

DISCIPLINE SPECIFIC COURSE MODEL

Grade Seven –
Life Sciences



Standards Arranged by
Disciplinary Core Ideas

California Department of Education

Clarification statements were created by the writers of NGSS to supply examples or additional clarification to the performance expectations and assessment boundary statements.

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The section titled “Disciplinary Core Ideas” is reproduced verbatim from *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. Revised March 2015.

MS-LS1 From Molecules to Organisms: Structures and Processes

MS-LS1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

- 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 (**including Bacteria, Archaea, and Eukarya) 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. **Viruses, while not cells, have features that are both common with, and distinct from, cellular life.]
- 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.]
- 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.]

MS-LS1 From Molecules to Organisms: Structures and Processes

- 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.]
- 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.]
- 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(s) above were developed using the following elements from the National Research Council (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. (MS-LS1-2) <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>	<p>LS1.A: Structure and Function</p> <ul style="list-style-type: none"> All living things are made up of cells. A cell 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) 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) 	<p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS1-8) 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) <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. (MS-LS1-1) <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. (MS-LS1-3)

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The section titled “Disciplinary Core Ideas” is reproduced verbatim from *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*.

MS-LS1 From Molecules to Organisms: Structures and Processes

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

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. (MS-LS1-5)

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)
- 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)

- 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)

LS1.B: Growth and Development of Organisms

- 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)

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. (MS-LS1-8)

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 and designed structures/systems can be analyzed to determine how they function. (MS-LS1-2)

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Connections 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)

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Connections to Nature of Science

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)

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MS-LS1 From Molecules to Organisms: Structures and Processes

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 method used, and describe how they are supported or not supported by evidence. (MS-LS1-8)

California Environmental Principles and Concepts aligned to the CA NGSS: (MS-LS1-4), (MS-LS1-5)

Principle II: The long-term functioning and health of terrestrial, freshwater, coastal, and marine ecosystems are influenced by their relationships with human societies.

Principle IV: The exchange of matter between natural systems and human societies affects the long-term functioning of both.

Connections to other DCIs in this grade-band: MS.LS2.A (MS-LS1-4), (MS-LS1-5); MS.LS3.A (MS-LS1-2)

Articulation to DCIs across grade-bands: 3.LS1.B (MS-LS1-4), (MS-LS1-5); 3.LS3.A (MS-LS1-5); 4.LS1.A (MS-LS1-2); 4.LS1.D (MS-LS1-8); HS.LS1.A (MS-LS1-1), (MS-LS1-2), (MS-LS1-3), (MS-LS1-8); HS.LS2.A (MS-LS1-4), (MS-LS1-5); HS.LS2.D (MS-LS1-4)

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MS-LS1 From Molecules to Organisms: Structures and Processes

California 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), (MS-LS1-4), (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)
- 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), (MS-LS1-4)
- WHST.6–8.1.a–e** Write arguments focused on *discipline-specific content*. (MS-LS1-3), (MS-LS1-4)
- WHST.6–8.2.a–f** Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. (MS-LS1-5)
- 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)
- WHST.6–8.8** Gather relevant information from multiple print and digital sources (**primary and secondary**), 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. **CA** (MS-LS1-8)
- WHST.6–8.9** Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS1-5)
- SL.8.5** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS1-2)

Mathematics –

- 6.EE.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. *For example, in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation $d = 65t$ to represent the relationship between distance and time.* (MS-LS1-1), (MS-LS1-2), (MS-LS1-3)
- 6.SP.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), (MS-LS1-5)
- 6.SP.4** Display numerical data in plots on a number line, including dot plots, histograms, and box plots. (MS-LS1-4), (MS-LS1-5)

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MS-LS1 From Molecules to Organisms: Structures and Processes

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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.]

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(s) above were 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 a model to describe unobservable mechanisms. (MS-LS1-7) <p>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.</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. (MS-LS1-6) 	<p>LS1.C: Organization for Matter and Energy Flow in Organisms</p> <ul style="list-style-type: none"> 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. (MS-LS1-6) ***Supplemental DCI PS1.A, PS1.B and grade 5 PS3.D 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. (MS-LS1-7) <p>PS3.D: Energy in Chemical Processes and Everyday Life</p> <ul style="list-style-type: none"> The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, 	<p>Energy and Matter</p> <ul style="list-style-type: none"> Matter is conserved because atoms are conserved in physical and chemical processes. (MS-LS1-7) Within a natural system, the transfer of energy drives the motion and/or cycling of matter. (MS-LS1-6)

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MS-LS1 From Molecules to Organisms: Structures and Processes

..... **Connections to Nature of Science**

Scientific Knowledge is Based on Empirical Evidence

- Science knowledge is based upon logical connections between evidence and explanations. (MS-LS1-6)

- carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. (secondary to MS-LS1-6)
- 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 to MS-LS1-7)

California Environmental Principles and Concepts aligned to the CA NGSS: (MS-LS1-6)

Principle II: The long-term functioning and health of terrestrial, freshwater, coastal, and marine ecosystems are influenced by their relationships with human societies.

Principle IV: The exchange of matter between natural systems and human societies affects the long-term functioning of both.

Connections to other DCIs in this grade-band: MS.PS1.B (MS-LS1-6), (MS-LS1-7); MS.ESS2.A (MS-LS1-6)

Articulation to DCIs across grade-bands: 5.PS3.D (MS-LS1-6), (MS-LS1-7); 5.LS1.C (MS-LS1-6), (MS-LS1-7); 5.LS2.A (MS-LS1-6); 5.LS2.B (MS-LS1-6), (MS-LS1-7); HS.PS1.B (MS-LS1-6), (MS-LS1-7); HS.LS1.C (MS-LS1-6), (MS-LS1-7); HS.LS2.B (MS-LS1-6), (MS-LS1-7); HS.ESS2.D (MS-LS1-6)

California 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.a–f Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. (MS-LS1-6)

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

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

Mathematics –

6.EE.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)

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MS-LS2 Ecosystems: Interactions, Energy, and Dynamics

MS-LS2 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

- 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.]
- 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.]
- 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.]
- 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.]
- 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(s) above were 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</p> <p>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 a model to describe phenomena. (MS-LS2-3) 	<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. (MS-LS2-1) ***<i>Supplemental DCI PS1.B</i> ▪ 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) 	<p>Patterns</p> <ul style="list-style-type: none"> ▪ Patterns can be used to identify cause and effect relationships. (MS-LS2-2) <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. (MS-LS2-1) <p>Energy and Matter</p> <ul style="list-style-type: none"> ▪ The transfer of energy can be tracked as energy flows through a natural system. (MS-LS2-3)

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MS-LS2 Ecosystems: Interactions, Energy, and Dynamics

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)

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)

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).

- 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. (MS-LS2-4)
- Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-LS2-5)

- Growth of organisms and population increases are limited by access to resources. (MS-LS2-1)
- 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)

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. (MS-LS2-3)

****Supplemental DCI PS1.B, ESS2.A*

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

- 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. (MS-LS2-4)

Stability and Change

- Small changes in one part of a system might cause large changes in another part. (MS-LS2-4), (MS-LS2-5)

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. (MS-LS2-5)

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. (MS-LS2-3)

Science Addresses Questions About the Natural and Material World

- Science knowledge can describe consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-LS2-5)

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MS-LS2 Ecosystems: Interactions, Energy, and Dynamics

..... **Connections to Nature of Science**

Scientific Knowledge is Based on Empirical Evidence

- Science disciplines share common rules of obtaining and evaluating empirical evidence. (MS-LS2-4)

- 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. (MS-LS2-5)

****Supplemental DCI PS1.B, ESS3.A, ESS3.C*

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 to MS-LS2-5)

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 to MS-LS2-5)

California Environmental Principles and Concepts aligned to the CA NGSS: (MS-LS2-1), (MS-LS2-3), (MS-LS2-4), (MS-LS2-5)

Principle I: The continuation and health of individual human lives and of human communities and societies depend on the health of the natural systems that provide essential goods and ecosystem services.

Principle II: The long-term functioning and health of terrestrial, freshwater, coastal, and marine ecosystems are influenced by their relationships with human societies.

Principle III: Natural systems proceed through cycles that humans depend upon, benefit from, and can alter.

Principle IV: The exchange of matter between natural systems and human societies affects the long-term functioning of both.

Principle V: Decisions affecting resources and natural systems are based on a wide range of considerations and decision-making processes.

Connections to other DCIs in this grade-band: MS.PS1.B (MS-LS2-3); MS.LS1.B (MS-LS2-2); MS.LS4.C (MS-LS2-4); MS.LS4.D (MS-LS2-4); MS.ESS2.A (MS-LS2-3), (MS-LS2-4); MS.ESS3.A (MS-LS2-1), (MS-LS2-4); MS.ESS3.C (MS-LS2-1), (MS-LS2-4), (MS-LS2-5)

Articulation across grade-bands: 1.LS1.B (MS-LS2-2); 3.LS2.C (MS-LS2-1), (MS-LS2-4); 3.LS4.D (MS-LS2-1), (MS-LS2-4); 5.LS2.A (MS-LS2-1), (MS-LS2-3); 5.LS2.B (MS-LS2-3); HS.PS3.B (MS-LS2-3); HS.LS1.C (MS-LS2-3); HS.LS2.A (MS-LS2-1), (MS-LS2-2), (MS-LS2-5); HS.LS2.B (MS-LS2-2), (MS-LS2-3); HS.LS2.C (MS-LS2-4), (MS-LS2-5); HS.LS2.D (MS-LS2-2); HS.LS4.C (MS-LS2-1), (MS-LS2-4); HS.LS4.D (MS-LS2-1), (MS-LS2-4), (MS-LS2-5); HS.ESS2.A (MS-LS2-3); HS.ESS2.E (MS-LS2-4); HS.ESS3.A (MS-LS2-1), (MS-LS2-5); HS.ESS3.B (MS-LS2-4); HS.ESS3.C (MS-LS2-4), (MS-LS2-5); HS.ESS3.D (MS-LS2-5)

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

**California clarification statements, marked with double asterisks, were incorporated by the California Science Expert Review Panel.

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The section titled “Disciplinary Core Ideas” is reproduced verbatim from *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*.

MS-LS2 Ecosystems: Interactions, Energy, and Dynamics

California Common Core State Standards Connections:

ELA/Literacy –

- RST.6–8.1** Cite specific textual evidence to support analysis of science and technical texts. (MS-LS2-1), (MS-LS2-2), (MS-LS2-4)
- 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)
- RST.6–8.8** Distinguish among facts, reasoned judgment based on research findings, and speculation in a text. (MS-LS2-5)
- RI.8.8** Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient; recognize when irrelevant evidence is introduced. (MS-LS-4), (MS-LS2-5)
- WHST.6–8.1.a–e** Write arguments focused on *discipline-specific content*. (MS-LS2-4)
- WHST.6–8.2.a–f** Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. (MS-LS2-2)
- WHST.6–8.9** Draw evidence from literary or informational texts to support analysis, reflection, and research. (MS-LS-2), (MS-LS2-4)
- SL.8.1.a–d** 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 (e.g., **argument, narrative, response to literature presentations**), 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. **CA a. Plan and present a narrative that: establishes a context and point of view, presents a logical sequence, uses narrative techniques (e.g., dialogue, pacing, description, sensory language), uses a variety of transitions, and provides a conclusion that reflects the experience. CA** (MS-LS2-2)
- SL.8.5** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS2-3)

Mathematics –

- MP.4** Model with mathematics. (MS-LS2-5)
- 6.RP.3.a–d** Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations. (MS-LS2-5)
- 6.EE.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. *For example, in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation $d = 65t$ to represent the relationship between distance and time.* (MS-LS2-3)
- 6.SP.5.a–d** Summarize numerical data sets in relation to their context. (MS-LS2-2)

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**California clarification statements, marked with double asterisks, were incorporated by the California Science Expert Review Panel.

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MS-LS3 Heredity: Inheritance and Variation of Traits

MS-LS3 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(s) above were 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</p> <p>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. (MS-LS3-1) 	<p>LS3.A: Inheritance of Traits</p> <ul style="list-style-type: none"> 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) <p>LS3.B: Variation of Traits</p> <ul style="list-style-type: none"> 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) 	<p>Structure and Function</p> <ul style="list-style-type: none"> 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 and designed structures/systems can be analyzed to determine how they function. (MS-LS3-1)

Connections to other DCIs in this grade-band: **MS.LS1.A** (MS-LS3-1)

Articulation across grade-bands: **3.LS3.A** (MS-LS3-1); **3.LS3.B** (MS-LS3-1); **HS.LS1.A** (MS-LS3-1); **HS.LS1.B** (MS-LS3-1); **HS.LS3.A** (MS-LS3-1); **HS.LS3-B** (MS-LS3-1)

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The section titled “Disciplinary Core Ideas” is reproduced verbatim from *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*.

MS-LS3 Heredity: Inheritance and Variation of Traits

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

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MS-LS3 Heredity: Inheritance and Variation of Traits

MS-LS3 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(s) above were 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</p> <p>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. (MS-LS3-2) 	<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. (secondary to MS-LS3-2) <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. (MS-LS3-2) <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. (MS-LS3-2) 	<p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS3-2)

Connections to other DCIs in this grade-band:

Articulation across grade-bands: **3.LS3.A** (MS-LS3-2); **3.LS3.B** (MS-LS3-2); **HS.LS1.B** (MS-LS3-2); **HS.LS3.A** (MS-LS3-2); **HS.LS3.B** (MS-LS3-2)

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MS-LS3 Heredity: Inheritance and Variation of Traits

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

Mathematics –

- MP.4** Model with mathematics. (MS-LS3-2)
- 6.SP.5.a–d** Summarize numerical data sets in relation to their context. (MS-LS3-2)

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MS-LS4 Biological Evolution: Unity and Diversity

MS-LS4 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.]
- 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.]
- 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.]
- 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.]
- 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.]
- 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.]

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MS-LS4 Biological Evolution: Unity and Diversity

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p>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.</p> <ul style="list-style-type: none"> ▪ Analyze displays of data to identify linear and non-linear relationships. (MS-LS4-3) ▪ Analyze and interpret data to determine similarities and differences in findings. (MS-LS4-1) <p>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.</p> <ul style="list-style-type: none"> ▪ Use mathematical representations to support scientific conclusions and design solutions. (MS-LS4-6) <p>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.</p> <ul style="list-style-type: none"> ▪ Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-2) ▪ Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena. (MS-LS4-4) 	<p>LS4.A: Evidence of Common Ancestry and Diversity</p> <ul style="list-style-type: none"> ▪ 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) ***<i>Supplemental DCI ESS1.C, ESS2.B</i> ▪ 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) ***<i>Supplemental DCI ESS1.C</i> ▪ Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully formed anatomy. (MS-LS4-3) <p>LS4.B: Natural Selection</p> <ul style="list-style-type: none"> ▪ Natural selection leads to the predominance of certain traits in a population, and the suppression of others. (MS-LS4-4) ▪ 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) 	<p>Patterns</p> <ul style="list-style-type: none"> ▪ Patterns can be used to identify cause and effect relationships. (MS-LS4-2) ▪ Graphs, charts, and images can be used to identify patterns in data. (MS-LS4-1), (MS-LS4-3) <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. (MS-LS4-4), (MS-LS4-5), (MS-LS4-6) <p style="text-align: center;">..... Connections to Engineering, Technology, and Applications of Science</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. (MS-LS4-5) <p style="text-align: center;">..... Connections to Nature of Science</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. (MS-LS4-1), (MS-LS4-2)

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MS-LS4 Biological Evolution: Unity and Diversity

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)

.....
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. (MS-LS4-1)

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. (MS-LS4-6)

Science Addresses Questions About the Natural and Material World

- Science knowledge can describe consequences of actions but does not make the decisions that society takes. (MS-LS4-5)

California Environmental Principles and Concepts aligned to the CA NGSS: (MS-LS4-1), (MS-LS4-2), (MS-LS4-6)

Principle II: The long-term functioning and health of terrestrial, freshwater, coastal, and marine ecosystems are influenced by their relationships with human societies.

Connections to other DCIs in this grade-band: MS.LS2.A (MS-LS4-3), (MS-LS4-6); MS.LS2.C (MS-LS4-6); MS.LS3.A (MS-LS4-2), (MS-LS4-3); MS.LS3.B (MS-LS4-2), (MS-LS4-3), (MS-LS4-6); MS.ESS1.C (MS-LS4-1), (MS-LS4-2), (MS-LS4-6); MS.ESS2.B (MS-LS4-1)

Articulation across grade-bands: 3.LS3.B (MS-LS4-4); 3.LS4.A (MS-LS4-1), (MS-LS4-2); 3.LS4.B (MS-LS4-4); 3.LS4.C (MS-LS4-6); HS.LS2.A (MS-LS4-4), (MS-LS4-6); HS.LS2.C (MS-LS4-6); HS.LS3.B (MS-LS4-4), (MS-LS4-5), (MS-LS4-6); HS.LS4.A (MS-LS4-1), (MS-LS4-2), (MS-LS4-3); HS.LS4.B (MS-LS4-4), (MS-LS4-6); HS.LS4.C (MS-LS4-4), (MS-LS4-5), (MS-LS4-6); HS.ESS1.C (MS-LS4-1), (MS-LS4-2)

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MS-LS4 Biological Evolution: Unity and Diversity

California Common Core State Standards Connections:

ELA/Literacy –

- RST.6–8.1** Cite specific textual evidence to support analysis of science and technical texts. (MS-LS4-1), (MS-LS4-2), (MS-LS4-3), (MS-LS4-4), (MS-LS4-5)
- 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), (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)
- WHST.6–8.2.a–f** Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. (MS-LS4-2), (MS-LS4-4)
- WHST.6–8.8** Gather relevant information from multiple print and digital sources (**primary and secondary**), 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. **CA** (MS-LS4-5)
- WHST.6–8.9** Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS4-2), (MS-LS4-4)
- SL.8.1.a–d** 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-LS4-2), (MS-LS4-4)
- SL.8.4** Present claims and findings (**e.g., argument, narrative, response to literature presentations**), 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. **CA**
a. Plan and present a narrative that: establishes a context and point of view, presents a logical sequence, uses narrative techniques (e.g., dialogue, pacing, description, sensory language), uses a variety of transitions, and provides a conclusion that reflects the experience. CA (MS-LS4-2), (MS-LS4-4)

Mathematics –

- MP.4** Model with mathematics. (MS-LS4-6)
- 6.RP.1** Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. *For example, “The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak.” “For every vote candidate A received, candidate C received nearly three votes.”* (MS-LS4-4), (MS-LS4-6)
- 7.RP.2.a–d** Recognize and represent proportional relationships between quantities. (MS-LS4-4), (MS-LS4-6)
- 6.SP.5.b** Summarize numerical data sets in relation to their context. (MS-LS4-4), (MS-LS4-6)
- 6.EE.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)

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MS-ETS1 Engineering Design

MS-ETS1 Engineering Design

Students who demonstrate understanding can:

- MS-ETS1-1.** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- MS-ETS1-2.** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- MS-ETS1-3.** Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
- MS-ETS1-4.** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

The performance expectation(s) above were 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>Asking Questions and Defining Problems Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.</p> <ul style="list-style-type: none"> ▪ Define a design problem that can be solved through the development of an object, tool, process, or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (MS-ETS1-1) <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 a model to generate data to test ideas about designed systems, including those representing inputs and outputs (MS-ETS1-4) 	<p>ETS1.A: Defining and Delimiting Engineering Problems</p> <ul style="list-style-type: none"> ▪ The more precisely a design task’s criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1) <p>ETS1.B: Developing Possible Solutions</p> <ul style="list-style-type: none"> ▪ A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) ▪ There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3) ▪ Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3) 	<p>Influence of Science, Engineering, and Technology on Society and the Natural World</p> <ul style="list-style-type: none"> ▪ All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ETS1-1) ▪ The uses of technologies and 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. (MS-ETS1-1)

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The section titled “Disciplinary Core Ideas” is reproduced verbatim from *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*.

MS-ETS1 Engineering Design

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-ETS1-3)

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.

- Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ETS1-2)

- Models of all kinds are important for testing solutions. (MS-ETS1-4)

ETS1.C: Optimizing the Design Solution

- Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3)
- The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4)

California Environmental Principles and Concepts aligned to the CA NGSS: (MS-ETS1-3)

Principle V: Decisions affecting resources and natural systems are based on a wide range of considerations and decision-making processes.

Connections to MS-ETS1.A: Defining and Delimiting Engineering Problems include:

Physical Science: MS-PS3-3

Connections to MS-ETS1.B: Developing Possible Solutions Problems include:

Physical Science: MS-PS1-6, MS-PS3-3, **Life Science:** MS-LS2-5

Connections to MS-ETS1.C: Optimizing the Design Solution include:

Physical Science: MS-PS1-6

Articulation of DCIs across grade-bands: 3–5.ETS1.A (MS-ETS1-1), (MS-ETS1-2), (MS-ETS1-3); 3–5.ETS1.B (MS-ETS1-2), (MS-ETS1-3), (MS-ETS1-4); 3–5.ETS1.C (MS-ETS1-2), (MS-ETS1-3), (MS-ETS1-4); HS.ETS1.A (MS-ETS1-1), (MS-ETS1-2); HS.ETS1.B (MS-ETS1-1), (MS-ETS1-2), (MS-ETS1-3), (MS-ETS1-4); HS.ETS1.C (MS-ETS1-3), (MS-ETS1-4)

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MS-ETS1 Engineering Design

California Common Core State Standards Connections:

ELA/Literacy –

- RST.6–8.1** Cite specific textual evidence to support analysis of science and technical texts. (MS-ETS1-1), (MS-ETS1-2), (MS-ETS1-3)
- 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-ETS1-3)
- 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-ETS1-2), (MS-ETS1-3)
- 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-ETS1-2)
- WHST.6–8.8** Gather relevant information from multiple print and digital sources (**primary and secondary**), 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. **CA** (MS-ETS1-1)
- WHST.6–8.9** Draw evidence from informational texts to support analysis, reflection, and research. (MS-ETS1-2)
- SL.8.5** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. *For example: If a woman making \$25 an hour gets a 10% raise, she will make an additional 1/10 of her salary an hour, or \$2.50, for a new salary of \$27.50. If you want to place a towel bar 9 3/4 inches long in the center of a door that is 27 1/2 inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation.* (MS-ETS1-4)

Mathematics –

- MP.2** Reason abstractly and quantitatively. (MS-ETS1-1), (MS-ETS1-2), (MS-ETS1-3), (MS-ETS1-4)
- 7.EE.3** Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. (MS-ETS1-1), (MS-ETS1-2), (MS-ETS1-3)
- 7.SP.7.a, b** Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy. (MS-ETS1-4)

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