Chariho Regional School District - Science Curriculum

September, 2016

ANIMAL SCIENCE CURRICULUM

Unit 1: Domestication and Classification

OVERVIEW

Summary

Students will be introduced to the characteristics of all domesticated animals and classification categories and explain why some animals can be domesticated and some cannot. They will review levels of classification from kingdom to species. They will identify characteristics of both mammals and avians that allow them to be classified into the seven classification categories and discuss relatedness determined by similar classification categories.

Content to Be Learned

- Characteristics of domesticable animals.
- History of the domestication of farm animals.
- The seven classification categories: Kingdom, Phylum, Class, Order, Family, Genus, Species.
- Taxonomy of animals based on relatedness and similar characteristics.

Practices

- Constructing and revising an explanation based on valid and reliable evidence describing why some animals possess traits that allow them to be domesticated while others do not.
- Obtaining, evaluating, and communicating information regarding the relatedness of domestic livestock and poultry.

Crosscutting Concepts

- Cause and effect.
- Influence of science, engineering and technology on society and the natural world.

Essential Questions

- Why are some animals able to be domesticated for human use and some are not?

Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards

- AS.02.01. Performance Indicator: Classify animals according to hierarchical taxonomy and agricultural use.
    - AS.01.01.01.a. Identify the origin, significance, distribution and domestication of animal species.
    - AS.02.01.01.c. Classify animals according to the taxonomical classification system.

- AS.02.01.02.a. Identify major animal species by common and scientific names.

Next Generation Science Standards

Students who demonstrate understanding can:

HS-ETS1-1. **Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.**

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

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.

- Analyze complex real-world problems by specifying criteria and constraints for successful solutions.

Disciplinary Core Ideas

ETS1.A: Defining and Delimiting Engineering Problems

- Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.
- Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.

Crosscutting Concepts

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World

- New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.

Connections to HS-ETS1.A: Defining and Delimiting Engineering Problems include:
Physical Science: HS-PS2-3, HS-PS3-3

Articulation of DCIs across grade-levels:
MS.ETS1.A

Common Core State Standards Connections:

ELA/Literacy -

RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-ETS1-1)

RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. *(HS-ETS1-1)*

RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. (HS-ETS1-1)

Mathematics -

MP.2 Reason abstractly and quantitatively. (HS-ETS1-1)

MP.4 Model with mathematics. (HS-ETS1-1)

* The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

Students who demonstrate understanding can:

HS-LS4-2. **Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.** [Clarification Statement: Emphasis is on using evidence to explain the influence each of the four factors has on number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Examples of evidence could include mathematical models such as simple distribution graphs and proportional reasoning.] [*Assessment Boundary: Assessment does not include other mechanisms of evolution, such as genetic drift, gene flow through migration, and co-evolution.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

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.

- Construct 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.

Disciplinary Core Ideas

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.

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.

Crosscutting Concepts

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Connections to other DCIs in this grade-band:
HS.LS2.A ; **HS.LS2.D** ; **HS.LS3.B** ; **HS.ESS2.E** ; **HS.ESS3.A**

Articulation of DCIs across grade-bands:
MS.LS2.A ; **LS3.B** ; **MS.LS4.B** ; **MS.LS4.C**

Common Core State Standards Connections:

ELA/Literacy -

RST-11.12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS4-2)
WHST.9-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS4-2)
WHST.9-12.9	Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS4-2)
SL.11-12.4	Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. *(HS-LS4-2)*

Mathematics -

MP.2	Reason abstractly and quantitatively. (HS-LS4-2)
MP.4	Model with mathematics. *(HS-LS4-2)*

* The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

The section entitled "Disciplinary Core Ideas" is reproduced verbatim from *A Framework for K-12 Science Education: Practices, Cross-*

Unit 2: Physiology - Skeletal System

OVERVIEW

Summary

Students will extend the levels of classification learned in the previous unit by examining the skeletal systems of domesticated mammals and avians. They will review the levels of organization (organelles, cells, tissues, organs, systems). They will generally review the functions of all physiological systems and focus specifically on the skeletal system. They will use a cat skeleton to illustrate the differences between terrestrial and airborne animals.

Content to Be Learned

- Levels of organization (organelles, cells, tissues, organs, systems).
- Systems are made up of numerous parts.
- Systems work together with other systems to perform a function.
- Name, location, and description of the functions of the parts of the skeletal system.

Practices

- Developing and using a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
- Developing and using models to illustrate differences in the avian and mammalian skeletal system.
- Constructing and revising an explanation based on valid and reliable evidence to describe evolutionary differences between avians and mammals.

Crosscutting Concepts

- System and system models.
- Cause and effect.
- Structure and function.

Essential Questions

- Why have mammals and avians evolved to have different physiological strategies to allow for locomotion and obtaining food to survive?

AFNR Career Cluster Content Standards

- AS.02. Performance Element: Classify, evaluate, select and manage animals based on anatomical and physiological characteristics.
    - AS.02.02.01.a. Identify basic characteristics of animal cells, tissues, organs and body systems.
    - systems of specialized cells help perform essential functions of life (LS1.A)
    - AS.02.02.01.b. Compare and contrast animal cells, tissues, organs and body systems.
    - AS.02.02.01.c. Explain how the components and systems of animal anatomy and physiology relate to the production and use of animals.

Next Generation Science Standards

HS-LS1-2 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

HS-LS1-2. **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.** [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] [*Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

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 worlds.

- Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.

Disciplinary Core Ideas

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.

Crosscutting Concepts

Systems and System Models

- 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.

Connections to other DCIs in this grade-band: N/A

Articulation of DCIs across grade-bands:

MS.LS1.A

Common Core State Standards Connections:

ELA/Literacy -

SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. *(HS-LS1-2)*

* The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

Students who demonstrate understanding can:

HS-LS4-2. **Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.** [Clarification Statement: Emphasis is on using evidence to explain the influence each of the four factors has on number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Examples of evidence could include mathematical models such as simple distribution graphs and proportional reasoning.] [*Assessment Boundary: Assessment does not include other mechanisms of evolution, such as genetic drift, gene flow through migration, and co-evolution.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

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.

- Construct 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.

Disciplinary Core Ideas

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.

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.

Crosscutting Concepts

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Connections to other DCIs in this grade-band:
HS.LS2.A ; **HS.LS2.D** ; **HS.LS3.B** ; **HS.ESS2.E** ; **HS.ESS3.A**

Articulation of DCIs across grade-bands:
MS.LS2.A ; **LS3.B** ; **MS.LS4.B** ; **MS.LS4.C**

Common Core State Standards Connections:

ELA/Literacy -

RST-11.12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS4-2)
WHST.9-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS4-2)
WHST.9-12.9	Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS4-2)
SL.11-12.4	Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. *(HS-LS4-2)*

Mathematics -

MP.2	Reason abstractly and quantitatively. (HS-LS4-2)
MP.4	Model with mathematics. *(HS-LS4-2)*

* The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

The section entitled "Disciplinary Core Ideas" is reproduced verbatim from *A Framework for K-12 Science Education: Practices, Cross-*

Unit 3: Physiology - Digestive System

OVERVIEW

Summary

Students will learn the differences between the monogastric and ruminant digestive system. These differences will explain why animals are able to eat different types of feed and digest them efficiently. Classify farm animals/domestic animals as ruminants or non-ruminants. Finally, students will used models to illustrate the processes of ruminant and non-ruminant digestion.

Content to Be Learned

- The structure and function of the digestive systems of ruminants and non-ruminants.
- Differentiation between ruminant or non-ruminant animals.
- The relationships of types of digestive systems to the ability of ruminants and non-ruminants to digest and absorb different classes of feed.
- Classes of feeds.
- Relationship between the types of digestive systems and the ability to digest and absorb different classes of feed.

Practices

- Developing and using models to show the specific workings on the ruminant and non-ruminant digestive systems.
- Constructing and revising an explanation based on valid and reliable evidence to explain how ruminant digestive systems are specially designed to digest large amounts of roughage while non-ruminant digestive systems are specially designed to digest large amounts of concentrates.
- Analyzing and interpreting data to illustrate the importance of rumen microbes and rumen health.

Crosscutting Concepts

- System and system models.
- Cause and effect.
- Structure and function.
- Energy and matter flow.

Essential Questions

- How do the systems of the body help to maintain homeostasis?
- What is the relationship between the function of ruminant and non-ruminant digestive systems and the feeds these animals are able to consume?

AFNR Career Cluster Content Standards

- AS.02. Performance Element: Classify, evaluate, select and manage animals based on anatomical and physiological characteristics.
    - AS.02.02.01.a. Identify basic characteristics of animal cells, tissues, organs and body systems.
    - systems of specialized cells help perform essential functions of life (LS1.A)
    - AS.02.02.01.b. Compare and contrast animal cells, tissues, organs and body systems.
    - AS.02.02.01.c. Explain how the components and systems of animal anatomy and physiology relate to the production and use of animals.
    - AS.02.02.05.a. Describe the properties, locations, functions and types of animal organs.
    - AS.02.02.06.a. Describe the functions of the animal body systems and system components.
    - AS.02.02.06.b. Compare and contrast body systems and system adaptations between animal species.
    - AS.02.02.06.c. Explain the impact of animal body systems on performance, health, growth and reproduction.
- AS.02.03. Performance Indicator: Select animals for specific purposes and maximum performance based on anatomy and physiology.

- AS.02.03.01.b. Compare and contrast desirable anatomical and physiological characteristics of animals within and between species.

Next Generation Science Standards

Students who demonstrate understanding can:

HS-LS1-2. **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.** [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] [*Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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 worlds. • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.	**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.	**Systems and System Models** • 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.

Connections to other DCIs in this grade-band: N/A

Articulation of DCIs across grade-bands:
MS.LS1.A

Common Core State Standards Connections:
ELA/Literacy -
SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. *(HS-LS1-2)*

* The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

Students who demonstrate understanding can:

HS-LS1-7. **Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.** [Clarification Statement: Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration.] [*Assessment Boundary: Assessment should not include identification of the steps or specific processes involved in cellular respiration.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

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 worlds.
- Use a model based on evidence to illustrate the relationships between systems or between components of a system.

Disciplinary Core Ideas

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.
- As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment.

Crosscutting Concepts

Energy and Matter
- Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems.

Connections to other DCIs in this grade-band:
HS.PS1.B ; **HS.PS2.B** ; **HS.PS3.B**

Articulation of DCIs across grade-bands:
MS.PS1.B ; **MS.PS3.D** ; **MS.LS1.C** ; **MS.LS2.B**

Common Core State Standards Connections:
ELA/Literacy -
SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. *(HS-LS1-7)*

* The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

Unit 4: Feed Nutrients, Feeds, and Feeding

OVERVIEW

Summary

Students will learn about the six basic nutrients groups and how they are digested and used by the body. They will also learn about and be able to identify feeds that are sources of each. Students will identify types and general purpose of feed additives and hormone implants as they pertain to the livestock industry. They will also investigate the implications of using feed additives in the human food supply. Finally, students will use different methods to create balanced rations for animals in all phases of life from maintenance and growth to work and reproduction.

Content to Be Learned

- The major function of the basic nutrient groups.
- Feeds that are sources of each of the basic nutrient groups.
- The characteristics of nutrient sources for each basic nutrient group.
- The general use and purpose of feed additives and hormone implants.
- Labeling and regulation of feed additives.

- The labels of livestock feeds.
- The impact of hormones on livestock product.
- The need for public education on the importance and effect of feed additives and hormones.
- Feed classification as roughages or concentrates.
- The six functions of a good ration.
- The characteristics of a good ration.
- Livestock rations using commonly accepted practices.

Practices

- Using models to determine the nutritional value of feedstuffs.
- Constructing an explanation of why a balanced ration specific to life stage is critically important to animal production.
- Constructing an explanation as to why feed additives are given to promote growth and increase rate of gain.

Crosscutting Concepts

- Systems and system models.
- Cause and effect.

Essential Questions

- Why are each of the nutrient groups critically important to life and using examples, explain how a deficiency or toxicity might impact the production of an animal?
- Why is a balanced ration important to all organisms and what affect does a poor ration have on organisms?
- Why do some people find the use of feed additives such as antibiotics, growth promotants and steroids acceptable in livestock and others do not?

AFNR

- PS.01.01.02.b. Identify agriculturally important plants by common names.
- AS.04.01. Performance Indicator: Formulate feed rations to provide for the nutritional needs of animals.
    - AS.04.01.01.a. Compare and contrast common types of feedstuffs and the roles they play in the diets of animals.
    - AS.04.01.01.b. Determine the relative nutritional value of feedstuffs by evaluating their general quality and condition.
    - AS.04.01.01.c. Select appropriate feedstuffs for animals based on factors such as economics, digestive system and nutritional needs.
    - AS.04.01.02.a. Explain the importance of a balanced ration for animals.
    - AS.04.01.02.b. Appraise the adequacy of feed rations using data from the analysis of feedstuffs, animal requirements and performance.
- AS.04.02. Performance Indicator: Prescribe and administer animal feed additives and growth promotants in animal production.
    - AS.04.02.01.a. Explain the purpose and benefits of feed additives and growth promotants in animal production.

- AS.04.02.01.b. Discuss how feed additives and growth promotants are administered and the precautions that should be taken.
- AS.04.02.01.c. Prescribe and administer feed additives and growth promotants.

Unit 5: Genetics and Reproduction

OVERVIEW

Summary

Students will learn about the process of meiosis, how it occurs, and its importance in terms of reproduction. Students will use punnett squares to illustrate sex determination of individuals. Students will explain how traits are passed from one generation to the next. Additionally, students will be able to identify and describe the male and female reproductive structures. They will describe the function of reproduction-specific glands and hormones in the processes of fertilization, gestation, parturition, and estrus. Finally, students will list different types of reproductive failures and explain how they occur.

Content to Be Learned

- Genetics influence to improvements in livestock production.
- Cell division.
- Process of inheritance of animal characteristics/traits.
- Sex determination in mammals and poultry.
- Male and female reproductive organs of mammals and poultry.
- Cause and effect of reproductive failures.
- Agricultural biotechnology developments.
- Positive and negative impacts of genetic engineering in animal science.
- Specific reproductive technology techniques: embryo transfer and artificial insemination.
- Common breeding systems used in livestock production.
- Advantages and disadvantages of using common breeding systems.

Practices

- Using a model to illustrate the role of cellular division and differentiation in producing and maintaining complex organisms.
- Using models to illustrate the difference in reproductive structures among mammals and avians.
- Asking questions and defining problems with modern reproductive technology techniques.

Crosscutting Concepts

- Cause and effect.
- Structure and function.
- Systems and system models.
- Stability and change.

Essential Questions

- How can selective breeding and reproductive technology be both beneficial and harmful to the livestock industry?

Agriculture, Food and Natural Resource AFNR

- AS.02.02. Performance Indicator: Apply principles of comparative anatomy and physiology to uses within various animal systems.
    - AS.02.02.01.a. Identify basic characteristics of animal cells, tissues, organs and body systems.
    - systems of specialized cells help perform essential functions of life (LS1.A).
    - AS.02.02.01.b. Compare and contrast animal cells, tissues, organs and body systems.
    - AS.02.02.01.c. Explain how the components and systems of animal anatomy and physiology relate to the production and use of animals.
    - AS.02.02.03.b. Detail the processes of meiosis and mitosis in animal growth, development, health and reproduction.
    - AS.02.02.03.c. Explain the application of the processes of meiosis and mitosis to animal growth, development, health and reproduction.
    - AS.02.03.01.b. Compare and contrast desirable anatomical and physiological characteristics of animals within and between species.
    - AS.02.02.05.a. Describe the properties, locations, functions and types of animal organs.
    - AS.02.02.05.b. Compare and contrast organ types and functions among animal species.
    - AS.02.02.05.c. Relate the importance of animal organs to the health, growth and reproduction of animals.
    - AS.02.02.06.a. Describe the functions of the animal body systems and system components.
    - AS.02.02.06.b. Compare and contrast body systems and system adaptations between animal species.
    - AS.02.02.06.c. Explain the impact of animal body systems on performance, health, growth and reproduction.
- AS.05.01. Performance Indicator: Evaluate the male and female reproductive systems in selecting animals.
    - AS.05.01.01.a. Explain the male and female reproductive organs of the major animal species.
    - AS.05.01.01.b. Describe the functions of major organs in the male and female reproductive systems.
- AS.05.03. Performance Indicator: Apply scientific principles in the selection and breeding of animals.
    - AS.05.03.01.a. Explain genetic inheritance in agricultural animals.
    - AS.05.03.01.b. Explain the advantages of using genetically superior animals in the production of animals and animal products.
    - AS.05.03.01.c. Select a breeding system based on the principles of genetics.
    - AS.05.03.02.a. Define natural and artificial breeding methods.
    - AS.05.03.02.b. Explain the processes of natural and artificial breeding methods.
    - AS.05.03.04.a. Explain the advantages of major reproductive management practices, including estrous synchronization, superovulation, flushing and embryo transfer.

- AS.05.03.04.b. Explain the processes of major reproductive management practices, including estrous synchronization, superovulation, flushing and embryo transfer.
- AS.05.03.05.a. Discuss the uses and advantages and disadvantages of natural breeding and artificial insemination.
- AS.05.03.05.b. Explain the materials, methods and processes of artificial insemination.

Next Generation Science Standards

HS-LS3-1 Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can:

HS-LS3-1. **Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.** [*Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. • Ask questions that arise from examining models or a theory to clarify relationships.	**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. *(secondary) (Note: This Disciplinary Core Idea is also addressed by HS-LS1-1.)* **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.	**Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Connections to other DCIs in this grade-band: N/A

Articulation of DCIs across grade-bands:
MS.LS3.A ; MS.LS3.B

Common Core State Standards Connections:
ELA/Literacy -

RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. *(HS-LS3-1)*
RST.11-12.9	Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. *(HS-LS3-1)*

* The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

HS-LS3-2 Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can:

HS-LS3-2. **Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.** [Clarification Statement: Emphasis is on using data to support arguments for the way variation occurs.] [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. • Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence.	**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. • 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.	**Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Connections to other DCIs in this grade-band: N/A

Articulation of DCIs across grade-bands:
MS.LS3.A ; MS.LS3.B

Common Core State Standards Connections:

ELA/Literacy -

RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. *(HS-LS3-2)*
WHST.9-12.1	Write arguments focused on *discipline-specific content.* (HS-LS3-2)

Mathematics -

MP.2	Reason abstractly and quantitatively. (HS-LS3-2)

* The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

Unit 6: Biotechnology and Current Events in Animal Science

OVERVIEW

Summary

Students will apply their knowledge of breeding systems to agricultural biotechnology. They will explore many topics within agricultural biotechnology including cloning and genetic modification. Students will construct an argument either for or against a controversial topic in the field of animal science. While working on this, students will pull from all of their experiences and knowledge gained during the course. Students will present their arguments to the class for discussion and debate.

Content to Be Learned

- Definition of agricultural biotechnology.

- Use of genetic engineering in animal science.
- Current research projects in genetic engineering as it applies to the livestock industry.
- Current research, ideas, arguments in the field of animal science.

Practices

- Communicating scientific information regarding current controversial topics in the field of animal science.
- Engaging in argument from evidence to persuade an audience opinion regarding controversial topics in the field of animal science.

Crosscutting Concepts

- Cause and effect.
- Stability and change.

Essential Questions

- How do producers find the balance between producing a livestock product and pleasing the general public in terms of the medical and human treatment?

Agriculture, Food and Natural Resource AFNR

- AS.01.01. Performance Indicator: Evaluate the development and implications of animal origin, domestication and distribution.
    - AS.01.01.02.a. Define major components of the animal industry.
    - AS.01.01.02.b. Outline the development of the animal industry and the resulting products, services and careers.
- BS.01. Performance Element: Recognize the historical, social, cultural and potential applications of biotechnology.
    - BS.01.01.01.a. Define biotechnology and explore the historical impact it has had on agriculture.
    - BS.01.01.02.a. Investigate current applications of biotechnology in agriculture.
    - BS.01.01.02.b. Research and report on current work being done in agricultural biotechnology.
- BS.01.03. Performance Indicator: Analyze the ethical, legal, social and cultural issues relating to biotechnology.
- BS.01.03.01.a. Explore ethical, legal and social biotechnology issues.
    - BS.01.03.01.b. Evaluate the benefits and risks associated with biotechnology.
    - BS.01.03.01.c. Research, evaluate and articulate the implications of an ethical, legal, social or cultural biotechnology issue.