pork as they make their way from farm to table. ISBN 978-1-926781-01-3

Artley, Bob. *Once Upon a Farm*. Pelican Publishing Company, 2000. Through detailed illustrations and text, this book shows the seasons of an old-time farm. ISBN 978-1-56554-753-7

Atwell, Debby. *Barn*. Houghton Mifflin Company, 2001. Using text and paintings, the life of a country barn is followed from the late eighteenth-century to the present day. ISBN 978-0-395-78568-3

Brady, Peter. *Ovejas*. Bridgestone Books, 1999. This book, with Spanish text, shows the raising and caring of sheep. ISBN 978-1-56065-790-3

Brady, Peter. *Vacas*. Bridgestone Books, 1999. This book, with Spanish text, shows the raising and caring of cattle. ISBN 978-1-56065-788-0

Bregoli, Jane. *The Goat Lady*. Tilbury House Publishers, 2004. A story about a lady who raises goats and helps others in need. ISBN 978-0-88448-309-0

Chaney, Rianna and Sheridan. *Little Star... Raising Our First Calf*. Down Under Publications, 2008. The Chaney twins, living on a farm with their parents, get the responsibility of raising their first farm animal. ISBN 978-0-9818468-0-4

Cooper, Elisha. *Farm*. Scholastic, 2010. Describes the activities throughout the year on a busy family farm. ISBN 978-0-545-07075-1

Cowley, Joy. *Where Horses Run Free*. Boyds Mills Press, 2003. A story about a cowboy who discovers wild mustangs have been captured and wants to set them free. ISBN 978-1-59078-062-6

DeLaCroix, Alice. *The Best Horse Ever*. Holiday House, 2010. Abby's going to finally have her very own horse: Griffin, a beautiful bay. As Abby learns how to manage her new horse, she also learns how to maintain an old friendship. ISBN 978-0-8234-2254-8

Ekarius, Carol. *Pocketful of Poultry*. Storey Publishing, 2007. In this handbook, discover interesting facts about chickens, turkeys, ducks, and geese. ISBN 978-1-58017-677-4

Related Literature

Enderle, Dotti. *Crosswire*. Boyds Mills Press, 2010. The cruel Texas drought of 1883 has Jesse and his family in turmoil. Crops are drying out, desperate free-range cattlemen are cutting fences and trespassing with their thirsty herds, threatening the family's precious water supply. ISBN 978-1-59078-751-9

Gibbons, Gail. *Pigs*. Holiday House, 2000. This book outlines the characteristics, habits, and uses of pigs. ISBN 978-0-8234-1554-0

Gibbons, Gail. *The Milk Makers*. Aladdin, 1987. Text and pictures explain how cows produce milk and how it is processed before being delivered to stores. ISBN 978-0-689-71116-9

Gunderson, Mary. *Cowboy Cooking*. Blue Earth Books, 2000. Learn about roundups and trail drives through the recipes cowboys enjoyed throughout history. ISBN 978-0-7368-0353-3

Hall, Margaret. *Cows and Their Calves*. Capstone Press, 2003. This nonfiction primary reader shows how calves are raised to become mature adults. ISBN 978-0-7368-2105-6

Hodges, Meredith. *Jasper: The Story of a Mule*. Lucky Three Productions, 2003. A heartwarming story that introduces children to mules and donkeys in an educational and entertaining way. ISBN 978-0-9702309-8-0

Icenoggle, Jodi. *'Til the Cows Come Home*. Boyds Mills Press, 2004. A resourceful cowboy finds a way to use one beautiful piece of leather in a variety of situations, making the piece last 'til the cows come home. ISBN 978-1-59078-800-4

Kalman, Bobbie. *In the Barn*. Crabtree Publishing, 1997. Find out about the history of the farm and the daily chores to be done. ISBN 978-0-86505-463-9

Kalman, Bobbie. *Life on the Ranch*. Crabtree Publishing Company, 1999. Provides historical information on ranchers of the Old West. Colorful pictures and photographs illustrate the complexity of this way of life. ISBN 978-0-7787-0103-3

Keeler, Patricia A. and Francis X. McCall, Jr. *Unraveling Fibers*. Atheneum, 1995. Text and photos show the raising and processing of natural fibers from plants and animals. ISBN 978-0-689-31777-4

Related Literature

Longenecker, Theresa. *Who Grows Up on the Farm? A Book About Farm Animals and Their Offspring*. Picture Window Books, 2002. Full-color illustrations and fact-filled text discuss the various kinds of babies that grow up on a farm. Includes factual charts and tables.
ISBN 978-1-4048-0029-8

Metivier, Gary. *A Hog Ate My Homework*. Wild Horses Publishing, 2009. Willie learns firsthand what a working farm is really like when sent to visit his aunt and uncle on an Iowa farm.
ISBN 978-0-9818946-0-7

Older, Jules. *Cow*. Charlesbridge, 1998. A lighthearted, nonfiction book on cows, breeds, and milk production. ISBN 978-0-88106-956-3

Older, Jules. *Pig*. Charlesbridge, 2004. This entertaining book contains lots of facts and trivia about pigs. Various pig breeds are described and the origins of each are listed. ISBN 978-0-88106-109-3

Paulsen, Gary. *The Haymeadow*. Yearling, 1994. John Barron is asked to spend the summer taking care of six sheep and is not quite sure how he will survive. ISBN 978-0-440-40923-6

Peterson, Cris. *Amazing Grazing*. Boyds Mills Press, 2002. Learn about grazing by examining real ranches throughout the country.
ISBN 978-1-56397-942-2

Peterson, Cris. *Clarabelle: Making Milk and So Much More*. Boyds Mills Press, 2007. This book is about how cows produce much more than just milk. ISBN 978-1-59078-310-8

Peterson, Cris. *Extra Cheese, Please!* Boyds Mills Press, 1994. Follow the cheese-making process from cow to pizza topping.
ISBN 978-1-56397-177-1

Pitts, Zachary. *The Pebble First Guide to Horses*. Capstone Press, 2008. A basic field guide format introduces 13 horse breeds.
ISBN 978-1-4296-2802-0

Pukite, John. *A Field Guide to Cows*. Penguin Books, 1998. Describes the 52 breeds of cattle in a format that assists in their identification.
ISBN 978-0-14-027388-5

Related Literature

Ray, Hannah. *Chickens*. Crabtree Publishing, 2008. In this book, learn about chicken anatomy, life cycle, different breeds, and uses. ISBN 978-0-7787-4050-6

Ray, Hannah. *Cows*. Crabtree Publishing, 2008. Read about cow anatomy, life cycle, different breeds, and uses. ISBN 978-0-7787-4051-3

Ray, Hannah. *Pigs*. Crabtree Publishing, 2008. In this book, learn that pigs are great swimmers, that they use mud as suntan lotion, and that the largest pig weighed the same as 14 grown men. ISBN 978-0-7787-4055-1

Ray, Hannah. *Sheep*. Crabtree Publishing, 2008. Identify the sheep's body parts, its life cycle, and why sheep live on a farm. ISBN 978-0-7787-4056-8

Rice, James. *Trail Drive*. Pelican Publishing Company, 1996. In a non-traditional writing style, learn about Texas cattle drives through Texas Jack, a jackrabbit. ISBN 978-1-56554-163-4

Rodenas, Paula. *The Random House Book of Horses and Horsemanship*. Random House, 1997. This nonfiction book describes in great detail horse history, anatomy, behavior, breeds, care, and training. ISBN 978-0-679-88726-3

Sandin, Joan. *Coyote School News*. Henry Holt and Company, 2003. This story, about students who attend Coyote School, is based on a collection of newsletters written by Arizona ranch country schools between 1932 and 1943. ISBN 978-0-8050-6558-9

Schuh, Mari C. *Cows on the Farm*. Capstone Press, 2001. Learn, through photographs and primary text, how farmers raise cows. ISBN 978-0-7368-0992-4

Schuh, Mari C. *Sheep on the Farm*. Capstone Press, 2001. Through photographs, this emerging reader discusses sheep that are raised for meat, wool and milk. ISBN 978-0-7368-0994-8

Simmons, Lynn Sheffield. *Sugar Lump, The Orphan Calf*. Pelican Publishing Company, 2009. Sugar Lump, a quirky orphan calf, needs someone to care for him, and Marcy accepts the responsibility. As the calf grows, he and Marcy experience many adventures and form a unique bond. ISBN 978-1-58980-216-2

Related Literature

Singer, Marilyn. *Eggs*. Holiday House, 2008. This picture book contains many surprising facts about eggs and the resourceful methods used to protect them. ISBN 978-0-8234-1727-8

Slade, Suzanne. *What if There Were No Bees?* Picture Window Books, 2011. A book about the grassland ecosystem showing what would happen to the ecosystem if bees disappeared. ISBN 978-1-4048-6019-3

Sloat, Teri. *Farmer Brown Shears His Sheep*. Scholastic, 2001. In this whimsical picture book with simple text, learn how a sheep is sheared and how the wool is processed and made into colorful sweaters. ISBN 978-0-7894-2637-6

Stanley, Jerry. *Cowboys & Longhorns: A Portrait of the Long Drive*. Crown Books for Young Readers, 2003. This true story about longhorn cattle and American cowboys includes excerpts from firsthand accounts, photos, maps, and more. ISBN 978-0-375-91565-9

Urbigkit, Cat. *A Young Shepherd*. Boyds Mills Press, 2006. Follow the life of a young kid who works on a sheep farm. ISBN 978-1-59078-364-1

Urbigkit, Cat. *Brave Dogs, Gentle Dogs*. Boyds Mills Press, 2005. This book explains how guardian dogs and sheep form bonds that last a lifetime. ISBN 978-1-59078-317-7

Urbigkit, Cat. *Cattle Kids*. Boyds Mills Press, 2007. Cowboys and cowgirls take part in many aspects of livestock operations. ISBN 978-1-59078-508-9

Urbigkit, Cat. *The Shepherd's Trail*. Boyds Mills Press, 2008. This book is about a shepherd's trail of herding sheep from breeding season to lambing season. ISBN 978-1-59078-509-6

Wallace, Bill and Carol. *That Doggone Calf*. Holiday House, 2009. Cookie, a calf, thinks he is going to be in charge of the cattle, but Hoss, the dog, is not about to give up his job. ISBN 978-0-8234-2228-9

Wolfman, Judy. *Life on a Goat Farm*. Carolrhoda Books, 2001. Describes the practices that occur on a goat farm and includes information on breeds, care, milking, and more. ISBN 978-1-57505-515-2

Matrix of Standards

3rd Grade

Standard	Description	Significant Surroundings	Build It Better	Roll of the Genes	Got Guts?	Homes on the Range
Science						
Life Sciences 3a	Students know plants and animals have structures that serve different functions in growth, survival, and reproduction.			x	x	
Life Sciences 3b	Students know examples of diverse life forms in different environments, such as oceans, deserts, tundra, forests, grasslands and wetlands.	x				x
Life Sciences 3c	Students know living things cause changes in the environment in which they live; some of these changes are detrimental to the organism or other organisms, and some are beneficial.					x
Life Sciences 3d	Students know when the environment changes, some plants and animals survive and reproduce; others die or move to new locations.	x				
Investigation and Experimentation 5c	Use numerical data in describing and comparing objects, events, and measurements.	x				
Investigation and Experimentation 5d	Predict the outcome of a simple investigation and compare the result with the prediction.	x				
Investigation and Experimentation 5e	Collect data in an investigation and analyze those data to develop a logical conclusion.	x		x		
English Language Arts						
Reading Informational Text 3.1	Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.	x				
Reading Informational Text 3.4	Determine the meaning of general academic and domain specific words and phrases in a text relevant to a <i>grade 3 topic or subject area</i> .			x		
Reading Informational Text 3.7	Use information gained from illustrations (e.g., maps, photographs) and the words in a text to demonstrate understanding of the text (e.g., where, when, why, and how key events occur).		x		x	x

Matrix of Standards

3rd Grade

Standard	Description	Significant Surroundings	Build It Better	Roll of the Genes	Got Guts?	Homes on the Range
Writing 3.2	Write informative/explanatory texts to examine a topic and convey ideas and information clearly.	x				
Writing 3.7	Conduct short research projects that build knowledge about a topic.		x		x	x
Language 3.6	Acquire and use accurately grade-appropriate conversational, general academic, and domain-specific words and phrases, including those that signal spatial and temporal relationships.				x	
Speaking and Listening 3.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 3 topics and texts, building on others' ideas and expressing their own clearly.	x				
Speaking and Listening 3.4	Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace.		x			
Mathematics						
3.MP.1	Make sense of problems and persevere in solving them.					x
3.MP.4	Model with mathematics		x			
3.MP.7	Look for and make use of structure.					x
3.NF.1	Understand a fraction as $1/b$ as the quantity formed by 1 part when a whole is partitioned into b equal parts; understand a fraction as a/b as the quantity formed by parts of size $1/b$.	x		x		
3.MD.3	Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one-and two-step "how many more" and "how many less" problems using information presented in scaled graphs.	x				
3.MD.4	Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch.		x			

Matrix of Standards 3rd Grade

Standard	Description	Significant Surroundings	Build It Better	Roll of the Genes	Got Guts?	Homes on the Range
3.MD.8	Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or the same area and different perimeters.		x			
Health Education						
Growth and Development 1.3.G	Identify major internal and external body parts and their functions.				x	



Matrix of Standards 4rd Grade

Standard	Description	Significant Surroundings	Build It Better	Roll of the Genes	Got Guts?	Homes on the Range
Science						
Life Sciences 2a	Students know plants are the primary source of matter and energy entering most food chains.					x
Life Sciences 3a	Students know ecosystems can be characterized by their living and nonliving components.	x				x
Life Sciences 3b	Students know that in any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all.	x				
Life Sciences 3d	Students know that most microorganisms do not cause disease and that many are beneficial.				x	
Investigation and Experimentation 6e	Construct and interpret graphs from measurements.	x				
Investigation and Experimentation 6f	Follow a set of written instructions for a scientific investigation.	x		x		
English Language Arts						
Reading Informational Text 4.1	Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.	x				
Reading Informational Text 4.4	Determine the meaning of general academic and domain specific words or phrases in a text relevant to a <i>grade 4 topic or subject area</i> .			x		
Reading Informational Text 4.7	Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.		x		x	
Writing 4.2	Write informative/explanatory texts to examine a topic and convey ideas and information clearly.	x				
Writing 4.7	Conduct short research projects that build knowledge through investigation of different aspects of a topic.		x		x	x



Matrix of Standards 4rd Grade

Standard	Description	Significant Surroundings	Build It Better	Roll of the Genes	Got Guts?	Homes on the Range
Language 4.6	Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases, including those that signal precise actions, emotions, or states of being and that are basic to a particular topic.				x	x
Speaking and Listening 4.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly.	x				
Speaking and Listening 4.4	Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.	x	x			
Mathematics						
4.MP.1	Make sense of problems and persevere in solving them.					x
4.MP.4	Model with mathematics.		x			
4.MP.7	Look for and make use of structure.					x
4.NF.1	Explain why a fraction a/b is equivalent to a fraction $(n \times a)/(n \times b)$ by using visual fraction models, with attention to how the number and size of the parts differ even though the two fractions themselves are the same size. Use this principle to recognize and generate equivalent fractions.	x				
4.NF.3b	Decompose a fraction into a sum of fractions with the same denominator in more than one way, recording each decomposition by an equation. Justify decompositions, e.g., by using a visual fraction model.			x		

Matrix of Standards

5th Grade

Standard	Description	Significant Surroundings	Build It Better	Roll of the Genes	Got Guts?	Homes on the Range
Science						
Life Sciences 2c	Students know the sequential steps of digestion and the roles of teeth and the mouth, esophagus, stomach, small intestine, large intestine, and colon in the function of the digestive system.				x	
Investigation and Experimentation 6b	Develop a testable question.	x				
Investigation and Experimentation 6c	Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure.		x			
Investigation and Experimentation 6g	Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data.	x		x		
Investigation and Experimentation 6i	Write a report of an investigation that includes conducting tests, collecting data or examining evidence, and drawing conclusions.	x				
English Language Arts						
Reading Informational Text 5.3	Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text.	x				
Reading Informational Text 5.4	Determine the meaning of general academic and domain specific words or phrases in a text relevant to a <i>grade 5 topic or subject area</i> .			x		
Reading Informational Text 5.7	Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.		x		x	x
Reading Informational Text 5.9	Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.	x				
Writing 5.2	Write informative/explanatory texts to examine a topic and convey ideas and information clearly.	x				

Matrix of Standards

5th Grade

Standard	Description	Significant Surroundings	Build It Better	Roll of the Genes	Got Guts?	Homes on the Range
Writing 5.7	Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.		x		x	x
Language 5.6	Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases, including those that signal contrast, addition, and other logical relationships.				x	x
Speaking and Listening 5.4	Report on a topic or text or present an opinion, sequencing ideas logically and using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.		x			
Mathematics						
5.MP.1	Make sense of problems and persevere in solving them.					x
5.MP.4	Model with mathematics.		x			
5.MP.7	Look for and make use of structure.					x

Glossary

Auction yard: A business where the public may purchase livestock by competitively bidding on an animal, or a herd of animals.

Behavior: The way in which an animal acts in response to a particular situation or stimulus.

Breed: To cause (an animal) to produce offspring, typically in a controlled and organized way.

Browse: To feed on leaves, twigs, or other high-growing vegetation.

Cattle chute: A narrow corridor built for cattle, sheep, pigs, and other animals to travel through when being moved from one location to another.

Corral: A circular enclosure for livestock.

Cultivate: To prepare and use land for crops.

Diet: The types of food that an animal habitually eats.

Domestic: An animal that is tamed and kept by humans.

Environment: The surroundings or conditions in which a person, animal, or plant lives or operates.

Feedlot: A facility where cattle are fed to produce beef for the commercial trade.

Fertilizer: A substance, chemical or natural, that is added to soil or land to increase its fertility.

Forage: Herbaceous plants or plant parts fed to domestic animals.

Gene: A unit of heredity that is transferred from parent to offspring and determines some characteristic of the offspring.

Graze: To feed on grass.

Habitat: A particular type of environment regarded as a home for organisms.

Handling: The manner in which an animal is treated.

Glossary

Heredity: The transmission of genetic characters from parents to offspring.

Implement: A tool or instrument used in doing work.

Invasive: Tending to spread prolifically and undesirably or harmfully.

Irrigation: The artificial application of water to the land or soil.

Livestock: Domesticated animals raised in an agricultural setting to produce commodities such as food, fiber, and labor.

Microorganism: Any organism, such as a bacterium, protozoan, or virus, of microscopic size.

Native: An organism indigenous to a particular region.

Offspring: The descendants of a person, animal, or plant.

Physiology: The scientific study of function in living systems.

Preference: A greater liking for one alternative over another.

Ranch: A large farm for the rearing of livestock.

Species: A group of organisms capable of interbreeding and producing fertile offspring.

Threatened: Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Trait: A genetically determined characteristic.

Well-being: The contentment of an animal. Measured by indicators including behavior, physiology, longevity, and reproduction.