CASE

# Principles of Agricultural Science – Animal
# Expanded Lesson Review

The following is a complied listing of the concepts, performance objectives, standards alignments, and essential questions by lesson.

## Lesson 1.1 Animal Planet

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Organization and record keeping are important to the success of an agricultural business. | • Develop and keep an Agriscience Notebook to record and store information presented in classroom discussions and activities throughout the course. (Activity 1.1.1)<br>• Select an animal to research throughout the course and develop a format for developing a management guide. (Project 1.1.4) |
| 2. Career opportunities exist in animal agriculture for all levels of education in the areas of production, processing, marketing, and regulation. | • Develop a presentation about an animal industry and related careers to share with the class. (Activity 1.1.2)<br>• Document and record animal industries and career opportunities shared during student presentations. (Activity 1.1.2) |
| 3. Animals serve many purposes in the lives of humans including providing life-sustaining products such as meat, milk, and fiber. | • Determine and analyze their usage of various animal products over the course of one day. (Activity 1.1.3)<br>• Develop a list of animal products commonly used based on former knowledge. (Activity 1.1.3) |

### National AFNR Career Cluster Content Standards Alignment

| AFNR: Agribusiness Systems Career Pathway Content Standards | |
|---|---|
| **ABS.03.** | Utilize record keeping to accomplish AFNR business objectives while complying with laws and regulations. |

| AFNR: Animal Systems Career Pathway Content Standards | |
|---|---|
| **AS.01.** | Examine the components, historical development, global implications, and future trends of the animal systems industry. |

### Common Core State Standards for English Language Arts

| CCSS: English Language Arts Standards » Writing » Grade 9-10 | |
|---|---|
| **Research to Build and Present Knowledge** | • **WHST.9-10.8 –** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.<br>• **WHST.9-10.9 –** Draw evidence from informational texts to support analysis, reflection, and research. |

## Essential Questions

1. What are the benefits of keeping an *Agriscience Notebook*?
2. Why is it important to keep a notebook and records organized?
3. How does keeping accurate records help the success of an agricultural business?
4. How do animals contribute to daily life?
5. What are the industries within animal agriculture?
6. What are by-products?
7. Differentiate between animal production, processing, marketing, and regulation.
8. What is the difference between a companion animal and a production animal?
9. What non-consumable items are produced from animals?
10. How can I develop my interest of animals into a career?

# Lesson 2.1 Taming Animals

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Domestication of animals is achieved through breeding, handling, and training. | • Conduct behavioral and historical research on a variety of animals. (Activity 2.1.1)<br>• Compare domestic and wild animals using the characteristics of domestication. (Activity 2.1.1) |
| 2. Animal species were domesticated at different times throughout history for the benefit of the animals and humans. | • Design a timeline recording the history of an animal. (Project 2.1.2)<br>• Examine the development and domestication of a common animal over time. (Project 2.1.2)<br>• Present to the class historical data collected regarding a selected animal species. (Project 2.1.2) |

## National AFNR Career Cluster Content Standards Alignment

| AFNR: LifeKnowledge® and Cluster Skills Content Standards | |
|---|---|
| **CS.04.** | Systems: Examine roles within teams, work units, departments, organizations, inter-organizational systems, and the larger environment. |

| AFNR: Animal Systems Career Pathway Content Standards | |
|---|---|
| **AS.01.** | Examine the components, historical development, global implications, and future trends of the animal systems industry. |

## Next Generation Science Standards Alignment

| Engineering, Technology, and the Application of Science | |
|---|---|
| **Science and Engineering Practices** | |
| **Obtaining, Evaluating, and** | Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. |

| | |
|---|---|
| **Communicating Information** | • Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.<br>• Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source. |

## Common Core State Standards for English Language Arts

| CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10 | |
|---|---|
| **Integration of Knowledge and Ideas** | • **RST.9-10.7 –** Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. |
| **Range of Reading and Level of Text Complexity** | • **RST.9-10.10 –** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. |

| CCSS: English Language Arts Standards » Writing » Grade 9-10 | |
|---|---|
| **Production and Distribution of Writing** | • **WHST.9-10.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. |
| **Research to Build and Present Knowledge** | • **WHST.9-10.9 –** Draw evidence from informational texts to support analysis, reflection, and research. |

## Essential Questions

1. Why are animals domesticated?
2. What characteristics allow certain animal species to be domesticated?
3. How have domesticated animal species adapted to human interactions over time?
4. How do animals benefit from domestication?
5. What is the difference between taming animals and domesticating them?
6. What are the benefits to humans by domesticating animals?
7. How have human lives changed through the domestication of animals?
8. What is a feral animal?
9. How are animals domesticated?

# Lesson 2.2 Naming Animals

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Animals are classified several different ways, such as binomial nomenclature, purpose, and characteristics of anatomy and physiology. | • Classify objects based on their physical characteristics. (Activity 2.2.1)<br>• Apply the hierarchical organizational system to a food group. (Activity 2.2.1) |
| 2. All living organisms are classified using kingdom, phylum, class, order, family, genus, and species. | • Determine the classification of the animal in their *Producer's Management Guide*. (Activity 2.2.2) |
| 3. Dichotomous keys are a classification tool that can be used to identify objects based on their physical features. | • Design a dichotomous key for five breeds of an animal species. (Project 2.2.3) |

## National AFNR Career Cluster Content Standards Alignment

| AFNR: LifeKnowledge® and Cluster Skills Content Standards | |
|---|---|
| **CS.04.** | Systems: Examine roles within teams, work units, departments, organizations, inter-organizational systems, and the larger environment. |

| AFNR: Animal Systems Career Pathway Content Standards | |
|---|---|
| **AS.01.** | Examine the components, historical development, global implications, and future trends of the animal systems industry. |
| **AS.02.** | Classify, evaluate, select, and manage animals based on anatomical and physiological characteristics. |

## Next Generation Science Standards Alignment

| Crosscutting Concepts | |
|---|---|
| **Structure and Function** | The way an object is shaped or structured determines many of its properties and functions. |
| | • The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. |

| Understandings about the Nature of Science | |
|---|---|
| **Science is a Way of Knowing** | • Science is both a body of knowledge that represents a current understanding of natural systems and the processes used to refine, elaborate, revise, and extend this knowledge.<br>• Science knowledge has a history that includes the refinement of, and changes to, theories, ideas, and beliefs over time. |
| **Science is a Human Endeavor** | • Scientific knowledge is a result of human endeavor, imagination, and creativity.<br>• Scientists' backgrounds, theoretical commitments, and fields of endeavor influence the nature of their findings. |

## Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

| CCSS: Conceptual Category – Functions | |
|---|---|
| **Linear, Quadratic, and Exponential Models** | • *Construct and compare linear, quadratic, and exponential models and solve problems.<br>• *Interpret expressions for functions in terms of the situation they model. |

## Common Core State Standards for English Language Arts

| CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10 | |
|---|---|
| **Key Ideas and Details** | • **RST.9-10.3 –** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. |
| **Craft and Structure** | • **RST.9-10.5 –** Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). |
| **Integration of Knowledge and Ideas** | • **RST.9-10.7 –** Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. |

| CCSS: English Language Arts Standards » Writing » Grade 9-10 | |
|---|---|
| **Production and Distribution of Writing** | • **WHST.9-10.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. |
| **Research to Build and Present Knowledge** | • **WHST.9-10.9 –** Draw evidence from informational texts to support analysis, reflection, and research. |

## Essential Questions

1. What is taxonomy?

2. How can you classify animals?
3. How can several classification categories be used on the same object?
4. What are the hierarchical levels for taxonomic classification?
5. What is the difference between a genus and a species designation?
6. How was binomial nomenclature developed?
7. What is a breed?
8. Why were breeds developed?
9. How is a dichotomous key used to identify animals?

# Lesson 3.1 Animal Rights or Animal Wrongs?

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. The value humans place on live animals and the use of products derived from animals is influenced by the beliefs of an individual | • Discuss the differences in the interpretation of the meaning of the word value. (Activity 3.1.1)<br>• Assess their personal values to determine their beliefs pertaining to animal use. (Activity 3.1.1) |
| 2. Animal welfare and animal rights are differing belief systems pertaining to the acceptable use of animals. | • Determine their current opinions towards the beliefs of animal rightists and animal welfarists. (Activity 3.1.2) |
| 3. The use of animals for food and fiber sometimes create ethical dilemmas for producers and consumers. | • Recognize issues in animal agriculture and discuss the positive and negative impacts of each issue. (Project 3.1.3)<br>• Analyze animal rights and animal welfare videos to determine the message and intent of each video. (Activity 3.1.4) |
| 4. Producers of animal products must consider the welfare of animals for maximum profitability. | • Develop a Producer's Code of Care document for the humane use of a species of animal under their care. (Project 3.1.5) |

## National AFNR Career Cluster Content Standards Alignment

| AFNR: LifeKnowledge® and Cluster Skills Content Standards | |
|---|---|
| **CS.01.** | Premier Leadership: Acquire the skills necessary to positively influence others. |
| **CS.06.** | Examine the importance of health, safety, and environmental management systems in organizations and their importance to performance and regulatory compliance. |
| **CS.09.** | Technical Skills: Compare and contrast issues affecting the AFNR industry. |

| AFNR: Animal Systems Career Pathway Content Standards | |
|---|---|
| **AS.01.** | Examine the components, historical development, global implications, and future trends of the animal systems industry. |
| **AS.03.** | Provide for the proper health care of animals. |

| | |
|---|---|
| **AS.06.** | Prepare and implement animal handling procedures for the safety of animals, producers, and consumers of animal products. |

## Next Generation Science Standards Alignment

| **Understandings about the Nature of Science** | |
|---|---|
| **Science is a Way of Knowing** | • Science is a unique way of knowing and there are other ways of knowing.<br>• Science distinguishes itself from other ways of knowing through use of empirical standards, logical arguments, and skeptical review.<br>• Science knowledge has a history that includes the refinement of, and changes to, theories, ideas, and beliefs over time. |
| **Science Addresses Questions About the Natural and Material World.** | • Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions.<br>• Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge.<br>• Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues. |

## Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

| **CCSS: Conceptual Category – Statistics and Probability** | |
|---|---|
| **Interpreting Categorical and Quantitative Data** | • *Summarize, represent, and interpret data on a single count or measurement variable. |
| **Making Inferences and Justifying Conclusions** | • *Make inferences and justify conclusions from sample surveys, experiments, and observational studies. |

## Common Core State Standards for English Language Arts

| **CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10** | |
|---|---|
| **Key Ideas and Details** | • **RST.9-10.1 –** Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. |
| **Craft and Structure** | • **RST.9-10.5 –** Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).<br>• **RST.9-10.6 –** Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address. |
| **Integration of Knowledge and Ideas** | • **RST.9-10.9 –** Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts. |

| **CCSS: English Language Arts Standards » Writing » Grade 9-10** | |
|---|---|
| **Text Types and Purposes** | **WHST.9-10.1 –** Write arguments focused on discipline-specific content.<br>**WHST.9-10.1.A –** Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence.<br>**WHST.9-10.2 –** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.<br>• **WHST.9-10.2.B –** Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.<br>• **WHST.9-10.2.D –** Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers. |
| **Production and Distribution of Writing** | • **WHST.9-10.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.<br>• **WHST.9-10.6 –** Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically. |
| **Research to Build and Present Knowledge** | • **WHST.9-10.8 –** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the |

research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
- **WHST.9-10.9 –** Draw evidence from informational texts to support analysis, reflection, and research.

## Essential Questions

1. What is meant by the phrase “this is an issue”?
2. How do personal beliefs and values affect an individual’s perception of animal use?
3. What is the philosophy of animal rights?
4. What is the philosophy of animal welfare?
5. How is the media used to promote the pros and cons of these philosophies?
6. What is the proper standard of care for an animal?
7. How does the treatment of a production animal affect profitability?
8. Why are there dilemmas for producers and consumers concerning the use of animals?
9. How can producers combat misunderstandings in animal agriculture?

# Lesson 3.2 Manipulating Manners

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Animals respond instinctively to stimuli and changes in their surroundings. | • Investigate the behavior of pillbugs in response to stimuli. (Activity 3.2.1)<br>• Conduct an inquiry lab on the behaviors of pillbugs. (Activity 3.2.1) |
| 2. Animals exhibit both instinctive and learned behaviors. | • Write a brief with annotated references that may be used as a preparatory guide for farm tours and field trips pertaining to animal behavior and safety. (Project 3.2.2) |
| 3. Safe handling and restraint procedures protect the animal and handler. | • Research and determine the typical behaviors of a species of animal and become familiar with the safe handling procedures of that animal. (Project 3.2.2) |

## National AFNR Career Cluster Content Standards Alignment

| AFNR: LifeKnowledge® and Cluster Skills Content Standards | |
|---|---|
| **CS.06.** | Examine the importance of health, safety, and environmental management systems in organizations and their importance to performance and regulatory compliance. |
| **CS.11.** | Scientific Inquiry: Utilize scientific inquiry as an investigative method. |

| AFNR: Animal Systems Career Pathway Content Standards | |
|---|---|
| **AS.02.** | Classify, evaluate, select, and manage animals based on anatomical and physiological characteristics. |
| **AS.06.** | Prepare and implement animal handling procedures for the safety of animals, producers, and consumers of animal products. |

## Next Generation Science Standards Alignment

| Disciplinary Core Ideas | |
|---|---|
| **Life Science** | |
| **LS1: From Molecules to Organisms: Structures and Processes** | |
| **LS1.A: Structure and Function** | • Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. |

| Science and Engineering Practices | |
|---|---|
| **Asking Questions and Defining Problems** | Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.<br>• Ask questions that arise from careful observation of phenomena, or unexpected results.<br>  ▪ to clarify and/or seek additional information.<br>  ▪ that arise from examining models or a theory, to clarify and/or seek additional information and relationships.<br>  ▪ to determine relationships, including quantitative relationships, between independent and dependent variables.<br>• Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory. |
| **Developing and Using Models** | Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).<br>• Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.<br>• Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems. |
| **Planning and Carrying Out Investigations** | Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.<br>• Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled.<br>• Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts.<br>• Select appropriate tools to collect, record, analyze, and evaluate data. |
| **Analyzing and Interpreting Data** | Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.<br>• Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. |

| Crosscutting Concepts | |
|---|---|
| **Cause and Effect: Mechanism and Prediction** | Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering. |
| | • Systems can be designed to cause a desired effect.<br>• Changes in systems may have various causes that may not have equal effects. |
| **Systems and System Models** | A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems. |
| | • When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.<br>• Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.<br>• Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. |

| Understandings about the Nature of Science |
|---|

| | |
|---|---|
| **Scientific Investigations Use a Variety of Methods** | • Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings.<br>• Scientific investigations use a variety of methods, tools, and techniques to revise and produce new knowledge. |
| **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** | • Models, mechanisms, and explanations collectively serve as tools in the development of a scientific theory.<br>• Scientists often use hypotheses to develop and test theories and explanations. |

## Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

| **CCSS: Conceptual Category – Number and Quantity** | |
|---|---|
| **Quantities** | • *Reason quantitatively and use units to solve problems. |
| **CCSS: Conceptual Category – Statistics and Probability** | |
| **Interpreting Categorical and Quantitative Data** | • *Summarize, represent, and interpret data on a single count or measurement variable. |

## Common Core State Standards for English Language Arts

| **CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10** | |
|---|---|
| **Key Ideas and Details** | • **RST.9-10.1 –** Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.<br>• **RST.9-10.3 –** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. |
| **Integration of Knowledge and Ideas** | • **RST.9-10.8 –** Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.<br>• **RST.9-10.9 –** Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts. |
| **Range of Reading and Level of Text Complexity** | • **RST.9-10.10 –** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. |

| **CCSS: English Language Arts Standards » Writing » Grade 9-10** | |
|---|---|
| **Text Types and Purposes** | **WHST.9-10.2 –** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.<br>• **WHST.9-10.2.B –** Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.<br>• **WHST.9-10.2.D –** Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.<br>• **WHST.9-10.2.E –** Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. |
| **Research to Build and Present Knowledge** | • **WHST.9-10.8 –** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation. |

## Essential Questions

1. Why study animal behavior?
2. How do animals respond to differences in their environment?
3. What are instinctive and learned behaviors?
4. How is conditioning used in animal agriculture?
5. How does novelty affect flighty animals?

6. What is a flight zone?
7. How can the flight zone of an animal be used to move and handle animals in a low-stress manner?
8. What are safe and calm practices to use when working with animals?
9. What is an annotated bibliography?
10. Why do researchers write annotated bibliographies?

# Lesson 3.3 Home Sweet Home

## Preface

Providing livestock and companion animals with adequate food, shelter, and water is the responsibility of every animal owner. Over the years, the facilities that producers use to fulfill these needs have increased in design and technology to provide carefully controlled environments for animals that maximize production efficiency. Animal housing ranges from a simple windbreak planted alongside a feedlot to computer-regulated barns where temperature, humidity, and light are all carefully managed. Producers must take into consideration the optimal production conditions for their animals, balance that with budget constraints, and return on investment. Facility design is similar to creating a floor plan for a house. There should be provisions for feeding, watering, sheltering, bedding, and providing health care in animal housing.

A current issue in animal facilities is providing adequate biosecurity measures. While many people think of bio-terrorism in relation to security on farms, there is much more to biosecurity than just that. Many facilities utilize confinement systems where large numbers of animals are kept in close quarters and diseases are easily transmitted. Biosecurity plans include the isolation of new and returning animals to the farm, disease transmission preventative measures for visitors, vaccination and parasite control, and sanitary practices to reduce pathogen spread within groups of animals.

In this lesson, students will explore livestock needs and how those needs affect facilities and biosecurity measures. Students will research specific needs for the animals in their *Producer's Management Guide*, examine possible scenarios to assist in developing biosecurity measures, and design a facility meeting the researched needs.

| **Concepts** | **Performance Objectives** |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Animal facilities differ based on food requirements, environmental factors, species, use, and size of operations. | • Research the basic feed, water, and shelter requirements for animals. (Activity 3.3.1)<br>• Determine the average environmental conditions of the students' facility location. (Activity 3.3.1) |
| 2. Biosecurity practices are implemented to reduce the spread of pathogens on farms. | • Conduct experiments to determine the risk levels related to spreading pathogens in a farm scenario. (Activity 3.3.2)<br>• Observe and record growth of cultures. (Activity 3.3.2) |
| 3. Proper use of scale is important when designing animal facilities. | • Calculate proportions, scale ratios, and dimensions of building plans. (Activity 3.3.3) |
| 4. Animal facilities are designed to protect the safety and health of animals and handlers and should include biosecurity protocols. | • Select a type of animal facility that provides for the safe handling and efficient production of animals. (Project 3.3.4) |

| | |
|---|---|
| | • Design and construct a model animal facility. (Project 3.3.4) |

## National AFNR Career Cluster Content Standards Alignment

| AFNR: LifeKnowledge® and Cluster Skills Content Standards | |
|---|---|
| **CS.06.** | Examine the importance of health, safety, and environmental management systems in organizations and their importance to performance and regulatory compliance. |
| **CS.07.** | Safety, Health, and Environmental: Demonstrate appropriate health and safety procedures for AFNR occupations. |
| **CS.08.** | Technical Skills: Use tools, equipment, machinery and technology appropriate to work within areas related to AFNR. |
| **CS.11.** | Scientific Inquiry: Utilize scientific inquiry as an investigative method. |

| AFNR: Animal Systems Career Pathway Content Standards | |
|---|---|
| **AS.06.** | Prepare and implement animal handling procedures for the safety of animals, producers, and consumers of animal products. |
| **AS.07.** | Select animal facilities and equipment that provide for the safe and efficient production, housing, and handling of animals. |
| **AS.08.** | Analyze environmental factors associated with animal production. |

| AFNR: Power, Structural and Technical Systems Career Pathway Content Standards | |
|---|---|
| **PST.04.** | Plan, build and maintain agricultural structures. |

## Next Generation Science Standards Alignment

| Science and Engineering Practices | |
|---|---|
| **Asking Questions and Defining Problems** | Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.<br>• Ask questions that arise from careful observation of phenomena, or unexpected results<br>▪ that arise from examining models or a theory, to clarify and/or seek additional information and relationships.<br>▪ to determine relationships, including quantitative relationships, between independent and dependent variables.<br>• Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.<br>• Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical and/or environmental considerations. |
| **Planning and Carrying Out Investigations** | Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.<br>• Select appropriate tools to collect, record, analyze, and evaluate data.<br>• Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated.<br>• Manipulate variables and collect data about a complex model of a proposed process or system to identify failure points or improve performance relative to criteria for success or other variables. |
| **Analyzing and Interpreting Data** | Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.<br>• Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations. |

| | |
|---|---|
| | • Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success. |
| **Constructing Explanations and Designing Solutions** | Constructing explanations and designing solutions in 9–12 builds on K– 8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.<br>• Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables.<br>• Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.<br>• Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. |
| **Understandings about the Nature of Science** | |
| **Scientific Investigations Use a Variety of Methods** | • Science investigations use diverse methods and do not always use the same set of procedures to obtain data.<br>• Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings.<br>• The discourse practices of science are organized around disciplinary domains that share exemplars for making decisions regarding the values, instruments, methods, models, and evidence to adopt and use.<br>• Scientific investigations use a variety of methods, tools, and techniques to revise and produce new knowledge. |

## Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

| **CCSS: Conceptual Category – Number and Quantity** | |
|---|---|
| **Quantities** | • *Reason quantitatively and use units to solve problems. |

| **CCSS: Conceptual Category – Algebra** | |
|---|---|
| **Seeing Structure in Expressions** | • *Write expressions in equivalent forms to solve problems. |
| **Reasoning with Equations and Inequalities** | • Understand solving equations as a process of reasoning and explain the reasoning.<br>• Solve equations and inequalities in one variable.<br>• *Represent and solve equations and inequalities graphically. |

| **CCSS: Conceptual Category – Geometry** | |
|---|---|
| **Geometric Measurement and Dimension** | • Visualize relationships between two-dimensional and three-dimensional objects. |
| **Modeling with Geometry** | • *Apply geometric concepts in modeling situations. |

| **CCSS: Conceptual Category – Statistics and Probability** | |
|---|---|
| **Making Inferences and Justifying Conclusions** | • *Make inferences and justify conclusions from sample surveys, experiments, and observational studies. |
| **Conditional Probability and the Rules of Probability** | • *Understand independence and conditional probability and use them to interpret data. |

## Common Core State Standards for English Language Arts

| **CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10** | |
|---|---|
| **Key Ideas and Details** | • **RST.9-10.3 –** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. |
| **Range of Reading and Level of Text Complexity** | • **RST.9-10.10 –** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. |

| **CCSS: English Language Arts Standards » Writing » Grade 9-10** | |
|---|---|
| **Production and Distribution of Writing** | • **WHST.9-10.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. |

| | |
|---|---|
| **Research to Build and Present Knowledge** | • **WHST.9-10.7 –** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. |

## Essential Questions

1. What are the basic needs of animals?
2. How does environment influence the design of animal facilities?
3. What determines the size of animal facilities?
4. How can scale ratio be used in facility design?
5. What are the areas needed in an animal facility?
6. What is biosecurity?
7. What are pathogens?
8. What risks do pathogens pose to farm animals?
9. What are the common risk factors to biosecurity on a farm?
10. How can biosecurity concerns be reduced at animal facilities?

# Lesson 4.1 Units of Life

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Animal cells are comprised of many parts that have essential functions for the survival of animal tissue. | • Identify and label animal cell organelles. (Activity 4.1.1)<br>• Develop a pictorial representation of cell function. (Activity 4.1.1)<br>• Examine and compare plant and animal cells and their structures under a microscope. (Activity 4.1.2) |
| 2. Cells use water, oxygen, and glucose to produce energy and metabolic by-products of carbon dioxide and water. | • Collect and analyze data to provide evidence of cell metabolism. (Activity 4.1.3) |
| 3. Cells use the processes of osmosis and diffusion for the uptake of water and dissolved nutrients required for metabolism and growth. | • Observe molecules moving across a membrane in a computer simulation. (Activity 4.1.4)<br>• Conduct an experiment to simulate the process of osmosis in animal cells. (Activity 4.1.5) |

## National AFNR Career Cluster Content Standards Alignment

| AFNR: LifeKnowledge® and Cluster Skills Content Standards | |
|---|---|
| **CS.08.** | Technical Skills: Use tools, equipment, machinery and technology appropriate to work within areas related to AFNR. |
| **CS.11.** | Scientific Inquiry: Utilize scientific inquiry as an investigative method. |

## Next Generation Science Standards Alignment

**Disciplinary Core Ideas**

| Life Science | |
|---|---|
| **LS1: From Molecules to Organisms: Structures and Processes** | |
| **LS1.A: Structure and Function** | • Systems of specialized cells within organisms help them perform the essential functions of life.<br>• Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. |
| **LS1.C: Organization for Matter and Energy Flow in Organisms** | • As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.<br>• As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another and release energy to the surrounding environment and to maintain body temperature. Cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. |
| **LS2: Ecosystems: Interactions, Energy, and Dynamics** | |
| **LS2.B: Cycles of Matter and Energy Transfer in Ecosystems** | • Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. |
| **Physical Science** | |
| **PS1: Matter and Its Interactions** | |
| **PS1.B: Chemical Reactions** | • In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. |

| Science and Engineering Practices | |
|---|---|
| **Asking Questions and Defining Problems** | Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.<br>• Evaluate a question to determine if it is testable and relevant.<br>• Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory. |
| **Planning and Carrying Out Investigations** | Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.<br>• Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated. |
| **Analyzing and Interpreting Data** | Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.<br>• Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. |
| **Obtaining, Evaluating, and Communicating Information** | Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.<br>• Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). |

| Crosscutting Concepts | |
|---|---|
| **Structure and Function** | The way an object is shaped or structured determines many of its properties and functions. |
| | • Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.<br>• The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. |
| **Understandings about the Nature of Science** | |
| **Scientific Investigations Use a Variety of Methods** | • New technologies advance scientific knowledge.<br>• Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings.<br>• The discourse practices of science are organized around disciplinary domains that share exemplars for making decisions regarding the values, instruments, methods, models, and evidence to adopt and use. |

| | |
|---|---|
| | • Scientific investigations use a variety of methods, tools, and techniques to revise and produce new knowledge. |

## Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

| CCSS: Conceptual Category – Number and Quantity | |
|---|---|
| **The Real Number System** | • Use properties of rational and irrational numbers. |
| **Quantities** | • *Reason quantitatively and use units to solve problems. |

| CCSS: Conceptual Category – Algebra | |
|---|---|
| **Seeing Structure in Expressions** | • *Write expressions in equivalent forms to solve problems. |
| **Reasoning with Equations and Inequalities** | • *Represent and solve equations and inequalities graphically. |

| CCSS: Conceptual Category – Statistics and Probability | |
|---|---|
| **Interpreting Categorical and Quantitative Data** | • *Summarize, represent, and interpret data on a single count or measurement variable. |
| **Making Inferences and Justifying Conclusions** | • *Make inferences and justify conclusions from sample surveys, experiments, and observational studies. |

## Common Core State Standards for English Language Arts

| CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10 | |
|---|---|
| **Range of Reading and Level of Text Complexity** | • **RST.9-10.10 –** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. |

| CCSS: English Language Arts Standards » Writing » Grade 9-10 | |
|---|---|
| **Production and Distribution of Writing** | • **WHST.9-10.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. |

## Essential Questions

1. What is the function of cell organelles and how do they work together?
2. How do cells contribute to the overall function of an animal?
3. How do animal cells convert raw nutrients into energy?
4. What is cellular respiration?
5. What are the by-products of cellular respiration?
6. Why are animal cells important to understanding animal systems?
7. How does a cell absorb water and nutrients?
8. What is diffusion?
9. What is osmosis?
10. What is the difference between hypertonic, hypotonic, and isotonic?
11. How does a cell reach equilibrium?

# Lesson 4.2 Putting the Puzzle Together

| Concepts | Performance Objectives |
|---|---|

| *Students will know and understand* | *Students will learn concepts by doing* |
|---|---|
| 1. External body parts of animals vary among different species and are important as reference tools for animal selection, health, and management. | • Identify common external animal parts and explain the purpose of each. (Activity 4.2.1)<br>• Identify unique external parts specific for livestock and poultry species and explain the purpose of each part. (Activity 4.2.1) |
| 2. A collection of organized cells create tissue responsible for various life sustaining functions. | • Examine two types of muscle tissue and describe the differences. (Activity 4.2.2) |
| 3. The collection of epithelial, connective, muscle, and nerve tissues interact to perform specific functions within the body of an animal. | • Dissect a chicken wing and identify epithelial and connective tissues. (Activity 4.2.2) |
| 4. The body structure of a vertebrate animal is comprised of a skeleton made of bone and cartilage with ligaments attached to muscle tissue to provide motion. | • Dissect a chicken wing and observe how tendons and ligaments provide movement to the structure of the skeleton. (Activity 4.2.2) |
| 5. Multiple organs work together and form physiological systems. | • Dissect a fetal pig and identify internal parts and organs that comprise systems. (Activity 4.2.3) |

## National AFNR Career Cluster Content Standards Alignment

| **AFNR: LifeKnowledge® and Cluster Skills Content Standards** | |
|---|---|
| **CS.04.** | Systems: Examine roles within teams, work units, departments, organizations, inter-organizational systems, and the larger environment. |
| **CS.07.** | Safety, Health, and Environmental: Demonstrate appropriate health and safety procedures for AFNR occupations. |
| **CS.08.** | Technical Skills: Use tools, equipment, machinery and technology appropriate to work within areas related to AFNR. |
| **AFNR: Animal Systems Career Pathway Content Standards** | |
| **AS.02.** | Classify, evaluate, select, and manage animals based on anatomical and physiological characteristics. |

## Next Generation Science Standards Alignment

| **Disciplinary Core Ideas** | |
|---|---|
| **Life Science** | |
| **LS1: From Molecules to Organisms: Structures and Processes** | |
| **LS1.A: Structure and Function** | • Systems of specialized cells within organisms help them perform the essential functions of life.<br>• Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.<br>• Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. |

| **Science and Engineering Practices** | |
|---|---|
| **Developing and Using Models** | Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).<br>• Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems. |

| Crosscutting Concepts | |
|---|---|
| **Systems and System Models** | A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems. |
| | • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.<br>• Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. |
| **Structure and Function** | The way an object is shaped or structured determines many of its properties and functions. |
| | • The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. |

## Common Core State Standards for English Language Arts

| CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10 | |
|---|---|
| **Range of Reading and Level of Text Complexity** | • **RST.9-10.10 –** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. |

| CCSS: English Language Arts Standards » Writing » Grade 9-10 | |
|---|---|
| **Production and Distribution of Writing** | • **WHST.9-10.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. |

## Essential Questions

1. Why are external parts necessary to know?
2. What common external parts are found on all livestock species?
3. What is a dissection?
4. What is an organ?
5. How are tissues formed in the body of an animal?
6. What are the different types of tissues in the body of an animal?
7. What is the body structure of a vertebrate?
8. What are the purposes of bone besides physical structure?
9. What is the purpose of tendons?
10. What is the purpose of ligaments?
11. How do muscle tissues differ based on their location in the body of an animal?
12. What is the largest internal organ in the body of an animal?
13. How do multiple organs work together in the body of an animal?
14. What is the relationship between external body parts and internal systems?
15. What are the main functions of the respiratory system?
16. What organs make up the respiratory system, digestive system, circulatory system, nervous and endocrine system?
17. What are the main functions of the digestive system?
18. What are the main functions of the nervous and endocrine systems?

# Lesson 4.3 Breathing, Beating, and Body Controls

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. The respiratory and circulatory systems are closely related and essential for animal life. | • Identify and explain the function of the parts of the respiratory and circulatory systems. (Activity 4.3.1) |
| 2. External respiration is a process of gas exchanges between the lungs and blood. | • Describe the process of gas exchange in external respiration. (Activity 4.3.2)<br>• Determine the presence of carbon dioxide in exhaled air. (Activity 4.3.2) |
| 3. The circulatory system relies on the heart to pump blood throughout the body. | • Design a travel brochure that highlights the flow of blood throughout the body. (Project 4.3.3) |
| 4. Respiration and heart rates may be affected by external conditions, such as temperature and physical activity. | • Conduct an inquiry on the effects of external conditions on respiration rate, pulse, and blood pressure. (Activity 4.3.4) |
| 5. The nervous, endocrine, and renal systems work together to transmit signals, secrete hormones, and filter wastes. | • Map the functions of body systems, specifically the nervous, endocrine, and renal systems in order to demonstrate their connection to each other and other systems in the body. (Project 4.3.5) |

## National AFNR Career Cluster Content Standards Alignment

| AFNR: LifeKnowledge® and Cluster Skills Content Standards | |
|---|---|
| **CS.04.** | Systems: Examine roles within teams, work units, departments, organizations, inter-organizational systems, and the larger environment. |
| **CS.11.** | Scientific Inquiry: Utilize scientific inquiry as an investigative method. |

| AFNR: Animal Systems Career Pathway Content Standards | |
|---|---|
| **AS.02.** | Classify, evaluate, select, and manage animals based on anatomical and physiological characteristics. |

## Next Generation Science Standards Alignment

| Disciplinary Core Ideas | |
|---|---|
| **Life Science** | |
| **LS1: From Molecules to Organisms: Structures and Processes** | |
| **LS1.A: Structure and Function** | • Systems of specialized cells within organisms help them perform the essential functions of life.<br>• Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.<br>• Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. |

| Science and Engineering Practices | |
|---|---|
| **Asking Questions and Defining Problems** | Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.<br>• Ask questions that arise from careful observation of phenomena, or unexpected results<br>▪ to clarify and/or seek additional information.<br>▪ to determine relationships, including quantitative relationships, between independent and dependent variables.<br>• Evaluate a question to determine if it is testable and relevant. |

| | |
|---|---|
| | • Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.<br>• Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical and/or environmental considerations. |
| **Planning and Carrying Out Investigations** | Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.<br>• Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled.<br>• Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.<br>• Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts.<br>• Select appropriate tools to collect, record, analyze, and evaluate data.<br>• Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated. |
| **Obtaining, Evaluating, and Communicating Information** | Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.<br>• Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.<br>• Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.<br>• Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source.<br>• Evaluate the validity and reliability of and/or synthesize multiple claims, methods, and/or designs that appear in scientific and technical texts or media reports, verifying the data when possible. |

| **Crosscutting Concepts** | |
|---|---|
| **Structure and Function** | The way an object is shaped or structured determines many of its properties and functions. |
| | • The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. |

| **Understandings about the Nature of Science** | |
|---|---|
| **Scientific Investigations Use a Variety of Methods** | • Science investigations use diverse methods and do not always use the same set of procedures to obtain data.<br>• Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings.<br>• The discourse practices of science are organized around disciplinary domains that share exemplars for making decisions regarding the values, instruments, methods, models, and evidence to adopt and use.<br>• Scientific investigations use a variety of methods, tools, and techniques to revise and produce new knowledge. |
| **Science Addresses Questions About the Natural and Material World.** | • Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge.<br>• Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues. |

## Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

| **CCSS: Conceptual Category – Number and Quantity** | |
|---|---|
| **Quantities** | • *Reason quantitatively and use units to solve problems. |
| **The Complex Number System** | • Represent complex numbers and their operations on the complex plane. |

| CCSS: Conceptual Category – Functions | |
|---|---|
| **Linear, Quadratic, and Exponential Models** | • *Construct and compare linear, quadratic, and exponential models and solve problems.<br>• *Interpret expressions for functions in terms of the situation they model. |

| CCSS: Conceptual Category – Geometry | |
|---|---|
| **Modeling with Geometry** | • *Apply geometric concepts in modeling situations. |

| CCSS: Conceptual Category – Statistics and Probability | |
|---|---|
| **Interpreting Categorical and Quantitative Data** | • *Summarize, represent, and interpret data on a single count or measurement variable. |
| **Making Inferences and Justifying Conclusions** | • *Make inferences and justify conclusions from sample surveys, experiments, and observational studies. |
| **Conditional Probability and the Rules of Probability** | • *Understand independence and conditional probability and use them to interpret data.<br>• *Use the rules of probability to compute probabilities of compound events in a uniform probability model. |
| **Using Probability to Make Decisions** | • *Calculate expected values and use them to solve problems. |

## Common Core State Standards for English Language Arts

| CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10 | |
|---|---|
| **Range of Reading and Level of Text Complexity** | • **RST.9-10.10 –** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. |

| CCSS: English Language Arts Standards » Writing » Grade 9-10 | |
|---|---|
| **Text Types and Purposes** | **WHST.9-10.2 –** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.<br>• **WHST.9-10.2.A –** Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.<br>• **WHST.9-10.2.B –** Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.<br>• **WHST.9-10.2.D –** Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.<br>• **WHST.9-10.2.F –** Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic). |
| **Research to Build and Present Knowledge** | • **WHST.9-10.9 –** Draw evidence from informational texts to support analysis, reflection, and research. |
| **Range of Writing** | • **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. |

## Essential Questions

1. What is respiration?
2. What is circulation?
3. How do the respiratory and circulatory systems work together?
4. What is the difference between external and internal respiration?
5. How are gases exchanged in the lungs?
6. What is the concentration of carbon dioxide in air that is exhaled?
7. What is the path of flow of blood throughout the body?

8. What is the difference between systemic and pulmonary circulation?
9. What is the difference between an artery and a vein?
10. How do arteries and veins connecting with the lungs differ from arteries and veins connecting with other organs?
11. What is blood pressure?
12. How do respiration rates, pulse, and blood pressure respond to rest and exercise?
13. What roles do hormones released by the endocrine system play in the body?
14. How do the nervous, endocrine, and renal systems relate to other systems and reactions within an animal?

# Lesson 5.1 Digestion Junction

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Digestive systems vary among species of animals. | • Define the terminology commonly used in digestive anatomy. (Activity 5.1.1)<br>• Match livestock species with the proper digestive system. (Activity 5.1.2) |
| 2. Ruminants have a four-chambered stomach consisting of the rumen, reticulum, omasum, and abomasum, each with a specific function. | • Label, identify, and explain the function of various parts of animal digestive systems. (Activity 5.1.3) |
| 3. Digestion and absorption are accomplished through a process of mechanical, chemical, and biological decomposition of food in different digestive systems. | • Build a model of a digestive system. (Project 5.1.4) |

## National AFNR Career Cluster Content Standards Alignment

| AFNR: LifeKnowledge® and Cluster Skills Content Standards | |
|---|---|
| **CS.01.** | Premier Leadership: Acquire the skills necessary to positively influence others. |
| **CS.04.** | Systems: Examine roles within teams, work units, departments, organizations, inter-organizational systems, and the larger environment. |
| **CS.08.** | Technical Skills: Use tools, equipment, machinery and technology appropriate to work within areas related to AFNR. |
| **CS.11.** | Scientific Inquiry: Utilize scientific inquiry as an investigative method. |

| AFNR: Animal Systems Career Pathway Content Standards | |
|---|---|
| **AS.02.** | Classify, evaluate, select, and manage animals based on anatomical and physiological characteristics. |
| **AS.04.** | Apply principles of animal nutrition to ensure the proper growth, development, reproduction, and economic production of animals. |

## Next Generation Science Standards Alignment

| Disciplinary Core Ideas |
|---|

| Life Science | |
|---|---|
| **LS1: From Molecules to Organisms: Structures and Processes** | |
| **LS1.A: Structure and Function** | • Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. |
| **LS1.C: Organization for Matter and Energy Flow in Organisms** | • As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another and release energy to the surrounding environment and to maintain body temperature. Cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. |

| Science and Engineering Practices | |
|---|---|
| **Developing and Using Models** | Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).<br>• Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. |
| **Obtaining, Evaluating, and Communicating Information** | Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.<br>• Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.<br>• Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). |

| Crosscutting Concepts | |
|---|---|
| **Structure and Function** | The way an object is shaped or structured determines many of its properties and functions. |
| | • The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. |

## Common Core State Standards for English Language Arts

| CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10 | |
|---|---|
| **Integration of Knowledge and Ideas** | • **RST.9-10.7 –** Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. |
| **Range of Reading and Level of Text Complexity** | • **RST.9-10.10 –** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. |

| CCSS: English Language Arts Standards » Writing » Grade 9-10 | |
|---|---|
| **Text Types and Purposes** | **WHST.9-10.2 –** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. |
| **Research to Build and Present Knowledge** | • **WHST.9-10.8 –** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation. |
| **Range of Writing** | • **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. |

## Essential Questions

1. What is a digestive system?
2. What is a ruminant?
3. What is a monogastric?

4. How do methods of prehension differ among animals?
5. How do different animals digest needed nutrients?
6. What is the difference between a monogastric, ruminant, and avian digestive system?
7. What are examples of animals with a ruminant, monogastric, pseudo-ruminant, and avian digestion system?
8. Why do ruminants have a multi-chambered stomach?
9. Where does most digestion of food occur?

# Lesson 5.2 The Need for Feed

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. The six nutrient groups all animals require include water, carbohydrates, protein, fats, vitamins, and minerals. | • Identify the six classes of nutrients, the function they serve in the body, and sources of each nutrient. (Activity 5.2.1) |
| 2. Animals require nutrients from all six nutrient groups to thrive, survive, and reproduce. | • Research and record the nutritional needs of an animal using Nutritional Requirement tables. (Activity 5.2.2) |
| 3. The specific nutritional requirements of individual animals are dependent upon species, age, and level of production. | • Evaluate nutrient requirements of various animals at different stages of production. (Activity 5.2.2) |

## National AFNR Career Cluster Content Standards Alignment

| AFNR: LifeKnowledge® and Cluster Skills Content Standards | |
|---|---|
| **CS.04.** | Systems: Examine roles within teams, work units, departments, organizations, inter-organizational systems, and the larger environment. |
| **CS.08.** | Technical Skills: Use tools, equipment, machinery and technology appropriate to work within areas related to AFNR. |

| AFNR: Animal Systems Career Pathway Content Standards | |
|---|---|
| **AS.04.** | Apply principles of animal nutrition to ensure the proper growth, development, reproduction, and economic production of animals. |

## Next Generation Science Standards Alignment

| Science and Engineering Practices | |
|---|---|
| **Analyzing and Interpreting Data** | Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.<br>• Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.<br>• Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations. |
| **Obtaining, Evaluating, and Communicating Information** | Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.<br>• Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. |

| | |
|---|---|
| | • Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source.<br>• Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). |

| **Crosscutting Concepts** | |
|---|---|
| **Systems and System Models** | A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems. |
| | • Systems can be designed to do specific tasks. |
| **Structure and Function** | The way an object is shaped or structured determines many of its properties and functions. |
| | • The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. |

## Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

| **CCSS: Conceptual Category – Number and Quantity** | |
|---|---|
| **The Real Number System** | • Use properties of rational and irrational numbers. |

| **CCSS: Conceptual Category – Statistics and Probability** | |
|---|---|
| **Interpreting Categorical and Quantitative Data** | • *Summarize, represent, and interpret data on a single count or measurement variable. |

## Common Core State Standards for English Language Arts

| **CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10** | |
|---|---|
| **Integration of Knowledge and Ideas** | • **RST.9-10.7 –** Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. |
| **Range of Reading and Level of Text Complexity** | • **RST.9-10.10 –** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. |

| **CCSS: English Language Arts Standards » Writing » Grade 9-10** | |
|---|---|
| **Text Types and Purposes** | • **WHST.9-10.2 –** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.<br>• **WHST.9-10.2.A –** Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. |
| **Production and Distribution of Writing** | • **WHST.9-10.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. |
| **Range of Writing** | • **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. |

## Essential Questions

1. What are the six essential nutrients for all animals?
2. What food sources provide animals with the six essential nutrients?
3. Do animals of different species require the same types and amounts of food throughout their lifetime?
4. What are the specific nutrient requirements of an individual animal at different stages of production?

# Lesson 5.3 Feedstuffs

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. The nutritional value of a feed can be determined through feed analysis. | • Conduct inquiry experiment to determine the energy in feedstuffs. (Activity 5.3.1)<br>• Identify and define feed analysis terms. (Activity 5.3.2) |
| 2. Animals derive nutrition from a variety of sources including roughages and concentrates. | • Classify feedstuffs as roughages, concentrates, and supplements. (Activity 5.3.2) |
| 3. Feedstuffs of the same type can vary in nutrient composition and nutritional value based on the location, time of harvest, growing conditions, water availability, and soil conditions of the area in which the feed is grown. | • Categorize feedstuffs into the nutrient group each feedstuff provides. (Activity 5.3.2) |
| 4. Feed labels are an important source of nutritional information. | • Read a feed label and interpret the information included on the label. (Activity 5.3.3)<br>• Compare the information on a feed label to the information found on a food label. (Activity 5.3.3) |

## National AFNR Career Cluster Content Standards Alignment

| AFNR: LifeKnowledge® and Cluster Skills Content Standards | |
|---|---|
| **CS.07.** | Safety, Health, and Environmental: Demonstrate appropriate health and safety procedures for AFNR occupations. |
| **CS.08.** | Technical Skills: Use tools, equipment, machinery and technology appropriate to work within areas related to AFNR. |
| **CS.11.** | Scientific Inquiry: Utilize scientific inquiry as an investigative method. |

| AFNR: Agribusiness Systems Career Pathway Content Standards | |
|---|---|
| **ABS.03.** | Utilize record keeping to accomplish AFNR business objectives while complying with laws and regulations. |
| **AFNR: Animal Systems Career Pathway Content Standards** | |
| **AS.04.** | Apply principles of animal nutrition to ensure the proper growth, development, reproduction, and economic production of animals. |

## Next Generation Science Standards Alignment

| Disciplinary Core Ideas | |
|---|---|
| **Life Science** | |
| **LS1: From Molecules to Organisms: Structures and Processes** | |
| **LS1.C: Organization for Matter and Energy Flow in Organisms** | • As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.<br>• As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another and release energy to the surrounding environment and to maintain body temperature. Cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. |

| Physical Science |
|---|
| **PS3: Energy** |

| | |
|---|---|
| **PS3.B: Conservation of Energy and Energy Transfer** | • Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. |
| **PS3.D: Energy in Chemical Processes and Everyday Life** | • Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. |

| **Science and Engineering Practices** | |
|---|---|
| **Asking Questions and Defining Problems** | Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.<br>• Ask questions that arise from careful observation of phenomena, or unexpected results<br>  ▪ to clarify and/or seek additional information.<br>  ▪ to determine relationships, including quantitative relationships, between independent and dependent variables.<br>• Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory. |
| **Analyzing and Interpreting Data** | Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.<br>• Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.<br>• Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data.<br>• Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations. |
| **Using Mathematics and Computational Thinking** | Mathematical and computational thinking in 9-12 builds on K-8 and experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.<br>• Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.<br>• Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, etc.). |
| **Constructing Explanations and Designing Solutions** | Constructing explanations and designing solutions in 9–12 builds on K– 8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.<br>• Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables. |
| **Obtaining, Evaluating, and Communicating Information** | Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.<br>• Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.<br>• Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source.<br>• Evaluate the validity and reliability of and/or synthesize multiple claims, methods, and/or designs that appear in scientific and technical texts or media reports, verifying the data when possible. |

| **Crosscutting Concepts** | |
|---|---|
| **Energy and Matter: Flows, Cycles, and Conservation** | Tracking energy and matter flows, into, out of, and within systems helps one understand their system's behavior. |
| | • Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.<br>• Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems.<br>• Energy drives the cycling of matter within and between systems. |

| Understandings about the Nature of Science | |
|---|---|
| **Scientific Investigations Use a Variety of Methods** | • Science investigations use diverse methods and do not always use the same set of procedures to obtain data.<br>• Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings.<br>• Scientific investigations use a variety of methods, tools, and techniques to revise and produce new knowledge. |

## Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

| CCSS: Conceptual Category – Number and Quantity | |
|---|---|
| **The Real Number System** | • Use properties of rational and irrational numbers. |
| **Quantities** | • *Reason quantitatively and use units to solve problems. |

| CCSS: Conceptual Category – Statistics and Probability | |
|---|---|
| **Interpreting Categorical and Quantitative Data** | • *Summarize, represent, and interpret data on a single count or measurement variable. |
| **Using Probability to Make Decisions** | • *Calculate expected values and use them to solve problems. |

## Common Core State Standards for English Language Arts

| CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10 | |
|---|---|
| **Key Ideas and Details** | • **RST.9-10.3 –** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. |
| **Integration of Knowledge and Ideas** | • **RST.9-10.9 –** Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts. |
| **Range of Reading and Level of Text Complexity** | • **RST.9-10.10 –** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. |

| CCSS: English Language Arts Standards » Writing » Grade 9-10 | |
|---|---|
| **Range of Writing** | • **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. |

## Essential Questions

1. What is energy?
2. How is energy measured?
3. What is a calorie?
4. What is a feedstuff?
5. What is a concentrate?
6. What is a roughage?
7. How does a feed differ from a feedstuff?
8. What nutrients do different feedstuffs provide?
9. What nutritional information is found on feed labels?
10. How does a feed label compare to a food label?
11. What is nutrition?
12. Why is nutrition important to animals?
13. What is nutritional value?

14. Why is understanding nutritional value important to know of a feedstuff?
15. What is feed analysis and how is it used?
16. How can the nutrient content of a feed vary?

# Lesson 5.4 Nutritional Disorders

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Animal growth, development, and health are directly related to meeting nutrient requirements of the animal. | • Research the nutritional disorders of a species of animal. (Project 5.4.1)<br>• Present a PowerPoint® as a team conveying their findings of the disorders to the class. (Project 5.4.1) |
| 2. Nutrient deficiencies in animals may result in poor performance and contribute to economic losses. | • Develop a reference for common nutritional disorders of many animals. (Activity 5.4.2) |

## National AFNR Career Cluster Content Standards Alignment

| AFNR: LifeKnowledge® and Cluster Skills Content Standards | |
|---|---|
| **CS.11.** | Scientific Inquiry: Utilize scientific inquiry as an investigative method. |

## Next Generation Science Standards Alignment

| Disciplinary Core Ideas | |
|---|---|
| **Life Science** | |
| **LS1: From Molecules to Organisms: Structures and Processes** | |
| **LS1.A: Structure and Function** | • Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.<br>• Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. |
| **Science and Engineering Practices** | |
| **Obtaining, Evaluating, and Communicating Information** | Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.<br>• Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.<br>• Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem. |

| Crosscutting Concepts | |
|---|---|
| **Cause and Effect: Mechanism and Prediction** | Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering. |
| | • Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. |

| Understandings about the Nature of Science |
|---|

| | |
|---|---|
| **Scientific Investigations Use a Variety of Methods** | • Science investigations use diverse methods and do not always use the same set of procedures to obtain data. |
| **Scientific Knowledge is Based on Empirical Evidence** | • Science knowledge is based on empirical evidence.<br>• Science disciplines share common rules of evidence used to evaluate explanations about natural systems.<br>• Science includes the process of coordinating patterns of evidence with current theory. |
| **Scientific Knowledge is Open to Revision in Light of New Evidence** | • Scientific explanations can be probabilistic.<br>• Most scientific knowledge is quite durable but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence.<br>• Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in revision of an explanation. |
| **Science Addresses Questions About the Natural and Material World.** | • Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge.<br>• Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues. |

## Common Core State Standards for English Language Arts

| CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10 | |
|---|---|
| **Integration of Knowledge and Ideas** | • **RST.9-10.7 –** Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.<br>• **RST.9-10.8 –** Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. |
| **Range of Reading and Level of Text Complexity** | • **RST.9-10.10 –** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. |

| CCSS: English Language Arts Standards » Writing » Grade 9-10 | |
|---|---|
| **Production and Distribution of Writing** | • **WHST.9-10.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. |
| **Range of Writing** | • **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. |

## Essential Questions

1. What is a nutritional disorder?
2. How can nutritional disorders be prevented?
3. What is a deficiency?
4. What is toxicity?
5. What is the difference between a deficiency and a toxicity?
6. What determines if an animal has a nutritional deficiency?
7. What disorders are common in different species of livestock?

# Lesson 5.5 What's for Dinner?

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand*<br>1. Livestock rations are developed to meet the requirements of animals, maximize feed efficiency, and minimize cost of production. | *Students will learn concepts by doing*<br>• Describe the characteristics of a good ration. (Activity 5.5.1)<br>• List the steps in balancing a ration. (Activity 5.5.1) |

| | |
|---|---|
| 2. Using mathematics and problem solving are important skills for animal producers when formulating rations.<br><br>3. Rations can be formulated using a variety of methods. | • Complete conversions of feedstuffs from a dry-matter basis to an as-fed basis. (Activity 5.5.1)<br><br>• Use the Pearson Square to balance a ration using two feedstuffs. (Activity 5.5.2)<br>• Formulate a ration and make a recipe using the Pearson Square. (Activity 5.5.3)<br>• Develop a balanced ration for livestock by hand and by using a computer-based ration-balancing program. (Activity 5.5.4) |

## National AFNR Career Cluster Content Standards Alignment

| AFNR: LifeKnowledge® and Cluster Skills Content Standards | |
|---|---|
| **CS.08.** | Technical Skills: Use tools, equipment, machinery and technology appropriate to work within areas related to AFNR. |
| **CS.11.** | Scientific Inquiry: Utilize scientific inquiry as an investigative method. |
| **AFNR: Animal Systems Career Pathway Content Standards** | |
| **AS.04.** | Apply principles of animal nutrition to ensure the proper growth, development, reproduction, and economic production of animals. |

## Next Generation Science Standards Alignment

| Science and Engineering Practices | |
|---|---|
| **Asking Questions and Defining Problems** | Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.<br>• Ask questions that arise from careful observation of phenomena, or unexpected results<br>▪ to clarify and/or seek additional information.<br>▪ to determine relationships, including quantitative relationships, between independent and dependent variables. |
| **Using Mathematics and Computational Thinking** | Mathematical and computational thinking in 9-12 builds on K-8 and experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.<br>• Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system.<br>• Apply techniques of algebra and functions to represent and solve scientific and engineering problems.<br>• Use simple limit cases to test mathematical expressions, computer programs, algorithms, or simulations of a process or system to see if a model “makes sense” by comparing the outcomes with what is known about the real world.<br>• Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, etc.). |
| **Obtaining, Evaluating, and Communicating Information** | Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.<br>• Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.<br>• Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). |

| Crosscutting Concepts | |
|---|---|
| **Stability and Change** | For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand. |

| | |
|---|---|
| | • Feedback (negative or positive) can stabilize or destabilize a system.<br>• Systems can be designed for greater or lesser stability. |

| Understandings about the Nature of Science | |
|---|---|
| **Scientific Investigations Use a Variety of Methods** | • Science investigations use diverse methods and do not always use the same set of procedures to obtain data.<br>• New technologies advance scientific knowledge. |
| **Science is a Way of Knowing** | • Science is both a body of knowledge that represents a current understanding of natural systems and the processes used to refine, elaborate, revise, and extend this knowledge.<br>• Science distinguishes itself from other ways of knowing through use of empirical standards, logical arguments, and skeptical review. |
| **Science is a Human Endeavor** | • Scientific knowledge is a result of human endeavor, imagination, and creativity.<br>• Technological advances have influenced the progress of science and science has influenced advances in technology. |

## Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

| CCSS: Conceptual Category – Number and Quantity | |
|---|---|
| **The Real Number System** | • Extend the properties of exponents to rational exponents.<br>• Use properties of rational and irrational numbers. |
| **Quantities** | • *Reason quantitatively and use units to solve problems. |
| **The Complex Number System** | • Perform arithmetic operations with complex numbers. |

| CCSS: Conceptual Category – Algebra | |
|---|---|
| **Seeing Structure in Expressions** | • *Write expressions in equivalent forms to solve problems. |
| **Arithmetic with Polynomials and Rational Expressions** | • Use polynomial identities to solve problems. |
| **Creating Equations** | • *Create equations that describe numbers or relationships. |
| **Reasoning with Equations and Inequalities** | • Understand solving equations as a process of reasoning and explain the reasoning.<br>• Solve equations and inequalities in one variable.<br>• Solve systems of equations. |

| CCSS: Conceptual Category – Functions | |
|---|---|
| **Interpreting Functions** | • *Analyze functions using different representations. |
| **Building Functions** | • *Build a function that models a relationship between two quantities. |
| **Linear, Quadratic, and Exponential Models** | • *Construct and compare linear, quadratic, and exponential models and solve problems. |

## Common Core State Standards for English Language Arts

| CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10 | |
|---|---|
| **Key Ideas and Details** | • **RST.9-10.2 –** Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. |
| **Integration of Knowledge and Ideas** | • **RST.9-10.9 –** Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts. |
| **Range of Reading and Level of Text Complexity** | • **RST.9-10.10 –** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. |

| CCSS: English Language Arts Standards » Writing » Grade 9-10 |
|---|

| | |
|---|---|
| **Text Types and Purposes** | **WHST.9-10.2 –** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.<br>• **WHST.9-10.2.B –** Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.<br>• **WHST.9-10.2.D –** Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.<br>• **WHST.9-10.2.F –** Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic). |
| **Production and Distribution of Writing** | • **WHST.9-10.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. |
| **Range of Writing** | • **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. |

## Essential Questions

1. What is a ration?
2. What are the characteristics of a good ration?
3. What are the steps in balancing a ration?
4. What is dry matter?
5. How is the water content of feeds determined?
6. What are concentrates?
7. What are roughages?
8. How is the Pearson Square method used in formulating a ration?
9. What is the limitation of using the Pearson Square method?
10. What are the advantages of using ration-balancing computer program?

# Lesson 6.1 Where Do Calves Come From?

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Male and female reproductive systems differ in structure and function. | • Identify and label the parts of the male and female reproductive tract. (Activity 6.1.1) |
| 2. The male reproductive system consists of testes, scrotum, epididymis, vas deferens, prostate gland, Cowper's gland, seminal vesicle, urethra, and penis. | • Observe a dissection of the male reproductive tract and identify the parts within the tract. (Activity 6.1.2)<br>• Draw a flow chart to show the process of sperm maturation. (Activity 6.1.2) |
| 3. The female reproductive system consists of the ovary, infundibulum, fallopian tubes (oviducts), uterus, cervix, vagina, and vulva. | • Dissect a female reproductive tract and identify parts within the tract. (Activity 6.1.3)<br>• Observe and compare the reproductive tracts of cows, sows, and ewes. (Activity 6.1.3)<br>• Describe the path of an egg from the ovary to birth. (Activity 6.1.3) |

## National AFNR Career Cluster Content Standards Alignment

| AFNR: LifeKnowledge® and Cluster Skills Content Standards | |
|---|---|
| **CS.08.** | Technical Skills: Use tools, equipment, machinery and technology appropriate to work within areas related to AFNR. |
| **CS.11.** | Scientific Inquiry: Utilize scientific inquiry as an investigative method. |
| **AFNR: Animal Systems Career Pathway Content Standards** | |
| **AS.02.** | Classify, evaluate, select, and manage animals based on anatomical and physiological characteristics. |

## Next Generation Science Standards Alignment

| Disciplinary Core Ideas | |
|---|---|
| **Life Science** | |
| **LS1: From Molecules to Organisms: Structures and Processes** | |
| **LS1.A: Structure and Function** | • Systems of specialized cells within organisms help them perform the essential functions of life. |

| Crosscutting Concepts | |
|---|---|
| **Patterns** | Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them. |
| | • Patterns of performance of designed systems can be analyzed and interpreted to reengineer and improve the system. |
| **Systems and System Models** | A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems. |
| | • Systems can be designed to do specific tasks. |

## Common Core State Standards for English Language Arts

| CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10 | |
|---|---|
| **Integration of Knowledge and Ideas** | • **RST.9-10.9 –** Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts. |
| **Range of Reading and Level of Text Complexity** | • **RST.9-10.10 –** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. |

| CCSS: English Language Arts Standards » Writing » Grade 9-10 | |
|---|---|
| **Production and Distribution of Writing** | • **WHST.9-10.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. |

## Essential Questions

1. What is a reproductive tract?
2. What are the eight major parts of the female reproductive tract?
3. What are the ten major parts of the male reproductive tract?
4. Where are the major parts of the male and female reproductive tract located in the body?
5. What are the functions of each of the parts of the female reproductive system?
6. What are the functions of each of the parts of the male reproductive system?
7. What is a sex characteristic?
8. What is a hormone?
9. What role does estrogen play in the female body?
10. What role does testosterone play in the male body?

11. What are ligaments and why are they important?

# Lesson 6.2 Generating Generations

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Four main breeding methods commonly chosen by producers when breeding livestock have advantages and disadvantages. | • Distinguish between the different livestock breeding systems. (Activity 6.2.1)<br>• Understand the advantages and disadvantages of breeding methods. (Activity 6.2.1) |
| 2. The potential fertility and viability of semen may be determined based on its motility, morphology, and concentration. | • Prepare slides using a variety of buffers and stains. (Activity 6.2.2)<br>• Evaluate semen samples for sperm motility, morphology, and concentration. (Activity 6.2.2) |

## National AFNR Career Cluster Content Standards Alignment

| AFNR: LifeKnowledge® and Cluster Skills Content Standards | |
|---|---|
| **CS.08.** | Technical Skills: Use tools, equipment, machinery and technology appropriate to work within areas related to AFNR. |
| **CS.09.** | Technical Skills: Compare and contrast issues affecting the AFNR industry. |
| **CS.10.** | Technical Skills: Envision emerging technology and globalization to project its influence on widespread markets. |
| **CS.11.** | Scientific Inquiry: Utilize scientific inquiry as an investigative method. |

| AFNR: Animal Systems Career Pathway Content Standards | |
|---|---|
| **AS.01.** | Examine the components, historical development, global implications, and future trends of the animal systems industry. |
| **AS.02.** | Classify, evaluate, select, and manage animals based on anatomical and physiological characteristics. |
| **AS.05.** | Evaluate and select animals based on scientific principles of animal production. |

## Next Generation Science Standards Alignment

| Disciplinary Core Ideas | |
|---|---|
| **Life Science** | |
| **LS1: From Molecules to Organisms: Structures and Processes** | |
| **LS1.A: Structure and Function** | • All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells.<br>• Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. |

| Science and Engineering Practices | |
|---|---|
| **Asking Questions and Defining Problems** | Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.<br>• Ask questions that arise from careful observation of phenomena, or unexpected results<br>▪ to clarify and/or seek additional information. |

| | |
|---|---|
| | ▪ to clarify and refine a model, an explanation, or an engineering problem.<br>• Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. |
| **Analyzing and Interpreting Data** | Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.<br>• Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. |
| **Using Mathematics and Computational Thinking** | Mathematical and computational thinking in 9-12 builds on K-8 and experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.<br>• Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, etc.). |
| **Engaging in Argument from Evidence** | Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.<br>• Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues.<br>• Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.<br>• Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge, and student-generated evidence. |

| **Crosscutting Concepts** | |
|---|---|
| **Structure and Function** | The way an object is shaped or structured determines many of its properties and functions. |
| | • Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.<br>• The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its materials. |
| **Understandings about the Nature of Science** | |
| **Scientific Investigations Use a Variety of Methods** | • New technologies advance scientific knowledge.<br>• Scientific investigations use a variety of methods, tools, and techniques to revise and produce new knowledge. |
| **Science is a Human Endeavor** | • Technological advances have influenced the progress of science and science has influenced advances in technology.<br>• Science and engineering are influenced by society and society is influenced by science and engineering. |

## Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

| **CCSS: Conceptual Category – Number and Quantity** | |
|---|---|
| **The Real Number System** | • Use properties of rational and irrational numbers. |
| **Quantities** | • *Reason quantitatively and use units to solve problems. |

| **CCSS: Conceptual Category – Statistics and Probability** | |
|---|---|
| **Interpreting Categorical and Quantitative Data** | • *Summarize, represent, and interpret data on a single count or measurement variable. |

## Common Core State Standards for English Language Arts

| **CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10** | |
|---|---|
| **Key Ideas and Details** | • **RST.9-10.2 –** Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. |

| | |
|---|---|
| | • **RST.9-10.3 –** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. |
| **Integration of Knowledge and Ideas** | • **RST.9-10.9 –** Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts. |
| **Range of Reading and Level of Text Complexity** | • **RST.9-10.10 –** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. |

| **CCSS: English Language Arts Standards » Writing » Grade 9-10** | |
|---|---|
| **Text Types and Purposes** | **WHST.9-10.1 –** Write arguments focused on discipline-specific content.<br>• **WHST.9-10.1.A –** Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence. |
| **Production and Distribution of Writing** | • **WHST.9-10.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. |
| **Research to Build and Present Knowledge** | • **WHST.9-10.7 –** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. |
| **Range of Writing** | • **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. |

## Essential Questions

1. What is natural breeding?
2. What is crossbreeding?
3. What are the advantages and disadvantages of various breeding methods?
4. How are straight breeding and crossbreeding used in the livestock industry?
5. When should forms of inbreeding be used?
6. What are natural breeding, pasture mating, and hand breeding?
7. What is estrus synchronization?
8. What is artificial insemination?
9. What is embryo transfer?
10. What is cloning and how is it used in the livestock industry?
11. Which species most commonly utilizes each breeding method?
12. What are the proper techniques to preserve viable semen?
13. What are the indicators of quality of semen and how are they evaluated?

# Lesson 6.3 The Pathway to Production

| **Concepts** | **Performance Objectives** |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Understanding of the estrus cycle and hormonal control is essential for reproductive success. | • Identify the main hormones of the estrous cycle and graph the levels of each hormone throughout the cycle. (Activity 6.3.1) |
| 2. The reproductive cycle of females consists of puberty, the estrous cycle, gestation, parturition, and lactation. | • Research and record reproductive facts regarding the species of animal identified in the *Producer's Management Guide*. (Activity 6.3.2) |

| | |
|---|---|
| 3. The breeding season of animals may be manipulated for economic gain. | • Determine the best time to breed an animal and manage the breeding season. (Problem 6.3.3) |

## National AFNR Career Cluster Content Standards Alignment

| AFNR: LifeKnowledge® and Cluster Skills Content Standards | |
|---|---|
| **CS.08.** | Technical Skills: Use tools, equipment, machinery and technology appropriate to work within areas related to AFNR. |
| **CS.11.** | Scientific Inquiry: Utilize scientific inquiry as an investigative method. |

| AFNR: Animal Systems Career Pathway Content Standards | |
|---|---|
| **AS.02.** | Classify, evaluate, select, and manage animals based on anatomical and physiological characteristics. |
| **AS.05.** | Evaluate and select animals based on scientific principles of animal production. |
| **AS.08.** | Analyze environmental factors associated with animal production. |

## Next Generation Science Standards Alignment

| Science and Engineering Practices | |
|---|---|
| **Asking Questions and Defining Problems** | Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.<br>• Ask questions that arise from careful observation of phenomena, or unexpected results<br>▪ to clarify and/or seek additional information.<br>▪ to clarify and refine a model, an explanation, or an engineering problem.<br>• Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. |
| **Constructing Explanations and Designing Solutions** | Constructing explanations and designing solutions in 9–12 builds on K– 8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.<br>• Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.<br>• Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.<br>• Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion.<br>• Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. |
| **Obtaining, Evaluating, and Communicating Information** | Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.<br>• Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.<br>• Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source.<br>• Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). |

| Crosscutting Concepts | |
|---|---|
| **Patterns** | Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them. |
| | • Patterns of performance of designed systems can be analyzed and interpreted to reengineer and improve the system. |

| | |
|---|---|
| | • Empirical evidence is needed to identify patterns. |
| **Systems and System Models** | A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems. |
| | • Systems can be designed to do specific tasks.<br>• When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.<br>• Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.<br>• Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. |
| **Structure and Function** | The way an object is shaped or structured determines many of its properties and functions. |
| | • Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.<br>• The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. |
| **Stability and Change** | For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand. |
| | • Much of science deals with constructing explanations of how things change and how they remain stable. |
| **Understandings about the Nature of Science** | |
| **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** | • Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. |
| **Science is a Human Endeavor** | • Technological advances have influenced the progress of science and science has influenced advances in technology. |
| **Science Addresses Questions About the Natural and Material World.** | • Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge.<br>• Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues. |

## Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

| **CCSS: Conceptual Category – Statistics and Probability** | |
|---|---|
| **Interpreting Categorical and Quantitative Data** | • *Summarize, represent, and interpret data on a single count or measurement variable.<br>• *Interpret linear models. |
| **Conditional Probability and the Rules of Probability** | • *Understand independence and conditional probability and use them to interpret data. |
| **Using Probability to Make Decisions** | • *Use probability to evaluate outcomes of decisions. |

## Common Core State Standards for English Language Arts

| **CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10** | |
|---|---|
| **Integration of Knowledge and Ideas** | • **RST.9-10.9 –** Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts. |
| **Range of Reading and Level of Text Complexity** | • **RST.9-10.10 –** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. |

| **CCSS: English Language Arts Standards » Writing » Grade 9-10** | |
|---|---|
| **Production and Distribution of Writing** | • **WHST.9-10.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. |
| **Range of Writing** | • **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. |

## Essential Questions

1. What are the reproductive stages of animals?
2. How do hormones control the estrous cycle?
3. What are the phases of the estrous cycle?
4. Which hormone maintains pregnancy?
5. What hormone controls the release of the egg at ovulation?
6. What visual indications of estrus do animals' exhibit?
7. What is gestation?
8. What visual indications of impending parturition do animals' exhibit?
9. How can changing the breeding season be beneficial to producers?

# Lesson 7.1 A New Pair of Genes

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Mitosis has five distinct phases necessary for cell division. | • Prepare a slide to be viewed under a microscope for the purpose of examining mitosis in plant tissue. (Activity 7.1.1)<br>• Examine a prepared slide of animal mitosis and make observations of the stages of mitosis. (Activity 7.1.1)<br>• Compare the different stages of mitosis between plant and animal cells. (Activity 7.1.1) |
| 2. Eggs, or ova, and sperm undergo meiosis and mitosis for development of new cell tissue. | • Sketch and label cells depicting meiosis. (Activity 7.1.2) |
| 3. Fertilization of egg cells requires the joining of genetic material in the form of gametes from both male and female parents. | • Write a paragraph describing what occurs during fertilization. (Activity 7.1.2) |
| 4. Dominant and recessive genes determine the phenotypic characteristics of animals. | • Perform computer simulations related to genetic heritance in order to learn about the role genetics plays in animal production. (Activity 7.1.3) |
| 5. Genetic traits, such as coat color, muscling, and horns, are passed from one generation to the next. | • Simulate Drosophila mating to study the role genetics plays in animal production. (Activity 7.1.3) |
| 6. Genetic variations among species occur due to exceptions to the law of dominance. | • Conduct a trial to test probability of codominance. (Activity 7.1.4) |
| 7. Some animals phenotypic characteristics are expressed as sex linked traits. | • Perform computer simulations to predict sex-linked traits in drosophila. (Activity 7.1.4) |

## National AFNR Career Cluster Content Standards Alignment

| AFNR: LifeKnowledge® and Cluster Skills Content Standards | |
|---|---|
| **CS.08.** | Technical Skills: Use tools, equipment, machinery and technology appropriate to work within areas related to AFNR. |

| | |
|---|---|
| **CS.10.** | Technical Skills: Envision emerging technology and globalization to project its influence on widespread markets. |
| **CS.11.** | Scientific Inquiry: Utilize scientific inquiry as an investigative method. |

| **AFNR: Animal Systems Career Pathway Content Standards** | |
|---|---|
| **AS.02.** | Classify, evaluate, select, and manage animals based on anatomical and physiological characteristics. |
| **AS.05.** | Evaluate and select animals based on scientific principles of animal production. |

## Next Generation Science Standards Alignment

| **Disciplinary Core Ideas** | |
|---|---|
| **Life Science** | |
| **LS1: From Molecules to Organisms: Structures and Processes** | |
| **LS1.A: Structure and Function** | • Systems of specialized cells within organisms help them perform the essential functions of life.<br>• All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. |
| **LS1.B: Growth and Development of Organisms** | • In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. |
| **LS3: Heredity: Inheritance and Variation of Traits** | |
| **LS3.A: Inheritance of Traits** | • Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. |
| **LS3.B: Variation of Traits** | • In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. |
| **LS4: Biological Evolution: Unity and Diversity** | |
| **LS4.C: Adaptation** | • Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not.<br>• Adaptation also means that the distribution of traits in a population can change when conditions change. |

| **Science and Engineering Practices** | |
|---|---|
| **Developing and Using Models** | Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).<br>• Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism, or system in order to select or revise a model that best fits the evidence or design criteria.<br>• Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.<br>• Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations. |
| **Analyzing and Interpreting Data** | Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.<br>• Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. |

| | |
|---|---|
| | • Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. |
| | • Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data.<br>• Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations. |
| **Using Mathematics and Computational Thinking** | Mathematical and computational thinking in 9-12 builds on K-8 and experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.<br>• Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations. |
| **Obtaining, Evaluating, and Communicating Information** | Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.<br>• Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.<br>• Evaluate the validity and reliability of and/or synthesize multiple claims, methods, and/or designs that appear in scientific and technical texts or media reports, verifying the data when possible.<br>• Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). |

| **Crosscutting Concepts** | |
|---|---|
| **Patterns** | Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them. |
| | • Patterns of performance of designed systems can be analyzed and interpreted to reengineer and improve the system.<br>• Empirical evidence is needed to identify patterns. |
| **Scale, Proportion, and Quantity** | In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change. |
| | • Patterns observable at one scale may not be observable or exist at other scales. |
| **Systems and System Models** | A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems. |
| | • When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.<br>• Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.<br>• Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. |
| **Structure and Function** | The way an object is shaped or structured determines many of its properties and functions. |
| | • The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. |

| **Understandings about the Nature of Science** | |
|---|---|
| **Scientific Investigations Use a Variety of Methods** | • New technologies advance scientific knowledge.<br>• Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings.<br>• Scientific investigations use a variety of methods, tools, and techniques to revise and produce new knowledge. |
| **Scientific Knowledge is Based on Empirical Evidence** | • Science knowledge is based on empirical evidence.<br>• Science disciplines share common rules of evidence used to evaluate explanations about natural systems.<br>• Science includes the process of coordinating patterns of evidence with current theory.<br>• Science arguments are strengthened by multiple lines of evidence supporting a single explanation. |

| | |
|---|---|
| **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** | • Theories and laws provide explanations in science, but theories do not with time become laws or facts.<br>• A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that has been repeatedly confirmed through observation and experiment, and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.<br>• Models, mechanisms, and explanations collectively serve as tools in the development of a scientific theory.<br>• Laws are statements or descriptions of the relationships among observable phenomena. |
| **Science is a Way of Knowing** | • Science is both a body of knowledge that represents a current understanding of natural systems and the processes used to refine, elaborate, revise, and extend this knowledge.<br>• Science distinguishes itself from other ways of knowing through use of empirical standards, logical arguments, and skeptical review.<br>• Science knowledge has a history that includes the refinement of, and changes to, theories, ideas, and beliefs over time. |
| **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** | • Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future.<br>• Science assumes the universe is a vast single system in which basic laws are consistent. |
| **Science is a Human Endeavor** | • Scientific knowledge is a result of human endeavor, imagination, and creativity.<br>• Technological advances have influenced the progress of science and science has influenced advances in technology. |
| **Science Addresses Questions About the Natural and Material World.** | • Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions.<br>• Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge.<br>• Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues. |

## Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

| CCSS: Conceptual Category – Number and Quantity | |
|---|---|
| **The Real Number System** | • Use properties of rational and irrational numbers. |
| **Quantities** | • *Reason quantitatively and use units to solve problems. |

| CCSS: Conceptual Category – Statistics and Probability | |
|---|---|
| **Interpreting Categorical and Quantitative Data** | • *Summarize, represent, and interpret data on a single count or measurement variable. |
| **Making Inferences and Justifying Conclusions** | • *Understand and evaluate random processes underlying statistical experiments. |
| **Conditional Probability and the Rules of Probability** | • *Understand independence and conditional probability and use them to interpret data.<br>• *Use the rules of probability to compute probabilities of compound events in a uniform probability model. |
| **Using Probability to Make Decisions** | • *Calculate expected values and use them to solve problems. |

## Common Core State Standards for English Language Arts

| CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10 | |
|---|---|
| **Integration of Knowledge and Ideas** | • **RST.9-10.7 –** Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. |
| **Range of Reading and Level of Text Complexity** | • **RST.9-10.10 –** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. |

| CCSS: English Language Arts Standards » Writing » Grade 9-10 | |
|---|---|
| **Production and Distribution of Writing** | • **WHST.9-10.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. |
| **Research to Build and Present Knowledge** | • **WHST.9-10.7 –** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when |

| | |
|---|---|
| | appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. |
| **Range of Writing** | • **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. |

## Essential Questions

1. How are the processes of sexual reproduction in animals similar to plants?
2. Where does cell multiplication take place in an animal?
3. How is meiosis involved in animal reproduction?
4. How do meiosis and mitosis differ?
5. What is a gamete and a zygote?
6. How can specific traits in animals be predicted in offspring?
7. What are dominant genetic traits and why are they important to understanding genetic probability?
8. What is genetics?
9. What is fertilization?
10. What is the Punnett Square method and how is it used in animal production?
11. What are the stages (phases) of mitosis?
12. What is codominance?
13. What is incomplete dominance?
14. What are sex-linked traits and how are animals influenced by them?

# Lesson 7.2 Predicting Genetic Inheritance

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Qualitative traits are inherited from a single gene pair and can be predicted using Punnett Squares. | • Use Punnett Squares to predict the probability of genetic frequencies. (Activity 7.2.1)<br>• Complete a Punnett Square with a dihybrid cross. (Activity 7.2.1) |
| 2. Ratios are used to compare animals within a contemporary group. | • Calculate a contemporary group ratio. (Activity 7.2.2) |
| 3. Expected Progeny Differences are utilized by producers to select animals for heritable traits. | • Compare animals based on their expected progeny differences (EPDs). (Activity 7.2.3) |
| 4. Quantitative traits are inherited through multiple gene pairs and can be affected by the environment. | • Evaluate the quantitative traits of livestock using EPDs. (Activity 7.2.3) |
| 5. Economically relevant traits can be predictably changed through genetic improvement by selective breeding using EPDs. | • Use EPDs in mating decisions. (Activity 7.2.3) |
| 6. Pedigrees contain important information for examining genetic history. | • Trace genetic inheritance through a pedigree. (Activity 7.2.4) |

## National AFNR Career Cluster Content Standards Alignment

| AFNR: LifeKnowledge® and Cluster Skills Content Standards | |
|---|---|
| **CS.08.** | Technical Skills: Use tools, equipment, machinery and technology appropriate to work within areas related to AFNR. |
| **CS.11.** | Scientific Inquiry: Utilize scientific inquiry as an investigative method. |

| AFNR: Animal Systems Career Pathway Content Standards | |
|---|---|
| **AS.02.** | Classify, evaluate, select, and manage animals based on anatomical and physiological characteristics. |
| **AS.05.** | Evaluate and select animals based on scientific principles of animal production. |

## Next Generation Science Standards Alignment

| Disciplinary Core Ideas | |
|---|---|
| **Life Science** | |
| **LS3: Heredity: Inheritance and Variation of Traits** | |
| **LS3.A: Inheritance of Traits** | • Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. |
| **LS3.B: Variation of Traits** | • Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors. |

| Science and Engineering Practices | |
|---|---|
| **Developing and Using Models** | Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).<br>• Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism, or system in order to select or revise a model that best fits the evidence or design criteria. |
| **Using Mathematics and Computational Thinking** | Mathematical and computational thinking in 9-12 builds on K-8 and experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.<br>• Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, etc.). |

| Crosscutting Concepts | |
|---|---|
| **Patterns** | Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them. |
| | • Patterns of performance of designed systems can be analyzed and interpreted to reengineer and improve the system.<br>• Empirical evidence is needed to identify patterns. |
| **Scale, Proportion, and Quantity** | In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change. |
| | • Patterns observable at one scale may not be observable or exist at other scales. |
| **Structure and Function** | The way an object is shaped or structured determines many of its properties and functions. |
| | • The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. |
| **Understandings about the Nature of Science** | |

| | |
|---|---|
| **Scientific Investigations Use a Variety of Methods** | • New technologies advance scientific knowledge.<br>• Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings.<br>• Scientific investigations use a variety of methods, tools, and techniques to revise and produce new knowledge. |
| **Scientific Knowledge is Based on Empirical Evidence** | • Science disciplines share common rules of evidence used to evaluate explanations about natural systems.<br>• Science includes the process of coordinating patterns of evidence with current theory. |
| **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** | • A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that has been repeatedly confirmed through observation and experiment, and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. |
| **Science is a Way of Knowing** | • Science is both a body of knowledge that represents a current understanding of natural systems and the processes used to refine, elaborate, revise, and extend this knowledge. |
| **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** | • Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. |
| **Science is a Human Endeavor** | • Scientific knowledge is a result of human endeavor, imagination, and creativity.<br>• Technological advances have influenced the progress of science and science has influenced advances in technology. |
| **Science Addresses Questions About the Natural and Material World.** | • Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions.<br>• Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge.<br>• Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues. |

## Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

| **CCSS: Conceptual Category – Number and Quantity** | |
|---|---|
| **The Real Number System** | • Use properties of rational and irrational numbers. |
| **Quantities** | • *Reason quantitatively and use units to solve problems. |

| **CCSS: Conceptual Category – Statistics and Probability** | |
|---|---|
| **Interpreting Categorical and Quantitative Data** | • *Summarize, represent, and interpret data on a single count or measurement variable. |
| **Making Inferences and Justifying Conclusions** | • *Understand and evaluate random processes underlying statistical experiments. |
| **Conditional Probability and the Rules of Probability** | • *Understand independence and conditional probability and use them to interpret data.<br>• *Use the rules of probability to compute probabilities of compound events in a uniform probability model. |
| **Using Probability to Make Decisions** | • *Calculate expected values and use them to solve problems. |

## Common Core State Standards for English Language Arts

| **CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10** | |
|---|---|
| **Integration of Knowledge and Ideas** | • **RST.9-10.7 –** Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. |
| **Range of Reading and Level of Text Complexity** | • **RST.9-10.10 –** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. |

| **CCSS: English Language Arts Standards » Writing » Grade 9-10** | |
|---|---|
| **Production and Distribution of Writing** | • **WHST.9-10.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. |

| | |
|---|---|
| **Research to Build and Present Knowledge** | • **WHST.9-10.7 –** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. |
| **Range of Writing** | • **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. |

## Essential Questions

1. What is genetic code?
2. What is genetic inheritance?
3. What is probability?
4. How are probabilities used in animal agriculture?
5. How are Punnett Squares used in animal agriculture?
6. What is the difference between qualitative and quantitative traits?
7. What is a contemporary group?
8. What is a ratio?
9. What is an index?
10. How would you utilize a ratio in genetic selection?
11. What is an Expected Progeny Difference (EPD)?
12. How would you utilize EPDs in genetic selection?
13. How would you utilize economic indexes in genetic selection?
14. What is a pedigree?
15. How can pedigrees be used in animal selection?

# Lesson 8.1 Popular Pathogens

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Disease agents can be spread in a variety of ways including vectors and fomites. | • Simulate the spread of a contagious disease and trace the route the disease takes through a population. (Activity 8.1.1) |
| 2. Infectious diseases are caused by bacteria, viruses, fungi, protozoa, and prions. | • Identify and sketch bacteria, mold, and protozoa from prepared slides. (Activity 8.1.2) |
| 3. Regulatory agencies are responsible for disease prevention and control. | • Research governmental regulatory agencies and identify primary purposes and responsibilities each agency has regarding disease prevention and control. (Project 8.1.3)<br>• Argue the role of a regulatory agency in a disease-outbreak scenario. (Project 8.1.3) |

## National AFNR Career Cluster Content Standards Alignment

| **AFNR: LifeKnowledge® and Cluster Skills Content Standards** |
|---|

| | |
|---|---|
| **CS.04.** | Systems: Examine roles within teams, work units, departments, organizations, inter-organizational systems, and the larger environment. |
| **CS.05.** | Systems: Identify how key organizational structures and processes affect organizational performance and the quality of products and services. |
| **CS.06.** | Examine the importance of health, safety, and environmental management systems in organizations and their importance to performance and regulatory compliance. |
| **CS.07.** | Safety, Health, and Environmental: Demonstrate appropriate health and safety procedures for AFNR occupations. |
| **CS.11.** | Scientific Inquiry: Utilize scientific inquiry as an investigative method. |

| **AFNR: Animal Systems Career Pathway Content Standards** | |
|---|---|
| **AS.03.** | Provide for the proper health care of animals. |
| **AS.08.** | Analyze environmental factors associated with animal production. |

## Next Generation Science Standards Alignment

| **Disciplinary Core Ideas** | |
|---|---|
| **Life Science** | |
| **LS1: From Molecules to Organisms: Structures and Processes** | |
| **LS1.A: Structure and Function** | • Systems of specialized cells within organisms help them perform the essential functions of life.<br>• Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. |

| **Science and Engineering Practices** | |
|---|---|
| **Constructing Explanations and Designing Solutions** | Constructing explanations and designing solutions in 9–12 builds on K– 8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.<br>• Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. |
| **Engaging in Argument from Evidence** | Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.<br>• Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.<br>• Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence.<br>• Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge, and student-generated evidence.<br>• Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations). |
| **Obtaining, Evaluating, and Communicating Information** | Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.<br>• Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem. |

| **Crosscutting Concepts** | |
|---|---|
| **Structure and Function** | The way an object is shaped or structured determines many of its properties and functions. |

| | |
|---|---|
| | • Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.<br>• The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. |

| **Understandings about the Nature of Science** | |
|---|---|
| **Scientific Investigations Use a Variety of Methods** | • Science investigations use diverse methods and do not always use the same set of procedures to obtain data.<br>• New technologies advance scientific knowledge.<br>• Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings. |

## Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

| **CCSS: Conceptual Category – Number and Quantity** | |
|---|---|
| **The Real Number System** | • Use properties of rational and irrational numbers. |
| **Quantities** | • *Reason quantitatively and use units to solve problems. |

| **CCSS: Conceptual Category – Algebra** | |
|---|---|
| **Reasoning with Equations and Inequalities** | • Understand solving equations as a process of reasoning and explain the reasoning. |

| **CCSS: Conceptual Category – Statistics and Probability** | |
|---|---|
| **Making Inferences and Justifying Conclusions** | • *Make inferences and justify conclusions from sample surveys, experiments, and observational studies. |

## Common Core State Standards for English Language Arts

| **CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10** | |
|---|---|
| **Key Ideas and Details** | • **RST.9-10.2 –** Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.<br>• **RST.9-10.3 –** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. |
| **Integration of Knowledge and Ideas** | • **RST.9-10.7 –** Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.<br>• **RST.9-10.8 –** Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. |
| **Range of Reading and Level of Text Complexity** | • **RST.9-10.10 –** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. |

| **CCSS: English Language Arts Standards » Writing » Grade 9-10** | |
|---|---|
| **Text Types and Purposes** | **WHST.9-10.1 –** Write arguments focused on discipline-specific content.<br>• **WHST.9-10.1.B –** Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns.<br>• **WHST.9-10.1.E –** Provide a concluding statement or section that follows from or supports the argument presented.<br>**WHST.9-10.2 –** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.<br>• **WHST.9-10.2.D –** Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.<br>• **WHST.9-10.2.E –** Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. |

| | |
|---|---|
| **Production and Distribution of Writing** | • **WHST.9-10.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. |
| **Research to Build and Present Knowledge** | • **WHST.9-10.7 –** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.<br>• **WHST.9-10.8 –** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation. |
| **Range of Writing** | • **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. |

## Essential Questions

1. What is a pathogen?
2. What is a disease?
3. How do you distinguish between an infectious disease, a contagious disease, and a noninfectious disease?
4. How are diseases transmitted?
5. What causes diseases?
6. What are the differences in bacteria, viruses, fungi, protozoa, and prions?
7. What are the three shapes of bacteria?
8. What is a regulatory agency?
9. How does a regulatory agency limit and control the spread of disease?
10. What is quarantine?
11. Who enforces quarantines?
12. What is APHIS and how are they responsible for regulating disease?
13. What role does the CDC play in limiting the spread of disease?

# Lesson 8.2 Diseased!

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Vital signs are used to identify health or illness and vary among species. | • Research and record the vital signs of an animal. (Activity 8.2.1)<br>• Assess vital signs of an animal. (Activity 8.2.1) |
| 2. Diseases are diagnosed through observation of symptoms and physical examinations. | • Research and record key facts and symptoms of two animal-related diseases. (Project 8.2.2)<br>• Determine what disease an animal has from case studies. (Activity 8.2.3) |

## National AFNR Career Cluster Content Standards Alignment

| **AFNR: LifeKnowledge® and Cluster Skills Content Standards** |
|---|

| | |
|---|---|
| **CS.05.** | Systems: Identify how key organizational structures and processes affect organizational performance and the quality of products and services. |
| **CS.06.** | Examine the importance of health, safety, and environmental management systems in organizations and their importance to performance and regulatory compliance. |
| **CS.11.** | Scientific Inquiry: Utilize scientific inquiry as an investigative method. |

| **AFNR: Animal Systems Career Pathway Content Standards** | |
|---|---|
| **AS.03.** | Provide for the proper health care of animals. |

## Next Generation Science Standards Alignment

| **Science and Engineering Practices** | |
|---|---|
| **Asking Questions and Defining Problems** | Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.<br>• Ask questions that arise from careful observation of phenomena, or unexpected results<br>▪ to clarify and/or seek additional information.<br>▪ to determine relationships, including quantitative relationships, between independent and dependent variables. |
| | • Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.<br>• Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical and/or environmental considerations. |
| **Analyzing and Interpreting Data** | Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.<br>• Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success. |
| **Constructing Explanations and Designing Solutions** | Constructing explanations and designing solutions in 9–12 builds on K– 8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.<br>• Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables.<br>• Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion.<br>• Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. |

| **Understandings about the Nature of Science** | |
|---|---|
| **Scientific Investigations Use a Variety of Methods** | • Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings.<br>• Scientific investigations use a variety of methods, tools, and techniques to revise and produce new knowledge. |
| **Scientific Knowledge is Based on Empirical Evidence** | • Science knowledge is based on empirical evidence.<br>• Science arguments are strengthened by multiple lines of evidence supporting a single explanation. |
| **Science Addresses Questions About the Natural and Material World.** | • Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions.<br>• Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues. |

## Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

| **CCSS: Conceptual Category – Number and Quantity** | |
|---|---|
| **The Real Number System** | • Use properties of rational and irrational numbers. |

| | |
|---|---|
| **Quantities** | • *Reason quantitatively and use units to solve problems. |

## Common Core State Standards for English Language Arts

| CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10 | |
|---|---|
| **Key Ideas and Details** | • **RST.9-10.3 –** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. |
| **Integration of Knowledge and Ideas** | • **RST.9-10.9 –** Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts. |
| **Range of Reading and Level of Text Complexity** | • **RST.9-10.10 –** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. |

| CCSS: English Language Arts Standards » Writing » Grade 9-10 | |
|---|---|
| **Research to Build and Present Knowledge** | • **WHST.9-10.7 –** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.<br>• **WHST.9-10.8 –** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation. |

## Essential Questions

1. What is health?
2. What is a disease?
3. What are signs of good health?
4. What are signs of poor health?
5. How are diseases diagnosed?
6. How can observing symptoms lead to a disease diagnosis?
7. What are zoonotic diseases?
8. What are vital signs?
9. Why is knowing the vital signs of an animal important?
10. Why is knowing the vital signs of a human important?
11. How do you know if a disease can be transmitted to a human from an animal?
12. What is considered a high body temperature?

# Lesson 8.3 Bugged!

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand*<br>1. A livestock producer's knowledge of the life cycle of parasites can aid in parasite control and prevention. | *Students will learn concepts by doing*<br>• Identify and diagram the life cycle of a common parasite. (Activity 8.3.1)<br>• Classify parasites according to their phylum and site of infestation on the body. (Activity 8.3.1) |

| | |
|---|---|
| 2. There are multiple methods to determine the presence of parasitic eggs in an animal, of which the laboratory is the most accurate. | • Prepare slides and observe to determine the presence of parasite eggs. (Activity 8.3.2) |

## National AFNR Career Cluster Content Standards Alignment

| AFNR: LifeKnowledge® and Cluster Skills Content Standards | |
|---|---|
| **CS.08.** | Technical Skills: Use tools, equipment, machinery and technology appropriate to work within areas related to AFNR. |
| **CS.11.** | Scientific Inquiry: Utilize scientific inquiry as an investigative method. |

| AFNR: Animal Systems Career Pathway Content Standards | |
|---|---|
| **AS.03.** | Provide for the proper health care of animals. |
| **AS.08.** | Analyze environmental factors associated with animal production. |

## Next Generation Science Standards Alignment

| Disciplinary Core Ideas | |
|---|---|
| **Life Science** | |
| **LS1: From Molecules to Organisms: Structures and Processes** | |
| **LS1.A: Structure and Function** | • Systems of specialized cells within organisms help them perform the essential functions of life.<br>• Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.<br>• Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. |

| Science and Engineering Practices | |
|---|---|
| **Asking Questions and Defining Problems** | Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.<br>• Ask questions that arise from careful observation of phenomena, or unexpected results<br>  ▪ to clarify and/or seek additional information.<br>• Evaluate a question to determine if it is testable and relevant.<br>• Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.<br>• Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical and/or environmental considerations. |
| **Obtaining, Evaluating, and Communicating Information** | Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.<br>• Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem. |

| Crosscutting Concepts | |
|---|---|
| **Structure and Function** | The way an object is shaped or structured determines many of its properties and functions. |
| | • The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. |

| Understandings about the Nature of Science |
|---|

| | |
|---|---|
| **Scientific Knowledge is Based on Empirical Evidence** | • Science knowledge is based on empirical evidence.<br>• Science disciplines share common rules of evidence used to evaluate explanations about natural systems. |

## Common Core State Standards for English Language Arts

| CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10 | |
|---|---|
| **Key Ideas and Details** | • **RST.9-10.3 –** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. |
| **Range of Reading and Level of Text Complexity** | • **RST.9-10.10 –** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. |

| CCSS: English Language Arts Standards » Writing » Grade 9-10 | |
|---|---|
| **Research to Build and Present Knowledge** | • **WHST.9-10.7 –** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. |
| **Range of Writing** | • **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. |

## Essential Questions

1. What is a parasite?
2. What is a host?
3. What is the difference between an external and an internal parasite?
4. How do parasites harm animals?
5. What is the life cycle of a parasite?
6. How can you determine if an animal has internal parasites?
7. How can parasites be prevented or controlled in animals?

# Lesson 8.4 Pathogens Prevented

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Disease prevention includes vaccination, sanitation, ventilation, and nutrition and is morally and economically warranted. | • Administer intramuscular and subcutaneous shots. (Activity 8.4.1)<br>• Demonstrate the proper procedures for filling a syringe for the purpose of giving shots. (Activity 8.4.1) |
| 2. Vaccines are available for many common diseases. | • Research diseases and parasites of their animals and the preventative controls of the diseases and parasites. (Project 8.4.2) |
| 3. Record keeping is important in scheduling and administering preventative medications. | • Develop a preventative care plan for their animal. (Project 8.4.2) |

## National AFNR Career Cluster Content Standards Alignment

| AFNR: LifeKnowledge® and Cluster Skills Content Standards |
|---|

| | |
|---|---|
| **CS.08.** | Technical Skills: Use tools, equipment, machinery and technology appropriate to work within areas related to AFNR. |
| **CS.11.** | Scientific Inquiry: Utilize scientific inquiry as an investigative method. |

| **AFNR: Animal Systems Career Pathway Content Standards** | |
|---|---|
| **AS.03.** | Provide for the proper health care of animals. |

## Next Generation Science Standards Alignment

| **Science and Engineering Practices** | |
|---|---|
| **Constructing Explanations and Designing Solutions** | Constructing explanations and designing solutions in 9–12 builds on K– 8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. |
| | • Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. |
| **Obtaining, Evaluating, and Communicating Information** | Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.<br>• Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.<br>• Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source.<br>• Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). |

| **Crosscutting Concepts** | |
|---|---|
| **Structure and Function** | The way an object is shaped or structured determines many of its properties and functions. |
| | • The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. |

| **Understandings about the Nature of Science** | |
|---|---|
| **Scientific Investigations Use a Variety of Methods** | • New technologies advance scientific knowledge.<br>• Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings.<br>• Scientific investigations use a variety of methods, tools, and techniques to revise and produce new knowledge. |
| **Scientific Knowledge is Based on Empirical Evidence** | • Science knowledge is based on empirical evidence.<br>• Science disciplines share common rules of evidence used to evaluate explanations about natural systems.<br>• Science includes the process of coordinating patterns of evidence with current theory.<br>• Science arguments are strengthened by multiple lines of evidence supporting a single explanation. |
| **Science Addresses Questions About the Natural and Material World.** | • Not all questions can be answered by science.<br>• Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions.<br>• Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge.<br>• Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues. |

## Common Core State Standards for English Language Arts

| **CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10** | |
|---|---|
| **Key Ideas and Details** | • **RST.9-10.3 –** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. |

| | |
|---|---|
| **Integration of Knowledge and Ideas** | • **RST.9-10.7 –** Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. |
| **Range of Reading and Level of Text Complexity** | • **RST.9-10.10 –** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. |

| **CCSS: English Language Arts Standards » Writing » Grade 9-10** | |
|---|---|
| **Text Types and Purposes** | **WHST.9-10.2 –** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.<br>• **WHST.9-10.2.D –** Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.<br>• **WHST.9-10.2.F –** Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic). |
| **Research to Build and Present Knowledge** | • **WHST.9-10.7 –** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.<br>• **WHST.9-10.8 –** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation. |
| **Range of Writing** | • **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. |

## Essential Questions

1. What are vaccinations?
2. How do vaccinations increase immunity?
3. How are shots administered?
4. What is the difference between intramuscular and subcutaneous shots?
5. What is the correct vaccination schedule for the animal in my *Producer's Management Guide*?
6. Why is record keeping essential to treating and preventing disease?
7. How do vaccinations increase productivity and profit?
8. What diseases do producers commonly vaccinate livestock?

# Lesson 9.1 The Products of Our Toil

| **Concepts** | **Performance Objectives** |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. The primary purpose of livestock production is food and fiber. | • Research an animal product and develop a presentation on that animal product. (Project 9.1.1)<br>• Work as a team to prepare and present a class lecture. (Project 9.1.1) |
| 2. Grading is used to provide consistent and palatable food products. | • Conduct sensory evaluation trials on meat samples and evaluate the samples. (Activity 9.1.2)<br>• Taste milk samples and determine the defects, if present. (Activity 9.1.3) |

| | |
|---|---|
| | • Identify samples of cheese based on appearance and taste. (Activity 9.1.3)<br>• Grade eggs based on their interior qualities using the candling and breakout methods. (Activity 9.1.4) |

## National AFNR Career Cluster Content Standards Alignment

| AFNR: LifeKnowledge® and Cluster Skills Content Standards | |
|---|---|
| **CS.05.** | Systems: Identify how key organizational structures and processes affect organizational performance and the quality of products and services. |
| **CS.06.** | Examine the importance of health, safety, and environmental management systems in organizations and their importance to performance and regulatory compliance. |
| **CS.07.** | Safety, Health, and Environmental: Demonstrate appropriate health and safety procedures for AFNR occupations. |
| **CS.08.** | Technical Skills: Use tools, equipment, machinery and technology appropriate to work within areas related to AFNR. |
| **CS.11.** | Scientific Inquiry: Utilize scientific inquiry as an investigative method. |

| AFNR: Animal Systems Career Pathway Content Standards | |
|---|---|
| **AS.02.** | Classify, evaluate, select, and manage animals based on anatomical and physiological characteristics. |

## Next Generation Science Standards Alignment

| Science and Engineering Practices | |
|---|---|
| **Asking Questions and Defining Problems** | Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.<br>• Ask questions that arise from careful observation of phenomena, or unexpected results<br>▪ to clarify and/or seek additional information.<br>▪ that arise from examining models or a theory, to clarify and/or seek additional information and relationships.<br>▪ to clarify and refine a model, an explanation, or an engineering problem.<br>• Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical and/or environmental considerations. |
| **Constructing Explanations and Designing Solutions** | Constructing explanations and designing solutions in 9–12 builds on K– 8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.<br>• Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. |
| | • Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge, and student-generated evidence. |
| **Obtaining, Evaluating, and Communicating Information** | Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.<br>• Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source.<br>• Evaluate the validity and reliability of and/or synthesize multiple claims, methods, and/or designs that appear in scientific and technical texts or media reports, verifying the data when possible.<br>• Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). |

| Crosscutting Concepts |
|---|

| | |
|---|---|
| **Cause and Effect: Mechanism and Prediction** | Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering. |
| | • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.<br>• Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.<br>• Systems can be designed to cause a desired effect.<br>• Changes in systems may have various causes that may not have equal effects. |
| **Structure and Function** | The way an object is shaped or structured determines many of its properties and functions. |
| | • The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. |
| **Understandings about the Nature of Science** | |
| **Scientific Investigations Use a Variety of Methods** | • Science investigations use diverse methods and do not always use the same set of procedures to obtain data.<br>• Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings.<br>• The discourse practices of science are organized around disciplinary domains that share exemplars for making decisions regarding the values, instruments, methods, models, and evidence to adopt and use.<br>• Scientific investigations use a variety of methods, tools, and techniques to revise and produce new knowledge. |

## Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

| CCSS: Conceptual Category – Number and Quantity | |
|---|---|
| **The Real Number System** | • Use properties of rational and irrational numbers. |
| **Quantities** | • *Reason quantitatively and use units to solve problems. |

| CCSS: Conceptual Category – Statistics and Probability | |
|---|---|
| **Interpreting Categorical and Quantitative Data** | • *Summarize, represent, and interpret data on a single count or measurement variable. |

## Common Core State Standards for English Language Arts

| CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10 | |
|---|---|
| **Key Ideas and Details** | • **RST.9-10.2 –** Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.<br>• **RST.9-10.3 –** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. |
| **Integration of Knowledge and Ideas** | • **RST.9-10.7 –** Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. |
| **Range of Reading and Level of Text Complexity** | • **RST.9-10.10 –** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. |

| CCSS: English Language Arts Standards » Writing » Grade 9-10 | |
|---|---|
| **Text Types and Purposes** | **WHST.9-10.2 –** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.<br>• **WHST.9-10.2.A –** Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.<br>• **WHST.9-10.2.B –** Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. |

| | |
|---|---|
| **Research to Build and Present Knowledge** | • **WHST.9-10.8 –** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation. |
| **Range of Writing** | • **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. |

## Essential Questions

1. What is an animal product?
2. What is grading?
3. What major product do consumers receive from each type of agricultural animal?
4. What are wholesale and retail cuts?
5. What is the difference between fresh and processed products?
6. What are food safety concerns in animal products?
7. What is sensory evaluation?
8. What is palatability?
9. How do flavor, tenderness, and juiciness influence palatability?
10. What causes milk to have off-flavors?
11. What is the breakout method?
12. What is the candling method?
13. How are eggs candled?
14. What characteristics of eggs are used in assigning them a grade?

# Lesson 9.2 In Search of the Ideal Animal

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Criterion-based selection establishes priorities and provides consistency when evaluating animal conformation for specific species and purposes. | • Make decisions based on given priorities and criteria, and analyze objects as they compare ideal criteria. (Activity 9.2.1) |
| 2. Producers use qualitative and quantitative comparison of live animals to predict value in the marketplace. | • Research and identify the priorities for evaluating an animal most commonly used in that animal industry. (Project 9.2.2)<br>• Write, illustrate, and publish a children's storybook on how to select an animal. (Project 9.2.2) |
| 3. Offspring performance may be predicted and improved by selecting animals based on performance records. | • Determine and recommend most appropriate sires using Expected Progeny Differences. (Problem 9.2.3) |

## National AFNR Career Cluster Content Standards Alignment

| **AFNR: LifeKnowledge® and Cluster Skills Content Standards** |
|---|
| **CS.02.** Personal Growth: Develop a skill set to enhance the positive evolution of the whole person. |

| | |
|---|---|
| **CS.08.** | Technical Skills: Use tools, equipment, machinery and technology appropriate to work within areas related to AFNR. |
| **CS.11.** | Scientific Inquiry: Utilize scientific inquiry as an investigative method. |
| **AFNR: Animal Systems Career Pathway Content Standards** | |
| **AS.02.** | Classify, evaluate, select, and manage animals based on anatomical and physiological characteristics. |
| **AS.05.** | Evaluate and select animals based on scientific principles of animal production. |

## Next Generation Science Standards Alignment

| **Disciplinary Core Ideas** | |
|---|---|
| **Life Science** | |
| **LS3: Heredity: Inheritance and Variation of Traits** | |
| **LS3.A: Inheritance of Traits** | • Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. |
| **LS3.B: Variation of Traits** | • In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited.<br>• Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors. |

| **Science and Engineering Practices** | |
|---|---|
| **Asking Questions and Defining Problems** | Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.<br>• Ask questions that arise from careful observation of phenomena, or unexpected results<br>▪ to clarify and/or seek additional information.<br>▪ that arise from examining models or a theory, to clarify and/or seek additional information and relationships.<br>• Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.<br>• Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. |
| **Analyzing and Interpreting Data** | Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.<br>• Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.<br>• Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations. |
| **Using Mathematics and Computational Thinking** | Mathematical and computational thinking in 9-12 builds on K-8 and experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.<br>• Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations. |
| **Engaging in Argument from Evidence** | Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. |

| | |
|---|---|
| | • Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.<br>• Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence. |
| | • Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge, and student-generated evidence.<br>• Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations). |

| **Crosscutting Concepts** | |
|---|---|
| **Structure and Function** | The way an object is shaped or structured determines many of its properties and functions. |
| | • The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. |

## Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

| **CCSS: Conceptual Category – Number and Quantity** | |
|---|---|
| **The Real Number System** | • Use properties of rational and irrational numbers. |
| **The Complex Number System** | • Represent complex numbers and their operations on the complex plane. |

| **CCSS: Conceptual Category – Statistics and Probability** | |
|---|---|
| **Interpreting Categorical and Quantitative Data** | • *Summarize, represent, and interpret data on a single count or measurement variable. |
| **Conditional Probability and the Rules of Probability** | • *Understand independence and conditional probability and use them to interpret data. |
| **Using Probability to Make Decisions** | • *Calculate expected values and use them to solve problems.<br>• *Use probability to evaluate outcomes of decisions. |

## Common Core State Standards for English Language Arts

| **CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10** | |
|---|---|
| **Key Ideas and Details** | • **RST.9-10.2 –** Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. |
| **Craft and Structure** | • **RST.9-10.5 –** Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). |
| **Integration of Knowledge and Ideas** | • **RST.9-10.7 –** Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.<br>• **RST.9-10.8 –** Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.<br>• **RST.9-10.9 –** Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts. |
| **Range of Reading and Level of Text Complexity** | • **RST.9-10.10 –** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. |

| **CCSS: English Language Arts Standards » Writing » Grade 9-10** | |
|---|---|
| **Text Types and Purposes** | **WHST.9-10.2 –** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.<br>• **WHST.9-10.2.A –** Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.<br>• **WHST.9-10.2.B –** Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. |

| | |
|---|---|
| | • **WHST.9-10.2.C –** Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts.<br>• **WHST.9-10.2.D –** Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.<br>• **WHST.9-10.2.E –** Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. |
| **Production and Distribution of Writing** | • **WHST.9-10.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.<br>• **WHST.9-10.5 –** Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.<br>• **WHST.9-10.6 –** Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically. |
| **Research to Build and Present Knowledge** | • **WHST.9-10.8 –** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation. |
| **Range of Writing** | • **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. |

## Essential Questions

1. What is criterion-based selection?
2. How can established priorities be used when making decisions?
3. What is conformation?
4. How do evaluating breeding and market animals differ?
5. What criteria are used in evaluating a species of animal?
6. How does data complement visual selection?
7. What are EPDs?
8. When are EPDs useful in selecting animals?

# Lesson 9.3 Value Added

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. The four elements of marketing are product, price, place, and promotion. | • Compare similar products based on their features, pricing, distribution, and promotion. (Activity 9.3.1) |
| 2. Brand name recognition, niche marketing, and value-added products increase the value of a good. | • Determine a target market and potential products based on the local community. (Project 9.3.2)<br>• Develop a plan to market a product from their project for the *Producer's Management Guide*. (Project 9.3.2) |
| 3. A solid marketing plan is necessary to increase the value and sales of a product and move goods from producer to consumer. | • Work on a team to determine a market for a product in an appropriate local marketplace. (Problem 9.3.3) |

## National AFNR Career Cluster Content Standards Alignment

| **AFNR: LifeKnowledge® and Cluster Skills Content Standards** |
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| **CS.03.** | Career Success: Demonstrate those qualities, attributes and skills necessary to succeed in, or further prepare for, a chosen career while effectively contributing to society. |
| **CS.04.** | Systems: Examine roles within teams, work units, departments, organizations, inter-organizational systems, and the larger environment. |
| **CS.05.** | Systems: Identify how key organizational structures and processes affect organizational performance and the quality of products and services. |
| **CS.10.** | Technical Skills: Envision emerging technology and globalization to project its influence on widespread markets. |
| **CS.11.** | Scientific Inquiry: Utilize scientific inquiry as an investigative method. |
| **AFNR: Agribusiness Systems Career Pathway Content Standards** | |
| **ABS.02.** | Utilize appropriate management planning principles in AFNR business enterprises. |
| **ABS.06.** | Use industry-accepted marketing principles to accomplish AFNR business objectives. |

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| **AFNR: Animal Systems Career Pathway Content Standards** | |
| **AS.01.** | Examine the components, historical development, global implications, and future trends of the animal systems industry. |
| **AS.02.** | Classify, evaluate, select, and manage animals based on anatomical and physiological characteristics. |

## Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

| **CCSS: Conceptual Category – Number and Quantity** | |
|---|---|
| **Quantities** | • *Reason quantitatively and use units to solve problems. |

## Common Core State Standards for English Language Arts

| **CCSS: English Language Arts Standards » Writing » Grade 9-10** | |
|---|---|
| **Production and Distribution of Writing** | • **WHST.9-10.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. |
| **Range of Writing** | • **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. |

## Essential Questions

1. What is the difference between marketing and selling?
2. Why is marketing beneficial in agriculture?
3. What are the four P's of marketing?
4. What specialty markets exist in agriculture?
5. How are products developed and marketed?
6. How does product branding influence the marketing mix?
7. What is niche marketing?

# Lesson 2.3 Livestock Across the United States (Optional)

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Livestock production occurs in different regions of the United States. | • Develop a poster examining the characteristics of a livestock production region. (Project 2.3.1)<br>• Explain how the resources available in different regions of the United States support and promote the production of animals. (Project 2.3.1) |
| 2. Characteristics, such as climate, land price, population, industry infrastructure, feed resources, and transportation systems influence where commercial animals are produced in the United States. | • Map the regions of commercial animal production. (Activity 2.3.2) |

## National AFNR Career Cluster Content Standards Alignment

| AFNR: Animal Systems Career Pathway Content Standards | |
|---|---|
| **AS.01.** | Examine the components, historical development, global implications, and future trends of the animal systems industry. |
| **AS.08.** | Analyze environmental factors associated with animal production. |

## Next Generation Science Standards Alignment

| Disciplinary Core Ideas | |
|---|---|
| **Life Science** | |
| **LS2: Ecosystems: Interactions, Energy, and Dynamics** | |
| **LS2.A: Interdependent Relationships in Ecosystems** | • Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. |
| **Earth and Space Science** | |
| **ESS3: Earth and Human Activity** | |
| **ESS3.A: Natural Resources** | • Resource availability has guided the development of human society. |
| **ESS3.C: Human Impacts on Earth Systems** | • The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. |

## Common Core State Standards for English Language Arts

| CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10 | |
|---|---|
| **Craft and Structure** | • **RST.9-10.4 –** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics. |
| **Range of Reading and Level of Text Complexity** | • **RST.9-10.10 –** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. |

| CCSS: English Language Arts Standards » Writing » Grade 9-10 | |
|---|---|
| **Research to Build and Present Knowledge** | • **WHST.9-10.7 –** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. |

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| **Range of Writing** | • **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. |

## Essential Questions

1. What are the six regions of livestock production in the United States?
2. What are the environmental characteristics that determine a region?
3. What makes one region of the United States well suited for a certain type of animal production and another region poorly suited for the same type of animal production?
4. What influences do large population centers have on agricultural animal production?
5. How do environmental characteristics influence animal production?
6. How do the varieties of crops produced affect the types of animals produced within a region?

# Lesson 7.3 Evolutionary Ideas (Optional)

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Animals today have descended from common ancestors. | • Study the process used to determine common ancestors of species. (Activity 7.3.1)<br>• Diagram a cladogram of seven types of animals. (Activity 7.3.1) |
| 2. Natural selection is an involuntary process of evolution where species adapt to their environment. | • Conduct an experiment on the process of natural selection using the peppered moth. (Activity 7.3.2) |
| 3. The diversity of organisms is the result of billions of years of evolutionary adaptation. | • Determine the types of selection that occur in certain environments. (Activity 7.3.3) |
| 4. Genetic mutations are separate events that can lead to change in the characteristics of a species. | • Determine the evolutionary path of a species of animal. (Project 7.3.4) |

## Next Generation Science Standards Alignment

| **Disciplinary Core Ideas** | |
|---|---|
| **Life Science** | |
| **LS4: Biological Evolution: Unity and Diversity** | |
| **LS4.B: Natural Selection** | • Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals.<br>• The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. |
| **LS4.C: Adaptation** | • Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment.<br>• Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not.<br>• Adaptation also means that the distribution of traits in a population can change when conditions change. |

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| | • Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species.<br>• Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost. |

| **Science and Engineering Practices** | |
|---|---|
| **Developing and Using Models** | Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).<br>• Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism, or system in order to select or revise a model that best fits the evidence or design criteria.<br>• Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations. |

| **Crosscutting Concepts** | |
|---|---|
| **Systems and System Models** | A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems. |
| | • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.<br>• Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. |
| **Structure and Function** | The way an object is shaped or structured determines many of its properties and functions. |
| | • The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. |
| **Stability and Change** | For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand. |
| | • Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.<br>• Systems can be designed for greater or lesser stability. |

| **Understandings about the Nature of Science** | |
|---|---|
| **Scientific Knowledge is Based on Empirical Evidence** | • Science knowledge is based on empirical evidence.<br>• Science disciplines share common rules of evidence used to evaluate explanations about natural systems.<br>• Science arguments are strengthened by multiple lines of evidence supporting a single explanation. |
| **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** | • A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that has been repeatedly confirmed through observation and experiment, and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.<br>• Models, mechanisms, and explanations collectively serve as tools in the development of a scientific theory. |
| **Science is a Way of Knowing** | • Science is both a body of knowledge that represents a current understanding of natural systems and the processes used to refine, elaborate, revise, and extend this knowledge.<br>• Science is a unique way of knowing and there are other ways of knowing. |
| **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** | • Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future.<br>• Science assumes the universe is a vast single system in which basic laws are consistent. |
| **Science Addresses Questions About the Natural and Material World.** | • Not all questions can be answered by science. |

## Common Core State Standards for English Language Arts

**CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10**

| | |
|---|---|
| **Key Ideas and Details** | • **RST.9-10.3 –** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. |
| **Integration of Knowledge and Ideas** | • **RST.9-10.9 –** Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts. |
| **Range of Reading and Level of Text Complexity** | • **RST.9-10.10 –** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently. |

| **CCSS: English Language Arts Standards » Writing » Grade 9-10** | |
|---|---|
| **Production and Distribution of Writing** | • **WHST.9-10.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. |
| **Research to Build and Present Knowledge** | • **WHST.9-10.7 –** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. |
| **Range of Writing** | • **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. |

## Essential Questions

1. How are organisms related?
2. Why do so many animals have similar structures?
3. How can a cladogram be used to demonstrate relatedness?
4. What is evolution?
5. How does evolution occur?
6. How do predators influence evolution?
7. What forces drive the change in organisms over time?
8. How do animals adapt to live in various environments?
9. Why do similar species evolve differently in separate areas?