

NORTH DAKOTA SCIENCE CONTENT STANDARDS

Draft – April 2014 – Draft

Performance Expectations by Grade: Middle School Life Science

Released for Public Comment



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North Dakota Science Content Standards, Draft: April 2014, Released for Public Comment is based on the Next Generation Science Standards.¹

¹ NGSS Lead States. 2013. **Next Generation Science Standards: For States, By States**. Washington, DC: The National Academies Press.

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North Dakota Science Content Standards

Performance Expectations by Grade

This document, released for public review, presents the North Dakota Science Content Standards in tables, which include individual Performance Expectations. Refer to the North Dakota *Introduction* for more information related to the layout of the document. A separate document presents the North Dakota Science Content Standards arranged in tables, which include groups of Performance Expectations arranged by Disciplinary Core Idea. Readers are invited to review both documents and provide feedback regarding preference for organizational format in the associated questionnaire.

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Middle School Life Science

Students in middle school develop understanding of key concepts to help them make sense of life science. The ideas build upon students' science understanding from earlier grades and from the disciplinary core ideas, science and engineering practices, and crosscutting concepts of other experiences with physical and earth sciences. There are four life science disciplinary core ideas in middle school: 1) From Molecules to Organisms: Structures and Processes, 2) Ecosystems: Interactions, Energy, and Dynamics, 3) Heredity: Inheritance and Variation of Traits, 4) Biological Evolution: Unity and Diversity. The performance expectations in middle school blend the core ideas with scientific and engineering practices and crosscutting concepts to support students in developing useable knowledge across the science disciplines. While the performance expectations in middle school life science couple particular practices with specific disciplinary core ideas, instructional decisions should include use of many science and engineering practices integrated in the performance expectations.

The performance expectations in **LS1: From Molecules to Organisms: Structures and Processes** help students formulate an answer to the question, "How can one explain the ways cells contribute to the function of living organisms." The LS1 Disciplinary Core Idea from the NRC Framework is organized into four sub-ideas: Structure and Function, Growth and Development of Organisms, Organization for Matter and Energy Flow in Organisms, and Information Processing. Students can gather information and use this information to support explanations of the structure and function relationship of cells. They can communicate understanding of cell theory. They have a basic understanding of the role of cells in body systems and how those systems work to support the life functions of the organism. The understanding of cells provides a context for the plant process of photosynthesis and the movement of matter and energy needed for the cell. Students can construct an explanation for how environmental and genetic factors affect growth of organisms. They can connect this to the role of animal behaviors in reproduction of animals as well as the dependence of some plants on animal behaviors for their reproduction. Crosscutting concepts of cause and effect, structure and function, and matter and energy are called out as organizing concepts for the core ideas about processes of living organisms.

The performance expectations in **LS2: Interactions, Energy, and Dynamics Relationships in Ecosystems** help students formulate an answer to the question, "How does a system of living and non-living things operate to meet the needs of the organisms in an ecosystem?" The LS2 Disciplinary Core Idea is divided into three sub-ideas: Interdependent Relationships in Ecosystems; Cycles of Matter and Energy Transfer in Ecosystems; and Ecosystem Dynamics, Functioning, and Resilience. Students can analyze and interpret data, develop models, and construct arguments and demonstrate a deeper understanding of resources and the cycling of matter and the flow of energy in ecosystems. They can also study patterns of the interactions among organisms within an ecosystem. They consider biotic and abiotic factors in an ecosystem and the effects these factors have on population. They evaluate competing design solutions for maintaining biodiversity and ecosystem services.

The performance expectations in **LS3: Heredity: Inheritance and Variation of Traits** help students formulate an answer to the question, “How do living organisms pass traits from one generation to the next?” The LS3 Disciplinary Core Idea from the NRC Framework includes two sub-ideas: Inheritance of Traits, and Variation of Traits. Students can use models to describe ways gene mutations and sexual reproduction contribute to genetic variation. Crosscutting concepts of cause and effect and structure and function provide students with a deeper understanding of how gene structure determines differences in the functioning of organisms.

The performance expectations in **LS4: Biological Evolution: Unity and Diversity** help students formulate an answer to the question, “How do organisms change over time in response to changes in the environment?” The LS4 Disciplinary Core Idea is divided into four sub-ideas: Evidence of Common Ancestry and Diversity, Natural Selection, Adaptation, and Biodiversity and Humans. Students can construct explanations based on evidence to support fundamental understandings of natural selection and evolution. They can use ideas of genetic variation in a population to make sense of organisms surviving and reproducing, hence passing on the traits of the species. They are able to use fossil records and anatomical similarities of the relationships among organisms and species to support their understanding. Crosscutting concepts of patterns and structure and function contribute to the evidence students can use to describe biological evolution.

MS-LS1 From Molecules to Organisms: Structures and Processes

MS-LS1-1 From Molecules to Organisms: Structures and Processes		
<p>Students who demonstrate understanding can:</p> <p>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 cells, and understanding that living things may be made of one cell or many and varied cells.]</p>		
<p>The performance expectation above was developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i>:</p>		
<p>Science and Engineering Practices</p> <p>Planning and Carrying Out Investigations Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions.</p> <ul style="list-style-type: none"> Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. 	<p>Disciplinary Core Ideas</p> <p>LS1.A: Structure and Function</p> <ul style="list-style-type: none"> 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). 	<p>Crosscutting Concepts</p> <p>Scale, Proportion, and Quantity</p> <ul style="list-style-type: none"> Phenomena that can be observed at one scale may not be observable at another scale. <p style="text-align: center;">-----</p> <p style="text-align: center;"><i>Connections to Engineering, Technology and Applications of Science</i></p> <p>Interdependence of Science, Engineering, and Technology</p> <ul style="list-style-type: none"> 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.
<p><i>Connections to other DCIs in this grade-band: N/A</i></p> <p><i>Articulation of DCIs across grade-bands:</i></p> <p>HS.LS1.A</p> <p><i>Common Core State Standards Connections:</i></p> <p><i>ELA/Literacy -</i> WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-LS1-1)</p> <p><i>Mathematics -</i> 6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. (MS-LS1-1)</p>		

**North Dakota Commentary: Consideration may be given to the distinction between living cells and viruses

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

Students who demonstrate understanding can:

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.]

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 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.

Disciplinary Core Ideas

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.

Crosscutting Concepts

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.

Connections to other DCIs in this grade-band:

MS.LS3.A

Articulation of DCIs across grade-bands:

4.LS1.A ; HS.LS1.A

Common Core State Standards Connections:

ELA/Literacy -

SL.8.5

Mathematics -

6.EE.C.9

Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS1-2)

Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. (MS-LS1-2)

MS-LS1-3 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

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.]

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

<p>Science and Engineering Practices</p> <p>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).</p> <ul style="list-style-type: none"> Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. 	<p>Disciplinary Core Ideas</p> <p>LS1.A: Structure and Function</p> <ul style="list-style-type: none"> 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. 	<p>Crosscutting Concepts</p> <p>Systems and System Models</p> <ul style="list-style-type: none"> Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. <p style="text-align: center;">-----</p> <p style="text-align: center;"><i>Connections to Nature of Science</i></p> <p>Science is a Human Endeavor</p> <ul style="list-style-type: none"> Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas.
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Connections to other DCIs in this grade-band: N/A

Articulation of DCIs across grade-bands:

HS.LS1.A

Common Core State Standards Connections:

ELA/Literacy -

RST.6-8.1

Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-3)

RI.6.8

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-LS1-3)

WHST.6-8.1

Write arguments focused on discipline content. (MS-LS1-3)

8.1

Mathematics -

6.EE.C.9

Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. (MS-LS1-3)

**North Dakota Commentary: Consideration may be given to the fact that interactions among the systems of the human body are introduced at this grade band.

MS-LS1-4 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

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.]

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

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.

Disciplinary Core Ideas

LS1.B: Growth and Development of Organisms

- Animals engage in characteristic behaviors that increase the odds of reproduction.
- Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction.

Crosscutting Concepts

Cause and Effect

- Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

Connections to other DCIs in this grade-band:

MS.LS2.A

Articulation of DCIs across grade-bands:

3.LS1.B ; HS.LS2.A ; HS.LS2.D

Common Core State Standards Connections:

ELA/Literacy -

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-4)

RI.6.8 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)

WHST.6-8.1 Write arguments focused on discipline content. (MS-LS1-4)

Mathematics -

6.SP.A.2 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)

6.SP.B.4 Summarize numerical data sets in relation to their context. (MS-LS1-4)

MS-LS1-5 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

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.]

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
<p>Constructing Explanations and Designing Solutions</p> <p>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 knowledge, principles, and theories.</p> <ul style="list-style-type: none"> 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. 	<p>LS1.B: Growth and Development of Organisms</p> <ul style="list-style-type: none"> Genetic factors as well as local conditions affect the growth of the adult plant. 	<p>Cause and Effect</p> <ul style="list-style-type: none"> Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

Connections to other DCIs in this grade-band:

MS.LS2.A

Articulation of DCIs across grade-bands:

3.LS1.B ; 3.LS3.A ; HS.LS2.A

Common Core State Standards Connections:

ELA/Literacy -

RST.6-8.1

Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-5)

RST.6-8.2

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)

WHST.6-8.2

Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS1-5)

WHST.6-8.9

Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS1-5)

Mathematics -

6.SP.A.2

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-LS1-5)

6.SP.B.4

Summarize numerical data sets in relation to their context. (MS-LS1-5)

MS-LS1-6 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

- MS-LS1-6. Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.** [Clarification Statement: Emphasis is on tracing movement of matter and flow of energy.] [Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.]

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 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 knowledge, 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.

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence

- Science knowledge is based upon logical connections between evidence and explanations.

Disciplinary Core Ideas

LS1.C: Organization for Matter and Energy Flow in Organisms

- Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use.

PS3.D: Energy in Chemical Processes and Everyday Life

- The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. (*secondary*)

Crosscutting Concepts

Energy and Matter

- Within a natural system, the transfer of energy drives the motion and/or cycling of matter.

Connections to other DCIs in this grade-band:

MS.PS1.B ; MS.ESS2.A

Articulation of DCIs across grade-bands:

5.PS3.D ; 5.LS1.C ; 5.LS2.A ; 5.LS2.B ; HS.PS1.B ; HS.LS1.C ; HS.LS2.B ; HS.ESS2.D

Common Core State Standards Connections:

ELA/Literacy -

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-6)

RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (MS-LS1-6)

WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS1-6)

WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS1-6)

Mathematics -

6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. (MS-LS1-6)

MS-LS1-7 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

- MS-LS1-7. Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.** [Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.] [Assessment Boundary: Assessment does not include details of the chemical reactions for photosynthesis or 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 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 unobservable mechanisms.

Disciplinary Core Ideas

LS1.C: Organization for Matter and Energy Flow in Organisms

- Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy.

PS3.D: Energy in Chemical Processes and Everyday Life

- Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (*secondary*)

Crosscutting Concepts

Energy and Matter

- Matter is conserved because atoms are conserved in physical and chemical processes.

Connections to other DCIs in this grade-band:

MS.PS1.B

Articulation of DCIs across grade-bands:

5.PS3.D ; 5.LS1.C ; 5.LS2.B ; HS.PS1.B ; HS.LS1.C ; HS.LS2.B

Common Core State Standards Connections:

ELA/Literacy -

SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (*MS-LS1-7*)

MS-LS1-8 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. *[Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.]*

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

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.

Disciplinary Core Ideas

LS1.D: Information Processing

- Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories.

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural systems.

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

Articulation of DCIs across grade-bands:

4.LS1.D ; HS.LS1.A

Common Core State Standards Connections:

ELA/Literacy -

WHST.6-8.8 Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. (MS-LS1-8)

MS-LS2 Ecosystems: Interactions, Energy, and Dynamics

MS-LS2-1 Ecosystems: Interactions, Energy, and Dynamics		
<p>Students who demonstrate understanding can:</p> <p>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.]</p>		
<p>The performance expectation above was developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i>:</p>		
<p>Science and Engineering Practices</p> <p>Analyzing and Interpreting Data</p> <p>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.</p> <ul style="list-style-type: none"> Analyze and interpret data to provide evidence for phenomena. 	<p>Disciplinary Core Ideas</p> <p>LS2.A: Interdependent Relationships in Ecosystems</p> <ul style="list-style-type: none"> Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. 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. Growth of organisms and population increases are limited by access to resources. 	<p>Crosscutting Concepts</p> <p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural or designed systems.
<p><i>Connections to other DCIs in this grade-band:</i> MS.ESS3.A ; MS.ESS3.C</p>		
<p><i>Articulation of DCIs across grade-bands:</i> 3.LS2.C ; 3.LS4.D ; 5.LS2.A ; HS.LS2.A ; HS.LS4.C ; HS.LS4.D ; HS.ESS3.A</p>		
<p><i>Common Core State Standards Connections:</i></p> <p><i>ELA/Literacy -</i></p> <p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-LS2-1)</p> <p>RST.6-8.7 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-LS2-1)</p>		

MS-LS2-2 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

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.]

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

<p>Science and Engineering Practices</p> <p>Constructing Explanations and Designing Solutions</p> <p>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.</p> <ul style="list-style-type: none"> Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena. 	<p>Disciplinary Core Ideas</p> <p>LS2.A: Interdependent Relationships in Ecosystems</p> <ul style="list-style-type: none"> 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. 	<p>Crosscutting Concepts</p> <p>Patterns</p> <ul style="list-style-type: none"> Patterns can be used to identify cause and effect relationships. (MS-LS2-2)
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Connections to other DCIs in this grade-band:

MS.LS1.B

Articulation of DCIs across grade-bands:

1.LS1.B ; HS.LS2.A ; HS.LS2.B ; HS.LS2.D

Common Core State Standards Connections:

ELA/Literacy -

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-LS2-2)

WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS2-2)

WHST.6-8.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. (MS-LS2-2)

SL.8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly. (MS-LS2-2)

SL.8.4 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. (MS-LS2-2)

Mathematics -

6.SP.B.5 Summarize numerical data sets in relation to their context. (MS-LS2-2)

MS-LS2-3 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

- MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.** [Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.] [Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.]

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 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.

Disciplinary Core Ideas

LS2.B: Cycle of Matter and Energy Transfer in Ecosystems

- Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.

Crosscutting Concepts

Energy and Matter

- The transfer of energy can be tracked as energy flows through a natural system.

Connections to Nature 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.

Connections to other DCIs in this grade-band:

MS.PS1.B

Articulation of DCIs across grade-bands:

5.LS2.A ; 5.LS2.B ; HS.PS3.B ; HS.LS1.C ; HS.LS2.B ; HS.ESS2.A

Common Core State Standards Connections:

ELA/Literacy -

SL.8.5

Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. *(MS-LS2-3)*

Mathematics -

6.EE.C.9

Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. *(MS-LS2-3)*

MS-LS2-4 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. [Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]

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

<p>Science and Engineering Practices</p>	<p>Disciplinary Core Ideas</p>	<p>Crosscutting Concepts</p>
<p>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).</p> <ul style="list-style-type: none"> Construct 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. <p>-----</p> <p style="text-align: center;"><i>Connections to Nature of Science</i></p> <p>Scientific Knowledge is Based on Empirical Evidence</p> <ul style="list-style-type: none"> Science disciplines share common rules of obtaining and evaluating empirical evidence. 	<p>LS2.C: Ecosystem Dynamics, Functioning, and Resilience</p> <ul style="list-style-type: none"> Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. 	<p>Stability and Change</p> <ul style="list-style-type: none"> Small changes in one part of a system might cause large changes in another part.
<p><i>Connections to other DCIs in this grade-band:</i> MS.LS4.C ; MS.LS4.D ; MS.ESS2.A ; MS.ESS3.A ; MS.ESS3.C</p>		
<p><i>Articulation of DCIs across grade-bands:</i> 3.LS2.C ; 3.LS4.D ; HS.LS2.C ; HS.LS4.C ; HS.LS4.D ; HS.ESS2.E ; HS.ESS3.B ; HS.ESS3.C</p>		
<p><i>Common Core State Standards Connections:</i> <i>ELA/Literacy -</i> RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-LS2-4) RI.8.8 Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims. (MS-LS2-4) WHST.6-8.1 Write arguments to support claims with clear reasons and relevant evidence. (MS-LS2-4) WHST.6-8.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. (MS-LS2-4)</p>		

MS-LS2-5 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.* [Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]

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

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).

- Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.

Disciplinary Core Ideas

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

- Biodiversity describes the variety of species found in Earth’s terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem’s biodiversity is often used as a measure of its health.

LS4.D: Biodiversity and Humans

- Changes in biodiversity can influence humans’ resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. *(secondary)*

ETS1.B: Developing Possible Solutions

- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. *(secondary)*

Crosscutting Concepts

Stability and Change

- Small changes in one part of a system might cause large changes in another part.

Connections to Engineering, Technology, and Applications of Science

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

- The use of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time.

Connections to Nature of Science

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.

Connections to other DCIs in this grade-band:

MS.ESS3.C

Articulation of DCIs across grade-bands:

HS.LS2.A ; HS.LS2.C ; HS.LS4.D ; HS.ESS3.A ; HS.ESS3.C ; HS.ESS3.D

Common Core State Standards Connections:

ELA/Literacy -

RST.6-8.8 Distinguish among facts, reasoned judgment based on research findings, and speculation in a text. (MS-LS2-5)

RI.8.8 Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims. (MS-LS2-5)

Mathematics -

MP.4 Model with mathematics. (MS-LS2-5)

6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-LS2-5)

MS-LS3 Heredity: Inheritance and Variation of Traits

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

Students who demonstrate understanding can:

- 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.]

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 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)

Disciplinary Core Ideas

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.

LS3.B: Variation of Traits

- 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.

Crosscutting Concepts

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.

Connections to other DCIs in this grade-band:

MS.LS1.A ; MS.LS4.A

Articulation of DCIs across grade-bands:

3.LS3.A ; 3.LS3.B ; HS.LS1.A ; HS.LS1.B ; HS.LS3.A ; HS.LS3.B

Common Core State Standards Connections:

ELA/Literacy -

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-LS3-1)

RST.6-8.4 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 6-8 texts and topics. (MS-LS3-1)

RST.6-8.7 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)

SL.8.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. (MS-LS3-1)

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

Students who demonstrate understanding can:

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.]

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
<p>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.</p> <ul style="list-style-type: none"> Develop and use a model to describe phenomena. 	<p>LS1.B: Growth and Development of Organisms</p> <ul style="list-style-type: none"> Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. (<i>secondary</i>) <p>LS3.A: Inheritance of Traits</p> <ul style="list-style-type: none"> Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. <p>LS3.B: Variation of Traits</p> <ul style="list-style-type: none"> 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. 	<p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural systems.

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

Articulation of DCIs across grade-bands:

3.LS3.A ; 3.LS3.B ; HS.LS1.B ; HS.LS3.A ; HS.LS3.B

Common Core State Standards Connections:

ELA/Literacy -

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (*MS-LS3-2*)

RST.6-8.4 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 6-8 texts and topics. (*MS-LS3-2*)

RST.6-8.7 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-LS3-2*)

SL.8.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. (*MS-LS3-2*)

Mathematics -

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

6.SP.B.5 Summarize numerical data sets in relation to their context. (*MS-LS3-2*)

MS-LS4 Biological Evolution: Unity and Diversity

MS-LS4-1 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

- 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.]

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

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.

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence

- Science knowledge is based upon logical and conceptual connections between evidence and explanations.

Disciplinary Core Ideas

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.

Crosscutting Concepts

Patterns

- Graphs, charts, and images can be used to identify patterns in data.

Connections to Nature 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.

Connections to other DCIs in this grade-band:

MS.ESS1.C ; MS.ESS2.B

Articulation of DCIs across grade-bands:

3.LS4.A ; HS.LS4.A ; HS.ESS1.C

Common Core State Standards Connections:

ELA/Literacy -

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. (*MS-LS4-1*)

RST.6-8.7 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-LS4-1*)

Mathematics -

6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (*MS-LS4-1*)

MS-LS4-2 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

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.]

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

<p>Science and Engineering Practices</p> <p>Constructing Explanations and Designing Solutions</p> <p>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.</p> <ul style="list-style-type: none"> Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. 	<p>Disciplinary Core Ideas</p> <p>LS4.A: Evidence of Common Ancestry and Diversity</p> <ul style="list-style-type: none"> 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. 	<p>Crosscutting Concepts</p> <p>Patterns</p> <ul style="list-style-type: none"> Patterns can be used to identify cause and effect relationships. <p>-----</p> <p style="text-align: center;"><i>Connections to Nature of Science</i></p> <p>Scientific Knowledge Assumes an Order and Consistency in Natural Systems</p> <ul style="list-style-type: none"> Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.
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Connections to other DCIs in this grade-band:

MS.LS3.A ; MS.LS3.B ; MS.ESS1.C

Articulation of DCIs across grade-bands:

3.LS4.A ; HS.LS4.A ; HS.ESS1.C

Common Core State Standards Connections:

ELA/Literacy -

RST.6-8.1

Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. (MS-LS4-2)

WHST.6-8.2

Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS4-2)

WHST.6-8.9

Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS4-2)

SL.8.1

Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. (MS-LS4-2)

SL.8.4

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. (MS-LS4-2)

Mathematics -

6.EE.B.6

Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-LS4-2)

MS-LS4-3 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

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.]

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

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.

Disciplinary Core Ideas

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.

Crosscutting Concepts

Patterns

- Graphs, charts, and images can be used to identify patterns in data.

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

Articulation of DCIs across grade-bands:

HS.LS4.A

Common Core State Standards Connections:

ELA/Literacy -

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. *(MS-LS4-3)*

RST.6-8.7 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-LS4-3)*

RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. *(MS-LS4-3)*

MS-LS4-4 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

- MS-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.** [Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations.]

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 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 describe phenomena.

Disciplinary Core Ideas

LS4.B: Natural Selection

- Natural selection leads to the predominance of certain traits in a population, and the suppression of others.

Crosscutting Concepts

Cause and Effect

- Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

Connections to other DCIs in this grade-band:

MS.LS2.A ; MS.LS3.A ; MS.LS3.B

Articulation of DCIs across grade-bands:

3.LS3.B ; 3.LS4.B ; HS.LS2.A ; HS.LS3.B ; HS.LS4.B ; HS.LS4.C

Common Core State Standards Connections:

ELA/Literacy -

- RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. *(MS-LS4-4)*
- RST.6-8.9** Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. *(MS-LS4-4)*
- WHST.6-8.2** Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. *(MS-LS4-4)*
- WHST.6-8.9** Draw evidence from informational texts to support analysis, reflection, and research. *(MS-LS4-4)*
- SL.8.1** Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. *(MS-LS4-4)*
- SL.8.4** 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. *(MS-LS4-4)*

Mathematics -

- 6.RP.A.1** Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. *(MS-LS4-4)*
- 6.SP.B.5** Summarize numerical data sets in relation to their context. *(MS-LS4-4)*
- 7.RP.A.2** Recognize and represent proportional relationships between quantities. *(MS-LS4-4)*

MS-LS4-5 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

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.]

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

<p>Science and Engineering Practices</p>	<p>Disciplinary Core Ideas</p>	<p>Crosscutting Concepts</p>
<p>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.</p> <ul style="list-style-type: none"> 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. 	<p>LS4.B: Natural Selection</p> <ul style="list-style-type: none"> In <i>artificial</i> 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. 	<p>Cause and Effect</p> <ul style="list-style-type: none"> Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. <p>-----</p> <p style="text-align: center;"><i>Connections to Engineering, Technology, and Applications of Science</i></p> <p>Interdependence of Science, Engineering, and Technology</p> <ul style="list-style-type: none"> 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. <p>-----</p> <p style="text-align: center;"><i>Connections to Nature of Science</i></p> <p>Science Addresses Questions About the Natural and Material World</p> <ul style="list-style-type: none"> Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes.

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

Articulation of DCIs across grade-bands:

HS.LS3.B ; HS.LS4.C

Common Core State Standards Connections:

ELA/Literacy -

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. *(MS-LS4-5)*

WHST.6-8.8 Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. *(MS-LS4-5)*

MS-LS4-6 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

MS-LS4-6. Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. [Clarification

Statement: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.] [Assessment Boundary: Assessment does not include Hardy Weinberg calculations.]

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

Using Mathematics and Computational Thinking

Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments.

- Use mathematical representations to support scientific conclusions and design solutions.

Disciplinary Core Ideas

LS4.C: Adaptation

- Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes.

Crosscutting Concepts

Cause and Effect

- Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

Connections to other DCIs in this grade-band:

MS.LS2.A ; MS.LS2.C ; MS.LS3.B ; MS.ESS1.C

Articulation of DCIs across grade-bands:

3.LS4.C ; HS.LS2.A ; HS.LS2.C ; HS.LS3.B ; HS.LS4.B ; HS.LS4.C

Common Core State Standards Connections:

Mathematics -

MP.4 Model with mathematics. (MS-LS4-6)

6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-LS4-6)

6.SP.B.5 Summarize numerical data sets in relation to their context. (MS-LS4-6)

7.RP.A.2 Recognize and represent proportional relationships between quantities. (MS-LS4-6)