Animals engage in characteristic behaviors that increase the odds of reproduction. (MS-LS1-4)

Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. (MS-LS1-4)

Genetic factors as well as local conditions affect the growth of the adult plant. (MS-LS1-5)
**Disciplinary Core Idea**

**MS.LS1.B: Growth and Development of Organisms**

Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. (MS-LS3-2)

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**Disciplinary Core Idea**

**MS.LS3.A: Inheritance of Traits**

Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. (MS-LS3-1)

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**Disciplinary Core Idea**

**MS.LS3.A: Inheritance of Traits**

Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3-2)
In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)

In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism. (MS-LS3-1)

In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed on to offspring. (MS-LS4-5)
**MS.LS1.A: Structure and Function**

All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (MS-LS1-1)

**MS.LS1.A: Structure and Function**

Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (MS-LS1-2)

**MS.LS1.A: Structure and Function**

In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (MS-LS1-3)
Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with non-living factors. (MS-LS2-1)

In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (MS-LS2-1)

Growth of organisms and population increases are limited by access to resources. (MS-LS2-1)
**MS.LS2.A: Interdependent Relationships in Ecosystems**

Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (MS-LS2-2)

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**MS.LS4.A: Evidence of Common Ancestry and Diversity**

The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. (MS-LS4-1)

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Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent. (MS-LS4-2)
**Disciplinary Core Idea**

**MS.LS4.A: Evidence of Common Ancestry and Diversity**

Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy. (MS-LS4-3)

**Performance Expectation**

**MS.LS1-4: Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.**

**Clarification Statement:** Examples of behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds, and creating conditions for seed germination and growth. Examples of plant structures could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.

**Assessment Boundary:** none

**Performance Expectation**

**MS.LS1-5: Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.**

**Clarification Statement:** Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.

**Assessment Boundary:** Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.
Performance Expectation

**MS-LS3-1:** Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.

**Clarification Statement:** Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.

**Assessment Boundary:** Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.

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Performance Expectation

**MS-LS3-2:** Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.

**Clarification Statement:** Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.

**Assessment Boundary:** none

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Performance Expectation

**MS-LS4-5:** Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.

**Clarification Statement:** Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and, on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.

**Assessment Boundary:** none
Performance Expectation

**MS-LS1-1:** Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.

**Clarification Statement:** Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living things, and understanding that living things may be made of one cell or many and varied cells.

**Assessment Boundary:** none

Performance Expectation

**MS-LS1-2:** Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.

**Clarification Statement:** Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.

**Assessment Boundary:** Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.

Performance Expectation

**MS-LS1-3:** Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.

**Clarification Statement:** Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.

**Assessment Boundary:** Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.
Performance Expectation

**MS-LS2-1**: Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

**Clarification Statement**: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.

**Assessment Boundary**: none

Performance Expectation

**MS-LS2-2**: Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

**Clarification Statement**: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.

**Assessment Boundary**: none

Performance Expectation

**MS-LS4-1**: Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.

**Clarification Statement**: Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers.

**Assessment Boundary**: Assessment does not include the names of individual species or geological eras in the fossil record.
Performance Expectation

**MS-LS4-2:** Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.

**Clarification Statement:** Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures.

**Assessment Boundary:** none

Performance Expectation

**MS-LS4-3:** Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.

**Clarification Statement:** Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures.

**Assessment Boundary:** Assessment of comparisons is limited to gross appearance of anatomical structures in embryological development.

Science and Engineering Practice

**Developing and Using Models**

Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

**Develop and use a model to describe phenomena.** (MS-LS3-1), (MS-LS3-2)
Science and Engineering Practice

**Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students’ own experiments) 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. (MS-LS1-5)

Science and Engineering Practice

**Engaging in Argument from Evidence**

Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).

Use an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-LS1-4)

Science and Engineering Practice

**Obtaining, Evaluating, and Communicating Information**

Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods.

Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS-LS4-5)
Science and Engineering Practice

Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions.

Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. (MS-LS1-1)

Science and Engineering Practice

Developing and Using Models

Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

Develop a model to describe phenomena. (MS-LS1-2)

Science and Engineering Practice

Engaging in Argument from Evidence

Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).

Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. (MS-LS1-3)
Science and Engineering Practice

**Analyzing and Interpreting Data**

Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

*Analyze and interpret data to provide evidence for phenomena.* (MS-LS2-1)

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Science and Engineering Practice

**Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

*Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena.* (MS-LS2-2)

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Science and Engineering Practice

**Analyzing and Interpreting Data**

Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

*Analyze and interpret data to determine similarities and differences in findings.* (MS-LS4-1)
Science and Engineering Practice

**Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-2)

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Science and Engineering Practice

**Analyzing and Interpreting Data**

Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

Analyze displays of data to identify linear and nonlinear relationships. (MS-LS4-3)

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Crosscutting Concept

**Cause and Effect**

Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS3-2)
Crosscutting Concept

**Cause and Effect**

Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS1-4), (MS-LS1-5), (MS-LS4-5)

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Crosscutting Concept

**Structure and Function**

Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS3-1)

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Crosscutting Concept

**Scale, Proportion, and Quantity**

Phenomena that can be observed at one scale may not be observable at another scale. (MS-LS1-1)
Crosscutting Concept

**Structure and Function**

Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS1-2)

Crosscutting Concept

**Systems and System Models**

Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. (MS-LS1-3)

Crosscutting Concept

**Cause and Effect**

Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS2-1)
**Patterns**

Patterns can be used to identify cause-and-effect relationships. (MS-LS2-2)

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**Patterns**

Graphs, charts, and images can be used to identify patterns in data. (MS-LS4-1)

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**Patterns**

Patterns can be used to identify cause-and-effect relationships. (MS-LS4-2)
Patterns
Graphs, charts, and images can be used to identify patterns in data.
(MS-LS4-3)

Science Addresses Questions About the Natural and Material World
Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-LS4-5)

Interdependence of Science, Engineering, and Technology
Engineering advances have led to important discoveries in virtually every field of science and scientific discoveries have led to the development of entire industries and engineered systems. (MS-LS4-5)
Science Knowledge Is Based on Empirical Evidence

Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-LS4-1)

Science Is a Human Endeavor

Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas. (MS-LS1-3)

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-LS4-1)
Connection to Engineering, Technology, and Applications of Science

**Scientific Knowledge Assumes an Order and Consistency in Natural Systems**

Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-LS4-2)

Connection to Engineering, Technology, and Applications of Science

**Interdependence of Science, Engineering, and Technology**

Engineering advances have led to important discoveries in virtually every field of science and scientific discoveries have led to the development of entire industries and engineered systems. (MS-LS1-1)

Common Core State Standards for ELA/Literacy

**Reading Informational Text**

**RI.6.8 - Integration of Knowledge and Ideas**

Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not. (MS-LS1-4)
Common Core State Standards for ELA/Literacy

**Reading in Science**

**RST.6-8.1 - Key Ideas and Details**

Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-4), (MS-LS1-5), (MS-LS3-1), (MS-LS3-2), (MS-LS4-5)

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**RST.6-8.2 - Key Ideas and Details**

Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (MS-LS1-5)

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**RST.6-8.4 - Craft and Structure**

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 6–8 texts and topics. (MS-LS3-1), (MS-LS3-2)
Common Core State Standards for ELA/Literacy

Reading in Science

RST.6-8.7 - Integration of Knowledge and Ideas

Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS3-1), (MS-LS3-2)

Common Core State Standards for ELA/Literacy

Speaking & Listening

SL.8.5 - Presentation of Knowledge and Ideas

Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS3-1), (MS-LS3-2)

Common Core State Standards for ELA/Literacy

Writing in Science

WHST.6-8.1 - Text Types and Purposes

Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-4)
**Common Core State Standards for ELA/Literacy**

**Writing in Science**

**WHST.6-8.2 - Text Types and Purposes**

Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. (MS-LS1-5)

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**Writing in Science**

**WHST.6-8.8 - Research to Build and Present Knowledge**

Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-LS4-5)

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**Writing in Science**

**WHST.6-8.9 - Research to Build and Present Knowledge**

Draw evidence from informational texts to support analysis reflection, and research. (MS-LS1-5)
Common Core State Standards for Mathematics

Statistics & Probability
6.SP.A.2 - Develop understanding of statistical variability.
Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape. (MS-LS1-4), (MS-LS1-5)

Common Core State Standards for Mathematics

Statistics & Probability
6.SP.B.4 - Summarize and describe distributions.
Display numerical data in plots on a number line, including dot plots, histograms, and box plots. (MS-LS1-4), (MS-LS1-5)

Common Core State Standards for Mathematics

Statistics & Probability
6.SP.B.5 - Summarize and describe distributions.
Summarize numerical data sets in relation to their context. (MS-LS3-2)
Common Core State Standards for Mathematics

Mathematical Practices
MP.4 - Model with mathematics
Model with mathematics. (MS-LS3-2)