Next Generation Science Standards for California Public Schools, Kindergarten through Grade Twelve

Grade Kindergarten
Standards Arranged by Topic 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 entitled "Disciplinary Core Ideas" is reproduced verbatim from *A Framework for K–12 Science Education: Practices, Cross-Cutting Concepts, and Core Ideas*. Revised March 2015.

K-LS1 From Molecules to Organisms: Structures and Processes

K-LS1 From Molecules to Organisms: Structures and Processes		
Students who demonstrate understanding can: **K-LS1-1.** **Use observations to describe patterns of what plants and animals (including humans) need to survive.** [Clarification Statement: Examples of patterns could include that animals need to take in food but plants do not; the different kinds of food needed by different types of animals; the requirement of plants to have light; and, that all living things need water.]		
The performance expectations 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**
Analyzing and Interpreting Data Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. ▪ Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. (K-LS1-1) **----------** ***Connections to Nature of Science***	**LS1.C: Organization for Matter and Energy Flow in Organisms** ▪ All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. (K-LS1-1)	**Patterns** ▪ Patterns in the natural and human designed world can be observed and used as evidence. (K-LS1-1)

Grade Kindergarten
Standards Arranged by Disciplinary Core Ideas

Scientific Knowledge is Based on Empirical Evidence ▪ Scientists look for patterns and order when making observations about the world. (K-LS1-1)		
Connections to other DCIs in kindergarten: N/A		
Articulation of DCIs across grade-bands: **1.LS1.A** (K-LS1-1); **2.LS2.A** (K-LS1-1); **3.LS2.C** (K-LS1-1); **3.LS4.B** (K-LS1-1); **5.LS1.C** (K-LS1-1); **5.LS2.A** (K-LS1-1)		
California Common Core State Standards Connections: *ELA/Literacy –* **W.K.7** Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them). (K-LS1-1) *Mathematics –* **K.MD.2** Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute, and describe the difference. (K-LS1-1)		

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Grade Kindergarten
Standards Arranged by Disciplinary Core Ideas

K-ESS2 Earth's Systems

K-ESS2 Earth's Systems

Students who demonstrate understanding can:

K-ESS2-1. **Use and share observations of local weather conditions to describe patterns over time.** [Clarification Statement: Examples of qualitative observations could include descriptions of the weather (such as sunny, cloudy, rainy, and warm); examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month. Examples of patterns could include that it is usually cooler in the morning than in the afternoon and the number of sunny days versus cloudy days in different months.] [Assessment Boundary: Assessment of quantitative observations limited to whole numbers and relative measures such as warmer/cooler.]

K-ESS2-2. **Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.** [Clarification Statement: Examples of plants and animals changing their environment could include a squirrel digs in the ground to hide its food and tree roots can break concrete.]

The performance expectations above were 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 K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.

- Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. (K-ESS2-1)

Engaging in Argument from Evidence
Engaging in argument from evidence in K–2 builds on prior experiences and

Disciplinary Core Ideas

ESS2.D: Weather and Climate

- Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time. (K-ESS2-1)

ESS2.E: Biogeology

- Plants and animals can change their environment. (K-ESS2-2)

ESS3.C: Human Impacts on Earth

Crosscutting Concepts

Patterns

- Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. (K-ESS2-1)

Systems and System Models

- Systems in the natural and designed world have parts that work together. (K-ESS2-2)

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Grade Kindergarten
Standards Arranged by Disciplinary Core Ideas

progresses to comparing ideas and representations about the natural and designed world(s). ▪ Construct an argument with evidence to support a claim. (K-ESS2-2) **----------** ***Connections to Nature of Science*** **Science Knowledge is Based on Empirical Evidence** ▪ Scientists look for patterns and order when making observations about the world. (K-ESS2-1)	**Systems** ▪ Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things. (secondary to K-ESS2-2)	
Connections to other DCIs in kindergarten: N/A		
Articulation of DCIs across grade-bands: **2.ESS2.A** (K-ESS2-1); **3.ESS2.D** (K-ESS2-1); **4.ESS2.A** (K-ESS2-1); **4.ESS2.E** (K-ESS2-2); **5.ESS2.A** (K-ESS2-2)		
California Common Core State Standards Connections: *ELA/Literacy –* **RI.K.1** With prompting and support, ask and answer questions about key details in a text. (K-ESS2-2) **W.K.1** Use a combination of drawing, dictating, and writing to compose opinion pieces in which they tell a reader the topic or the name of the book they are writing about and state an opinion or preference about the topic or book. (K-ESS2-2) **W.K.2** Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic. (K-ESS2-2) **W.K.7** Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them). (K-ESS2-1) *Mathematics –* **MP.2** Reason abstractly and quantitatively. (K-ESS2-1)		

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MP.4	Model with mathematics. (K-ESS2-1)
K.CC.1-3	Know number names and the count sequence. (K-ESS2-1)
K.MD.1	Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object. (K-ESS2-1)
K.MD.3	Classify objects into given categories; count the number of objects in each category and sort the categories by count. (K-ESS2-1)

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Grade Kindergarten
Standards Arranged by Disciplinary Core Ideas

K-ESS3 Earth and Human Activity

K-ESS3 Earth and Human Activity

Students who demonstrate understanding can:

K-ESS3-1. **Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.** [Clarification Statement: Examples of relationships could include that deer eat buds and leaves, therefore, they usually live in forested areas; and, grasses need sunlight so they often grow in meadows. Plants, animals, and their surroundings make up a system.]

K-ESS3-2. **Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.*** [Clarification Statement: Emphasis is on local forms of severe weather.]

K-ESS3-3. **Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.*** [Clarification Statement: Examples of human impact on the land could include cutting trees to produce paper and using resources to produce bottles. Examples of solutions could include reusing paper and recycling cans and bottles.]

The performance expectations 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
Asking Questions and Defining Problems Asking questions and defining problems in grades K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. ▪ Ask questions based on observations to find more information about the designed world. (K-ESS3-2) **Developing and Using Models** Modeling in K–2 builds on prior experiences	**ESS3.A: Natural Resources** ▪ Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do. (K-ESS3-1) **ESS3.B: Natural Hazards** ▪ Some kinds of severe weather are more likely than others in a given region. Weather scientists forecast severe weather so that the communities can prepare for and respond to	**Cause and Effect** ▪ Events have causes that generate observable patterns. (K-ESS3-2),(K-ESS3-3) **Systems and System Models** ▪ Systems in the natural and designed world have parts that work together. (K-ESS3-1) ----------

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Grade Kindergarten
Standards Arranged by Disciplinary Core Ideas

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<tr>
<td>and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, storyboard) that represent concrete events or design solutions.
▪ Use a model to represent relationships in the natural world. (K-ESS3-1)
Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.
▪ Read grade-appropriate texts and/or use media to obtain scientific information to describe patterns in the natural world. (K-ESS3-2)
▪ Communicate solutions with others in oral and/or written forms using models and/or drawings that provide detail about scientific ideas. (K-ESS3-3)</td>
<td>these events. (K-ESS3-2)
ESS3.C: Human Impacts on Earth Systems
▪ Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things. (K-ESS3-3)
ETS1.A: Defining and Delimiting an Engineering Problem
▪ Asking questions, making observations, and gathering information are helpful in thinking about problems. (secondary to K-ESS3-2)
ETS1.B: Developing Possible Solutions
▪ Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem’s solutions to other people. (secondary to K-ESS3-3)</td>
<td>Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology
▪ People encounter questions about the natural world every day. (K-ESS3-2)
Influence of Engineering, Technology, and Science on Society and the Natural World
▪ People depend on various technologies in their lives; human life would be very different without technology. (K-ESS3-2)</td>
</tr>
<tr>
<td colspan="3">Connections to other DCIs in kindergarten: K.ETS1.A (K-ESS3-2),(K-ESS3-3)</td>
</tr>
<tr>
<td colspan="3">Articulation of DCIs across grade-bands: 1.LS1.A (K-ESS3-1); 2.ESS1.C (K-ESS3-2); 2.ETS1.B (K-ESS3-3); 3.ESS3.B (K-ESS3-2); 4.ESS3.A (K-ESS3-3); 4.ESS3.B (K-ESS3-2); 5.LS2.A (K-ESS3-1); 5.ESS2.A (K-ESS3-1); 5.ESS3.C (K-ESS3-3)</td>
</tr>
<tr>
<td colspan="3">California Common Core State Standards Connections:
ELA/Literacy –
RI.K.1 With prompting and support, ask and answer questions about key details in a text. (K-ESS3-2)
W.K.2 Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what</td>
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	they are writing about and supply some information about the topic. (K-ESS3-3)
SL.K.3	Ask and answer questions in order to seek help, get information, or clarify something that is not understood. (K-ESS3-2)
SL.K.5	Add drawings or other visual displays to descriptions as desired to provide additional detail. (K-ESS3-1)
Mathematics –	
MP.2	Reason abstractly and quantitatively. (K-ESS3-1)
MP.4	Model with mathematics. (K-ESS3-1),(K-ESS3-2)
K.CC.1-3	Know number names and the count sequence. (K-ESS3-1),(K-ESS3-2)
K.CC.4-5	Count to tell the number of objects. (K-ESS3-1),(K-ESS3-2)
K.CC.6-7	Compare numbers. (K-ESS3-1),(K-ESS3-2)

Grade Kindergarten
Standards Arranged by Disciplinary Core Ideas

K-PS2 Motion and Stability: Forces and Interactions

K-PS2 Motion and Stability: Forces and Interactions

Students who demonstrate understanding can:

K-PS2-1. **Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.** [Clarification Statement: Examples of pushes or pulls could include a string attached to an object being pulled, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing on each other.] [Assessment Boundary: Assessment is limited to different relative strengths or different directions, but not both at the same time. Assessment does not include non-contact pushes or pulls such as those produced by magnets.]

K-PS2-2. **Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.*** [Clarification Statement: Examples of problems requiring a solution could include having a marble or other object move a certain distance, follow a particular path, and knock down other objects. Examples of solutions could include tools such as a ramp to increase the speed of the object and a structure that would cause an object such as a marble or ball to turn.] [Assessment Boundary: Assessment does not include friction as a mechanism for change in speed.]

The performance expectations 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
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or	**PS2.A: Forces and Motion** ▪ Pushes and pulls can have different strengths and directions. (K-PS2-1),(K-PS2-2) ▪ Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. (K-PS2-1),(K-PS2-2)	**Cause and Effect** ▪ Simple tests can be designed to gather evidence to support or refute student ideas about causes. (K-PS2-1),(K-PS2-2)

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<td>design solutions.
▪ With guidance, plan and conduct an investigation in collaboration with peers. (K-PS2-1)
Analyzing and Interpreting Data
Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.
▪ Analyze data from tests of an object or tool to determine if it works as intended. (K-PS2-2)

Connections to Nature of Science

Scientific Investigations Use a Variety of Methods
▪ Scientists use different ways to study the world. (K-PS2-1)</td>
<td>PS2.B: Types of Interactions
▪ When objects touch or collide, they push on one another and can change motion. (K-PS2-1)
PS3.C: Relationship Between Energy and Forces
▪ A bigger push or pull makes things speed up or slow down more quickly (secondary to K-PS2-1)
ETS1.A: Defining Engineering Problems
▪ A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions. (secondary to K-PS2-2)</td>
<td></td>
</tr>
<tr>
<td colspan="3">Connections to other DCIs in kindergarten: K.ETS1.A (K-PS2-2); K.ETS1.B (K-PS2-2)</td>
</tr>
<tr>
<td colspan="3">Articulation of DCIs across grade-bands: 2.ETS1.B (K-PS2-2); 3.PS2.A (K-PS2-1),(K-PS2-2); 3.PS2.B (K-PS2-1); 4.PS3.A (K-PS2-1); 4.ETS1.A (K-PS2-2)</td>
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<td colspan="3">California Common Core State Standards Connections:
ELA/Literacy –
RI.K.1 With prompting and support, ask and answer questions about key details in a text. (K-PS2-2)
W.K.7 Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them). (K-PS2-1)
SL.K.3 Ask and answer questions in order to seek help, get information, or clarify something that is not understood. (K-PS2-2)</td>
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Mathematics –

MP.2 Reason abstractly and quantitatively. (K-PS2-1)

K.MD.1-2 Describe and compare measurable attributes. (K-PS2-1)

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Standards Arranged by Disciplinary Core Ideas

K-PS3 Energy

K-PS3 Energy

Students who demonstrate understanding can:

K-PS3-1. **Make observations to determine the effect of sunlight on Earth's surface.** [Clarification Statement: Examples of Earth's surface could include sand, soil, rocks, and water] [Assessment Boundary: Assessment of temperature is limited to relative measures such as warmer/cooler.]

K-PS3-2. **Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.*** [Clarification Statement: Examples of structures could include umbrellas, canopies, and tents that minimize the warming effect of the sun.]

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Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. ▪ Make observations (firsthand or from media) to collect data that can be used to make comparisons. (K-PS3-1) **Constructing Explanations and Designing Solutions**	**PS3.B: Conservation of Energy and Energy Transfer** ▪ Sunlight warms Earth's surface. (K-PS3-1),(K-PS3-2)	**Cause and Effect** ▪ Events have causes that generate observable patterns. (K-PS3-1),(K-PS3-2)

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Standards Arranged by Disciplinary Core Ideas

Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. ▪ Use tools and materials provided to design and build a device that solves a specific problem or a solution to a specific problem. (K-PS3-2) **----------** ***Connections to Nature of Science*** **Scientific Investigations Use a Variety of Methods** ▪ Scientists use different ways to study the world. (K-PS3-1)		
Connections to other DCIs in kindergarten: **K.ETS1.A** (K-PS3-2); **K.ETS1.B** (K-PS3-2)		
Articulation of DCIs across grade-bands: **1.PS4.B** (K-PS3-1),(K-PS3-2); **2.ETS1.B** (K-PS3-2), **3.ESS2.D** (K-PS3-1); **4.ETS1.A** (K-PS3-2)		
California Common Core State Standards Connections: *ELA/Literacy –* **W.K.7** Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them). (K-PS3-1),(K-PS3-2) *Mathematics –* **K.MD.2** Directly compare two objects with a measurable attribute in common, to see which object has “more of”/”less of” the attribute, and describe the difference. (K-PS3-1),(K-PS3-2)		

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Grade Kindergarten
Standards Arranged by Disciplinary Core Ideas

K–2 Engineering Design

K–2 ETS1 Engineering Design

Students who demonstrate understanding can:

K–2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

K–2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

K–2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K–12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems

Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions.

- Ask questions based on observations to find more information about the natural and/or designed world(s). (K–2-ETS1-1)
- Define a simple problem that can be solved through the development of a new or improved object or tool. (K–2-ETS1-1)

Disciplinary Core Ideas

ETS1.A: Defining and Delimiting Engineering Problems

- A situation that people want to change or create can be approached as a problem to be solved through engineering. (K–2-ETS1-1)
- Asking questions, making observations, and gathering information are helpful in thinking about problems. (K–2-ETS1-1)
- Before beginning to design a solution, it is important to clearly understand the problem. (K–2-ETS1-1)

ETS1.B: Developing Possible Solutions

- Designs can be conveyed through

Crosscutting Concepts

Structure and Function

- The shape and stability of structures of natural and designed objects are related to their function(s). (K–2-ETS1-2)

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<td>Developing and Using Models
Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.
▪ Develop a simple model based on evidence to represent a proposed object or tool. (K–2-ETS1-2)
Analyzing and Interpreting Data
Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.
▪ Analyze data from tests of an object or tool to determine if it works as intended. (K–2-ETS1-3)</td>
<td>sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (K–2-ETS1-2)
ETS1.C: Optimizing the Design Solution
▪ Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (K–2-ETS1-3)</td>
<td></td>
</tr>
<tr>
<td colspan="3">Connections to other DCIs in this grade-band:
Connections to K–2-ETS1.A: Defining and Delimiting Engineering Problems include:
Kindergarten: K-PS2-2, K-ESS3-2
Connections to K–2-ETS1.B: Developing Possible Solutions Problems include:
Kindergarten: K-ESS3-3, First Grade: 1-PS4-4, Second Grade: 2-LS2-2
Connections to K–2-ETS1.C: Optimizing the Design Solution include:
Second Grade: 2-ESS2-1</td>
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<td colspan="3">Articulation of DCIs across grade-bands: 3–5.ETS1.A (K–2-ETS1-1),(K–2-ETS1-2),(K–2-ETS1-3); 3–5.ETS1.B (K–2-ETS1-2); 3–5.ETS1.C (K–2-ETS1-1),(K–2-ETS1-2),(K–2-ETS1-3)</td>
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California Common Core State Standards Connections:

ELA/Literacy –

RI.2.1	Ask and answer such questions as *who*, *what*, *where*, *when*, *why*, and *how* to demonstrate understanding of key details in a text. (K–2-ETS1-1)
W.2.6	With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. (K–2-ETS1-1),(K–2-ETS1-3)
W.2.8	Recall information from experiences or gather information from provided sources to answer a question. (K–2-ETS1-1),(K–2-ETS1-3)
SL.2.5	Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. (K–2-ETS1-2)

Mathematics –

MP.2	Reason abstractly and quantitatively. (K–2-ETS1-1),(K–2-ETS1-3)
MP.4	Model with mathematics. (K–2-ETS1-1),(K–2-ETS1-3)
MP.5	Use appropriate tools strategically. (K–2-ETS1-1),(K–2-ETS1-3)

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Grade One
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 entitled "Disciplinary Core Ideas" is reproduced verbatim from *A Framework for K–12 Science Education: Practices, Cross-Cutting Concepts, and Core Ideas*. Revised March 2015.

1-LS1 From Molecules to Organisms: Structures and Processes

1-LS1 From Molecules to Organisms: Structures and Processes		
Students who demonstrate understanding can: **1-LS1-1.** **Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.*** [Clarification Statement: Examples of human problems that can be solved by mimicking plant or animal solutions could include designing clothing or equipment to protect bicyclists by mimicking turtle shells, acorn shells, and animal scales; stabilizing structures by mimicking animal tails and roots on plants; keeping out intruders by mimicking thorns on branches and animal quills; and, detecting intruders by mimicking eyes and ears.] **1-LS1-2.** **Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.** [Clarification Statement: Examples of patterns of behaviors could include the signals that offspring make (such as crying, cheeping, and other vocalizations) and the responses of the parents (such as feeding, comforting, and protecting the offspring).]		
The performance expectations 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**
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing	**LS1.A: Structure and Function** ▪ All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take	**Patterns** ▪ Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. (1-LS1-2)

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<table>
<tr>
<td>evidence-based accounts of natural phenomena and designing solutions.
▪ Use materials to design a device that solves a specific problem or a solution to a specific problem. (1-LS1-1)
Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.
▪ Read grade-appropriate texts and use media to obtain scientific information to determine patterns in the natural world. (1-LS1-2)

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence
▪ Scientists look for patterns and order when making observations about the world. (1-LS1-2)</td>
<td>in food, water and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow. (1-LS1-1)
LS1.B: Growth and Development of Organisms
▪ Adult plants and animals can have young. In many kinds of animals, parents and the offspring themselves engage in behaviors that help the offspring to survive. (1-LS1-2)
LS1.D: Information Processing
▪ Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs. (1-LS1-1)</td>
<td>Structure and Function
▪ The shape and stability of structures of natural and designed objects are related to their function(s). (1-LS1-1)

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering and Technology on Society and the Natural World
▪ Every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world. (1-LS1-1)</td>
</tr>
<tr><td colspan="3">Connections to other DCIs in first grade: N/A</td></tr>
<tr><td colspan="3">Articulation of DCIs across grade-bands: K.ETS1.A (1-LS1-1); 3.LS2.D (1-LS1-2); 4.LS1.A (1-LS1-1); 4.LS1.D (1-LS1-1); 4.ETS1.A (1-LS1-1)</td></tr>
<tr><td colspan="3">California Common Core State Standards Connections:</td></tr>
</table>

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ELA/Literacy –	
RI.1.1	Ask and answer questions about key details in a text. (1-LS1-2)
RI.1.2	Identify the main topic and retell key details of a text. (1-LS1-2)
RI.1.10	With prompting and support, read informational texts appropriately complex for grade. a. Activate prior knowledge related to the information and events in a text. **CA** b. Confirm predictions about what will happen next in a text. **CA** (1-LS1-2)
W.1.7	Participate in shared research and writing projects (e.g., explore a number of "how-to" books on a given topic and use them to write a sequence of instructions). (1-LS1-1)
Mathematics –	
1.NBT.3	Compare two two-digit numbers based on the meanings of the tens and one digits, recording the results of comparisons with the symbols >, =, and <. (1-LS1-2)
1.NBT.4-6	Use place value understanding and properties of operations to add and subtract. (1-LS1-2)

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1-LS3 Heredity: Inheritance and Variation of Traits

1-LS3 Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can:

1-LS3-1. **Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents.** [Clarification Statement: Examples of patterns could include features plants or animals share. Examples of observations could include leaves from the same kind of plant are the same shape but can differ in size; and, a particular breed of dog looks like its parents but is not exactly the same.] [Assessment Boundary: Assessment does not include inheritance or animals that undergo metamorphosis or hybrids.]

The performance expectations 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
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. ▪ Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. (1-LS3-1)	**LS3.A: Inheritance of Traits** ▪ Young animals are very much, but not exactly like, their parents. Plants also are very much, but not exactly, like their parents. (1-LS3-1) **LS3.B: Variation of Traits** ▪ Individuals of the same kind of plant or animal are recognizable as similar but can also vary in many ways. (1-LS3-1)	**Patterns** ▪ Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. (1-LS3-1)

Connections to other DCIs in first grade: N/A

Articulation of DCIs across grade-bands: **3.LS3.A** (1-LS3-1); **3.LS3.B** (1-LS3-1)

California Common Core State Standards Connections:

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RI.1.1	Ask and answer questions about key details in a text. (1-LS3-1)
W.1.7	Participate in shared research and writing projects (e.g., explore a number of "how-to" books on a given topic and use them to write a sequence of instructions). (1-LS3-1)
W.1.8	With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question. (1-LS3-1)
Mathematics –	
MP.2	Reason abstractly and quantitatively. (1-LS3-1)
MP.5	Use appropriate tools strategically. (1-LS3-1)
1.MD.1	Order three objects by length; compare the lengths of two objects indirectly by using a third object. (1-LS3-1)

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Grade One
Standards Arranged by Disciplinary Core Ideas

1-ESS1 Earth's Place in the Universe

1-ESS1 Earth's Place in the Universe

Students who demonstrate understanding can:

1-ESS1-1. **Use observations of the sun, moon, and stars to describe patterns that can be predicted.** [Clarification Statement: Examples of patterns could include that the sun and moon appear to rise in one part of the sky, move across the sky, and set; and stars other than our sun are visible at night but not during the day.] [Assessment Boundary: Assessment of star patterns is limited to stars being seen at night and not during the day.]

1-ESS1-2. **Make observations at different times of year to relate the amount of daylight to the time of year.** [Clarification Statement: Emphasis is on relative comparisons of the amount of daylight in the winter to the amount in the spring or fall.] [Assessment Boundary: Assessment is limited to relative amounts of daylight, not quantifying the hours or time of daylight.]

The performance expectations 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
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. ▪ Make observations (firsthand or from media) to collect data that can be used to make comparisons. (1-ESS1-2)	**ESS1.A: The Universe and its Stars** ▪ Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted. (1-ESS1-1) **ESS1.B: Earth and the Solar System** ▪ Seasonal patterns of sunrise and sunset can be observed, described, and predicted. (1-ESS1-2)	**Patterns** ▪ Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. (1-ESS1-1),(1-ESS1-2) --- ***Connections to Nature of Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** ▪ Science assumes natural events happen

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Grade One
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Analyzing and Interpreting Data Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. ▪ Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. (1-ESS1-1)		today as they happened in the past. (1-ESS1-1) ▪ Many events are repeated. (1-ESS1-1)

Connections to other DCIs in first grade: N/A

Articulation of DCIs across grade-bands: **3.PS2.A** (1-ESS1-1); **5.PS2.B** (1-ESS1-1),(1-ESS1-2); **5-ESS1.B** (1-ESS1-1),(1-ESS1-2)

California Common Core State Standards Connections:

ELA/Literacy –

W.1.7 Participate in shared research and writing projects (e.g., explore a number of "how-to" books on a given topic and use them to write a sequence of instructions). (1-ESS1-1),(1-ESS1-2)

W.1.8 With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question. (1-ESS1-1),(1-ESS1-2)

Mathematics –

MP.2 Reason abstractly and quantitatively. (1-ESS1-2)

MP.4 Model with mathematics. (1-ESS1-2)

MP.5 Use appropriate tools strategically. (1-ESS1-2)

1.OA.1 Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem. (1-ESS1-2)

1.MD.4 Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another. (1-ESS1-2)

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1-PS4 Waves and their Applications in Technologies for Information Transfer

1-PS4 Waves and their Applications in Technologies for Information Transfer

Students who demonstrate understanding can:

1-PS4-1. **Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.** [Clarification Statement: Examples of vibrating materials that make sound could include tuning forks and plucking a stretched string. Examples of how sound can make matter vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.]

1-PS4-2. **Make observations to construct an evidence-based account that objects in darkness can be seen only when illuminated.** [Clarification Statement: Examples of observations could include those made in a completely dark room, a pinhole box, and a video of a cave explorer with a flashlight. Illumination could be from an external light source or by an object giving off its own light.]

1-PS4-3. **Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light.** [Clarification Statement: Examples of materials could include those that are transparent (such as clear plastic), translucent (such as wax paper), opaque (such as cardboard), and reflective (such as a mirror).] [Assessment Boundary: Assessment does not include the speed of light.]

1-PS4-4. **Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.*** [Clarification Statement: Examples of devices could include a light source to send signals, paper cup and string "telephones," and a pattern of drum beats.] [Assessment Boundary: Assessment does not include technological details for how communication devices work.]

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Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and	**PS4.A: Wave Properties** ▪ Sound can make matter vibrate, and vibrating matter can make sound. (1-PS4-1)	**Cause and Effect** ▪ Simple tests can be designed to gather evidence to support or refute student ideas about causes.

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progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.
- Plan and conduct investigations collaboratively to produce data to serve as the basis for evidence to answer a question. (1-PS4-1),(1-PS4-3)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.
- Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. (1-PS4-2)
- Use tools and materials provided to design a device that solves a specific problem. (1-PS4-4)

Connections to Nature of Science

Scientific Investigations Use a Variety of Methods
- Science investigations begin with a question. (1-PS4-1)

PS4.B: Electromagnetic Radiation
- Objects can be seen if light is available to illuminate them or if they give off their own light. (1-PS4-2)
- Some materials allow light to pass through them, others allow only some light through and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. Mirrors can be used to redirect a light beam. (Boundary: The idea that light travels from place to place is developed through experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light.) (1-PS4-3)

PS4.C: Information Technologies and Instrumentation
- People also use a variety of devices to communicate (send and receive information) over long distances. (1-PS4-4)

(1-PS4-1),(1-PS4-2),(1-PS4-3)

Connections to Engineering, Technology, and Applications of Science

Influence of Engineering, Technology, and Science, on Society and the Natural World
- People depend on various technologies in their lives; human life would be very different without technology. (1-PS4-4)

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▪ Scientists use different ways to study the world. (1-PS4-1)		
Connections to other DCIs in first grade: N/A		
Articulation of DCIs across grade-bands: **K.ETS1.A** (1-PS4-4); **2.PS1.A** (1-PS4-3); **2.ETS1.B** (1-PS4-4); **4.PS4.B** (1-PS4-4); **4.PS4.C** (1-PS4-4); **4.ETS1.A** (1-PS4-1)		
California Common Core State Standards Connections: *ELA/Literacy –* **W.1.2** Write informative/explanatory texts in which they name a topic, supply some facts about the topic, and provide some sense of closure. (1-PS4-2) **W.1.7** Participate in shared research and writing projects (e.g., explore a number of "how-to" books on a given topic and use them to write a sequence of instructions). (1-PS4-1),(1-PS4-2),(1-PS4-3),(1-PS4-4) **W.1.8** With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question. (1-PS4-1),(1-PS4-2),(1-PS4-3) **SL.1.1.a–c** Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups. (1-PS4-1),(1-PS4-2),(1-PS4-3) *Mathematics –* **MP.5** Use appropriate tools strategically. (1-PS4-4) **1.MD.1-2** Measure lengths indirectly and by iterating length units. (1-PS4-4)		

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K–2 Engineering Design

K–2 ETS1 Engineering Design

Students who demonstrate understanding can:

K–2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

K–2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

K–2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

The performance expectations 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
Asking Questions and Defining Problems Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions. ▪ Ask questions based on observations to find more information about the natural and/or designed world(s). (K–2-ETS1-1) ▪ Define a simple problem that can be solved through the development of a new or improved object or tool. (K–2-ETS1-1) ▪	**ETS1.A: Defining and Delimiting Engineering Problems** ▪ A situation that people want to change or create can be approached as a problem to be solved through engineering. (K–2-ETS1-1) ▪ Asking questions, making observations, and gathering information are helpful in thinking about problems. (K–2-ETS1-1) ▪ Before beginning to design a solution, it is important to clearly understand the problem. (K–2-ETS1-1) **ETS1.B: Developing Possible Solutions** ▪ Designs can be conveyed through	**Structure and Function** ▪ The shape and stability of structures of natural and designed objects are related to their function(s). (K–2-ETS1-2)

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<td>Developing and Using Models
Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.
▪ Develop a simple model based on evidence to represent a proposed object or tool. (K–2-ETS1-2)
Analyzing and Interpreting Data
Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.
▪ Analyze data from tests of an object or tool to determine if it works as intended. (K–2-ETS1-3)</td>
<td>sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem’s solutions to other people. (K–2-ETS1-2)
ETS1.C: Optimizing the Design Solution
▪ Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (K–2-ETS1-3)</td>
<td></td>
</tr>
<tr>
<td colspan="3">Connections to other DCIs in other grade-bands:
Connections to K–2-ETS1.A: Defining and Delimiting Engineering Problems include:
Kindergarten: K-PS2-2, K-ESS3-2
Connections to K–2-ETS1.B: Developing Possible Solutions to Problems include:
Kindergarten: K-ESS3-3, First Grade: 1-PS4-4, Second Grade: 2-LS2-2
Connections to K–2-ETS1.C: Optimizing the Design Solution include:
Second Grade: 2-ESS2-1</td>
</tr>
<tr>
<td colspan="3">Articulation of DCIs across grade-bands: 3–5.ETS1.A (K–2-ETS1-1),(K–2-ETS1-2),(K–2-ETS1-3); 3–5.ETS1.B (K–2-ETS1-2); 3–5.ETS1.C (K–2-ETS1-1),(K–2-ETS1-2),(K–2-ETS1-3)</td>
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California Common Core State Standards Connections:

ELA/Literacy –

RI.2.1	Ask and answer such questions as *who*, *what*, *where*, *when*, *why*, and *how* to demonstrate understanding of key details in a text. (2-ESS1-1)
W.2.6	With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. (K–2-ETS1-1),(K–2-ETS1-3)
W.2.8	Recall information from experiences or gather information from provided sources to answer a question. (K–2-ETS1-1),(K–2-ETS1-3)
SL.2.5	Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. (K–2-ETS1-2)

Mathematics –

MP.2	Reason abstractly and quantitatively. (K–2-ETS1-1),(K–2-ETS1-3)
MP.4	Model with mathematics. (K–2-ETS1-1),(K–2-ETS1-3)
MP.5	Use appropriate tools strategically. (K–2-ETS1-1),(K–2-ETS1-3)

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Next Generation Science Standards for California Public Schools, Kindergarten through Grade Twelve

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2-LS2 Ecosystems: Interactions, Energy, and Dynamics

2-LS2 Ecosystems: Interactions, Energy, and Dynamics		
Students who demonstrate understanding can: **2-LS2-1.** **Plan and conduct an investigation to determine if plants need sunlight and water to grow.** [Assessment Boundary: Assessment is limited to testing one variable at a time.] **2-LS2-2.** **Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.***		
The performance expectations 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**
Developing and Using Models Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. ▪ Develop a simple model based on evidence to represent a proposed object or tool. (2-LS2-2) **Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to	**LS2.A: Interdependent Relationships in Ecosystems** ▪ Plants depend on water and light to grow. (2-LS2-1) ▪ Plants depend on animals for pollination or to move their seeds around. (2-LS2-2) **ETS1.B: Developing Possible Solutions** ▪ Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (secondary to 2-LS2-2)	**Cause and Effect** ▪ Events have causes that generate observable patterns. (2-LS2-1) **Structure and Function** ▪ The shape and stability of structures of natural and designed objects are related to their function(s). (2-LS2-2)

problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. ▪ Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. (2-LS2-1)		
Connections to other DCIs in second grade: N/A		
Articulation of DCIs across grade-bands: **K.LS1.C** (2-LS2-1); **K-ESS3.A** (2-LS2-1); **K.ETS1.A** (2-LS2-2); **5.LS1.C** (2-LS2-1); **5.LS2.A** (2-LS2-2)		
California Common Core State Standards Connections: *ELA/Literacy –* **W.2.7** Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). (2-LS2-1) **W.2.8** Recall information from experiences or gather information from provided sources to answer a question. (2-LS2-1) **SL.2.5** Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. (2-LS2-2) *Mathematics –* **MP.2** Reason abstractly and quantitatively. (2-LS2-1) **MP.4** Model with mathematics. (2-LS2-1),(2-LS2-2) **MP.5** Use appropriate tools strategically. (2-LS2-1) **2.MD.10** Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. (2-LS2-2)		

Grade Two
Standards Arranged by Disciplinary Core Ideas

2-LS4 Biological Evolution: Unity and Diversity

2-LS4 Biological Evolution: Unity and Diversity		
Students who demonstrate understanding can: **2-LS4-1.** **Make observations of plants and animals to compare the diversity of life in different habitats.** [Clarification Statement: Emphasis is on the diversity of living things in each of a variety of different habitats.] [Assessment Boundary: Assessment does not include specific animal and plant names in specific habitats.]		
The performance expectations 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**
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. ▪ Make observations (firsthand or from media) to collect data which can be used to make comparisons. (2-LS4-1) **----------** ***Connections to Nature of Science***	**LS4.D: Biodiversity and Humans** ▪ There are many different kinds of living things in any area, and they exist in different places on land and in water. (2-LS4-1)	

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Grade Two
Standards Arranged by Disciplinary Core Ideas

Scientific Knowledge is Based on Empirical Evidence ▪ Scientists look for patterns and order when making observations about the world. (2-LS4-1)		
Connections to other DCIs in second grade: N/A		
Articulation of DCIs across grade-bands: **3.LS4.C** (2-LS4-1); **3.LS4.D** (2-LS4-1); **5.LS2.A** (2-LS4-1)		
California Common Core State Standards Connections: *ELA/Literacy* – **W.2.7** Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). (2-LS4-1) **W.2.8** Recall information from experiences or gather information from provided sources to answer a question. (2-LS4-1) *Mathematics* – **MP.2** Reason abstractly and quantitatively. (2-LS4-1) **MP.4** Model with mathematics. (2-LS4-1) **2.MD.10** Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. (2-LS4-1)		

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Grade Two
Standards Arranged by Disciplinary Core Ideas

2-ESS1 Earth's Place in the Universe

2-ESS1 Earth's Place in the Universe

Students who demonstrate understanding can:

2-ESS1-1. **Use information from several sources to provide evidence that Earth events can occur quickly or slowly.** [Clarification Statement: Examples of events and timescales could include volcanic explosions and earthquakes, which happen quickly and erosion of rocks, which occurs slowly.] [Assessment Boundary: Assessment does not include quantitative measurements of timescales.]

The performance expectations 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
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. ▪ Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. (2-ESS1-1)	**ESS1.C: The History of Planet Earth** ▪ Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe. (2-ESS1-1)	**Stability and Change** ▪ Things may change slowly or rapidly. (2-ESS1-1)

Connections to other DCIs in second grade: N/A

Articulation of DCIs across grade-bands: **3.LS2.C** (2-ESS1-1); **4.ESS1.C** (2-ESS1-1); **4.ESS2.A** (2-ESS1-1)

California Common Core State Standards Connections:
ELA/Literacy –

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Grade Two
Standards Arranged by Disciplinary Core Ideas

RI.2.1	Ask and answer such questions as *who*, *what*, *where*, *when*, *why*, and *how* to demonstrate understanding of key details in a text. (2-ESS1-1)
RI.2.3	Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text. (2-ESS1-1)
W.2.6	With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. (2-ESS1-1)
W.2.7	Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). (2-ESS1-1)
W.2.8	Recall information from experiences or gather information from provided sources to answer a question. (2-ESS1-1)
SL.2.2	Recount or describe key ideas or details from a text read aloud or information presented orally or through other media. a. Give and follow three- and four-step oral directions. **CA** (2-ESS1-1)
Mathematics –	
MP.2	Reason abstractly and quantitatively. (2-ESS1-1)
MP.4	Model with mathematics. (2-ESS1-1)
2.NBT.1-4	Understand place value. (2-ESS1-1)

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Grade Two
Standards Arranged by Disciplinary Core Ideas

2-ESS2 Earth's Systems

2-ESS2 Earth's Systems

Students who demonstrate understanding can:

2-ESS2-1. **Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.*** [Clarification Statement: Examples of solutions could include different designs of dikes and windbreaks to hold back wind and water, and different designs for using shrubs, grass, and trees to hold back the land.]

2-ESS2-2. **Develop a model to represent the shapes and kinds of land and bodies of water in an area.** [Assessment Boundary: Assessment does not include quantitative scaling in models.]

2-ESS2-3. **Obtain information to identify where water is found on Earth and that it can be solid or liquid.**

The performance expectations above were 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 K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.

- Develop a model to represent patterns in the natural world. (2-ESS2-2)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in K–2 builds on prior

Disciplinary Core Ideas

ESS2.A: Earth Materials and Systems

- Wind and water can change the shape of the land. (2-ESS2-1)

ESS2.B: Plate Tectonics and Large-Scale System Interactions

- Maps show where things are located. One can map the shapes and kinds of land and water in any area. (2-ESS2-2)

ESS2.C: The Roles of Water in Earth's Surface Processes

- Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. (2-ESS2-3)

ETS1.C: Optimizing the Design Solution

Crosscutting Concepts

Patterns

- Patterns in the natural world can be observed. (2-ESS2-2),(2-ESS2-3)

Stability and Change

- Things may change slowly or rapidly. (2-ESS2-1)

Connections to Engineering, Technology, and Applications of Science

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

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<table>
<tr>
<td>experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.
▪ Compare multiple solutions to a problem. (2-ESS2-1)
Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.
▪ Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question. (2-ESS2-3)</td>
<td>▪ Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (secondary to 2-ESS2-1)</td>
<td>World
▪ Developing and using technology has impacts on the natural world. (2-ESS2-1)

Connections to Nature of Science

Science Addresses Questions About the Natural and Material World
▪ Scientists study the natural and material world. (2-ESS2-1)</td>
</tr>
<tr><td colspan="3">Connections to other DCIs in second grade: 2.PS1.A (2-ESS2-3)</td></tr>
<tr><td colspan="3">Articulation of DCIs across grade-bands: K.ETS1.A (2-ESS2-1); 4.ESS2.A (2-ESS2-1); 4.ESS2.B (2-ESS2-2); 4.ETS1.A (2-ESS2-1); 4.ETS1.B (2-ESS2-1); 4.ETS1.C (2-ESS2-1); 5.ESS2.A (2-ESS2-1); 5.ESS2.C (2-ESS2-2),(2-ESS2-3)</td></tr>
<tr><td colspan="3">California Common Core State Standards Connections:
ELA/Literacy –
RI.2.3 Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text. (2-ESS2-1)
RI.2.9 Compare and contrast the most important points presented by two texts on the same topic. (2-ESS2-1)
W.2.6 With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. (2-ESS2-3)</td></tr>
</table>

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Grade Two
Standards Arranged by Disciplinary Core Ideas

W.2.8	Recall information from experiences or gather information from provided sources to answer a question. (2-ESS2-3)
SL.2.5	Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. (2-ESS2-2)
Mathematics –	
MP.2	Reason abstractly and quantitatively. (2-ESS2-1),(2-ESS2-2)
MP.4	Model with mathematics. (2-ESS2-1),(2-ESS2-2)
MP.5	Use appropriate tools strategically. (2-ESS2-1)
2.NBT.3	Read and write numbers to 1000 using base-ten numerals, number names, and expanded form. (2-ESS2-2)
2.MD.5	Use addition and subtraction within 100 to solve word problems involving lengths that are given in the same units, e.g., by using drawings (such as drawings of rulers) and equations with a symbol for the unknown number to represent the problem. (2-ESS2-1)

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Grade Two
Standards Arranged by Disciplinary Core Ideas

2-PS1 Matter and its Interactions

2-PS1 Matter and its Interactions

Students who demonstrate understanding can:

2-PS1-1. **Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.** [Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.]

2-PS1-2. **Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.*** [Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency.] [Assessment Boundary: Assessment of quantitative measurements is limited to length.]

2-PS1-3. **Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.** [Clarification Statement: Examples of pieces could include blocks, building bricks, or other assorted small objects.]

2-PS1-4. **Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.** [Clarification Statement: Examples of reversible changes could include materials such as water and butter at different temperatures. Examples of irreversible changes could include cooking an egg, freezing a plant leaf, and heating paper.]

The performance expectations 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
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple	**PS1.A: Structure and Properties of Matter** ▪ Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its	**Patterns** ▪ Patterns in the natural and human designed world can be observed. (2-PS1-1) **Cause and Effect**

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investigations, based on fair tests, which provide data to support explanations or design solutions. ▪ Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. (2-PS1-1) **Analyzing and Interpreting Data** Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. ▪ Analyze data from tests of an object or tool to determine if it works as intended. (2-PS1-2) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. ▪ Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. (2-PS1-3) **Engaging in Argument from Evidence**	observable properties. (2-PS1-1) ▪ Different properties are suited to different purposes. (2-PS1-2),(2-PS1-3) ▪ A great variety of objects can be built up from a small set of pieces. (2-PS1-3) **PS1.B: Chemical Reactions** ▪ Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not. (2-PS1-4)	▪ Events have causes that generate observable patterns. (2-PS1-4) ▪ Simple tests can be designed to gather evidence to support or refute student ideas about causes. (2-PS1-2) **Energy and Matter** ▪ Objects may break into smaller pieces and be put together into larger pieces, or change shapes. (2-PS1-3) **----------** ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Engineering, Technology, and Science on Society and the Natural World** ▪ Every human-made product is designed by applying some knowledge of the natural world and is built by using natural materials. (2-PS1-2)

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Grade Two
Standards Arranged by Disciplinary Core Ideas

Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s). ▪ Construct an argument with evidence to support a claim. (2-PS1-4) **----------** ***Connections to Nature of Science*** **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** ▪ Scientists search for cause and effect relationships to explain natural events. (2-PS1-4)		

Connections to other DCIs in second grade: N/A

Articulation of DCIs across grade-bands: **4.ESS2.A** (2-PS1-3); **5.PS1.A** (2-PS1-1),(2-PS1-2),(2-PS1-3); **5.PS1.B** (2-PS1-4); **5.LS2.A** (2-PS1-3)

California Common Core State Standards Connections:
ELA/Literacy –

RI.2.1 Ask and answer such questions as *who*, *what*, *where*, *when*, *why*, and *how* to demonstrate understanding of key details in a text. (2-PS1-4)

RI.2.3 Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text. (2-PS1-4)

RI.2.8 Describe how reasons support specific points the author makes in a text. (2-PS1-2),(2-PS1-4)

W.2.1 Write opinion pieces in which they introduce the topic or book they are writing about, state an opinion, supply reasons

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	that support the opinion, use linking words (e.g., *because, and, also*) to connect opinion and reasons, and provide a concluding statement or section. (2-PS1-4)
W.2.7	Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). (2-PS1-1),(2-PS1-2),(2-PS1-3)
W.2.8	Recall information from experiences or gather information from provided sources to answer a question. (2-PS1-1),(2-PS1-2),(2-PS1-3)
Mathematics –	
MP.2	Reason abstractly and quantitatively. (2-PS1-2)
MP.4	Model with mathematics. (2-PS1-1),(2-PS1-2)
MP.5	Use appropriate tools strategically. (2-PS1-2)
2.MD.10	Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. (2-PS1-1),(2-PS1-2)

Grade Two
Standards Arranged by Disciplinary Core Ideas

K–2 Engineering Design

K–2-ETS1 Engineering Design

Students who demonstrate understanding can:

K–2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

K–2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

K–2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K–12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems

Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions.

- Ask questions based on observations to find more information about the natural and/or designed world(s). (K–2-ETS1-1)
- Define a simple problem that can be solved through the development of a new or improved object or tool. (K–2-ETS1-1)

Developing and Using Models

Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing,

Disciplinary Core Ideas

ETS1.A: Defining and Delimiting Engineering Problems

- A situation that people want to change or create can be approached as a problem to be solved through engineering. (K–2-ETS1-1)
- Asking questions, making observations, and gathering information are helpful in thinking about problems. (K–2-ETS1-1)
- Before beginning to design a solution, it is important to clearly understand the problem. (K–2-ETS1-1)

ETS1.B: Developing Possible Solutions

- Designs can be conveyed through

Crosscutting Concepts

Structure and Function

- The shape and stability of structures of natural and designed objects are related to their function(s). (K–2-ETS1-2)

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physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. ▪ Develop a simple model based on evidence to represent a proposed object or tool. (K–2-ETS1-2) **Analyzing and Interpreting Data** Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. ▪ Analyze data from tests of an object or tool to determine if it works as intended. (K–2-ETS1-3)	sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (K–2-ETS1-2) **ETS1.C: Optimizing the Design Solution** ▪ Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (K–2-ETS1-3)	
Connections to other DCIs in this grade-band: *Connections to K–2-ETS1.A: Defining and Delimiting Engineering Problems include:* **Kindergarten:** K-PS2-2, K-ESS3-2 *Connections to K–2-ETS1.B: Developing Possible Solutions Problems include:* **Kindergarten:** K-ESS3-3, **First Grade:** 1-PS4-4, **Second Grade:** 2-LS2-2 *Connections to K–2-ETS1.C: Optimizing the Design Solution include:* **Second Grade:** 2-ESS2-1		
Articulation of DCIs across grade-bands: **3–5.ETS1.A** (K–2-ETS1-1),(K–2-ETS1-2),(K–2-ETS1-3); **3–5.ETS1.B** (K–2-ETS1-2); **3–5.ETS1.C** (K–2-ETS1-1),(K–2-ETS1-2),(K–2-ETS1-3)		
California Common Core State Standards Connections: *ELA/Literacy –* **RI.2.1** Ask and answer such questions as *who*, *what*, *where*, *when*, *why*, and *how* to demonstrate understanding of key details in a text. (2-ESS1-1) **W.2.6** With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. (K–2-ETS1-1),(K–2-ETS1-3)		

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Grade Two
Standards Arranged by Disciplinary Core Ideas

W.2.8	Recall information from experiences or gather information from provided sources to answer a question. (K–2-ETS1-1),(K–2-ETS1-3)
SL.2.5	Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. (K–2-ETS1-2)
Mathematics –	
MP.2	Reason abstractly and quantitatively. (K–2-ETS1-1),(K–2-ETS1-3)
MP.4	Model with mathematics. (K–2-ETS1-1),(K–2-ETS1-3)
MP.5	Use appropriate tools strategically. (K–2-ETS1-1),(K–2-ETS1-3)
2.MD.10	Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. (K–2-ETS1-1),(K–2-ETS1-3)

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Next Generation Science Standards for California Public Schools, Kindergarten through Grade Twelve

Grade Three
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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3-LS1 From Molecules to Organisms: Structures and Processes

3-LS1 From Molecules to Organisms: Structures and Processes		
Students who demonstrate understanding can: **3-LS1-1.** **Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.** [Clarification Statement: Changes organisms go through during their life form a pattern.] [Assessment Boundary: Assessment of plant life cycles is limited to those of flowering plants. Assessment does not include details of human reproduction.]		
The performance expectations 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**
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. ▪ Develop models to describe phenomena. (3-LS1-1) --- ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence**	**LS1.B: Growth and Development of Organisms** ▪ Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles. (3-LS1-1)	**Patterns** ▪ Patterns of change can be used to make predictions. (3-LS1-1)

Grade Three

Standards Arranged by Disciplinary Core Ideas

▪ Science findings are based on recognizing patterns. (3-LS1-1)		
Connections to other DCIs in third grade: N/A		
Articulation of DCIs across grade-bands: **MS.LS1.B** (3-LS1-1)		
California Common Core State Standards Connections: *ELA/Literacy –* **RI.3.7** Use information gained from illustrations (e.g., maps, photographs) and the words in a text to demonstrate understanding of the text (e.g., where, when, why, and how key events occur). (3-LS1-1) **SL.3.5** Create engaging audio recordings of stories or poems that demonstrate fluid reading at an understandable pace; add visual displays when appropriate to emphasize or enhance certain facts or details. (3-LS1-1) *Mathematics –* **MP.4** Model with mathematics. (3-LS1-1) **3.NBT.1-3** Use place value understanding and properties of operations to perform multi-digit arithmetic. (3-LS1-1) **3.NF.1-3** Develop understanding of fractions as numbers. (3-LS1-1)		

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Grade Three

Standards Arranged by Disciplinary Core Ideas

3-LS2 Ecosystems: Interactions, Energy, and Dynamics

3-LS2 Ecosystems: Interactions, Energy, and Dynamics		
Students who demonstrate understanding can: **3-LS2-1. Construct an argument that some animals form groups that help members survive.**		
The performance expectations 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**
Engaging in Argument from Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). ▪ Construct an argument with evidence, data, and/or a model. (3-LS2-1)	**LS2.D: Social Interactions and Group Behavior** ▪ Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size (Note: Moved from K–2). (3-LS2-1)	**Cause and Effect** ▪ Cause and effect relationships are routinely identified and used to explain change. (3-LS2-1)
Connections to other DCIs in third grade: N/A		
Articulation of DCIs across grade-bands: **1.LS1.B** (3-LS2-1); **MS.LS2.A** (3-LS2-1)		
California Common Core State Standards Connections: *ELA/Literacy –* **RI.3.1** Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-LS2-1) **RI.3.3** Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. (3-LS2-1) **W.3.1.a–d** Write opinion pieces on topics or texts, supporting a point of view with reasons. (3-LS2-1) **W.3.9** Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. (3-LS4-1) *Mathematics –*		

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Grade Three

Standards Arranged by Disciplinary Core Ideas

MP.4	Model with mathematics. (3-LS2-1)
3.NBT.1-3	Use place value understanding and properties of operations to perform multi-digit arithmetic. (3-LS2-1)

Grade Three

Standards Arranged by Disciplinary Core Ideas

3-LS3 Heredity: Inheritance and Variation of Traits

3-LS3 Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can:

3-LS3-1. **Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.** [Clarification Statement: Patterns are the similarities and differences in traits shared between offspring and their parents, or among siblings. Emphasis is on organisms other than humans.] [Assessment Boundary: Assessment does not include genetic mechanisms of inheritance and prediction of traits. Assessment is limited to non-human examples.]

3-LS3-2. **Use evidence to support the explanation that traits can be influenced by the environment.** [Clarification Statement: Examples of the environment affecting a trait could include normally tall plants grown with insufficient water are stunted; and, a pet dog that is given too much food and little exercise may become overweight.]

The performance expectations above were 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 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations.

When possible and feasible, digital tools should be used.

- Analyze and interpret data to make sense of phenomena using logical reasoning. (3-LS3-1)

Constructing Explanations and Designing Solutions

Disciplinary Core Ideas

LS3.A: Inheritance of Traits

- Many characteristics of organisms are inherited from their parents. (3-LS3-1)
- Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment. (3-LS3-2)

LS3.B: Variation of Traits

- Different organisms vary in how they look and function because they have different inherited information. (3-LS3-1)

Crosscutting Concepts

Patterns

- Similarities and differences in patterns can be used to sort and classify natural phenomena. (3-LS3-1)

Cause and Effect

- Cause and effect relationships are routinely identified and used to explain change. (3-LS3-2)

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Grade Three

Standards Arranged by Disciplinary Core Ideas

Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. ▪ Use evidence (e.g., observations, patterns) to support an explanation. (3-LS3-2)	▪ The environment also affects the traits that an organism develops. (3-LS3-2)	

Connections to other DCIs in third grade: N/A

Articulation of DCIs across grade-bands: **1.LS3.A** (3-LS3-1); **1.LS3.B** (3-LS3-1); **MS.LS1.B** (3-LS3-2); **MS.LS3.A** (3-LS3-1); **MS.LS3.B** (3-LS3-1)

California Common Core State Standards Connections:

ELA/Literacy –

RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-LS3-1),(3-LS3-2)

RI.3.2 Determine the main idea of a text; recount the key details and explain how they support the main idea. (3-LS3-1),(3-LS3-2)

RI.3.3 Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. (3-LS3-1),(3-LS3-2)

W.3.2.a–d Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (3-LS3-1),(3-LS3-2)

SL.3.4 Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace.

a. Plan and deliver an informative/explanatory presentation on a topic that: organizes ideas around major points of information, follows a logical sequence, includes supporting details, uses clear and specific vocabulary, and provides a strong conclusion. **CA** (3-LS3-1),(3-LS3-2)

Mathematics –

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Grade Three

Standards Arranged by Disciplinary Core Ideas

MP.2	Reason abstractly and quantitatively. (3-LS3-1),(3-LS3-2)
MP.4	Model with mathematics. (3-LS3-1),(3-LS3-2)
3.MD.4	Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters. (3-LS3-1),(3-LS3-2)

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Grade Three

Standards Arranged by Disciplinary Core Ideas

3-LS4 Biological Evolution: Unity and Diversity

3-LS4 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

3-LS4-1. **Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.** [Clarification Statement: Examples of data could include type, size, and distributions of fossil organisms. Examples of fossils and environments could include marine fossils found on dry land, tropical plant fossils found in Arctic areas, and fossils of extinct organisms.] [Assessment Boundary: Assessment does not include identification of specific fossils or present plants and animals. Assessment is limited to major fossil types and relative ages.]

3-LS4-2. **Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.** [Clarification Statement: Examples of cause and effect relationships could be plants that have larger thorns than other plants may be less likely to be eaten by predators; and, animals that have better camouflage coloration than other animals may be more likely to survive and therefore more likely to leave offspring.]

3-LS4-3. **Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.** [Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]

3-LS4-4. **Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.*** [Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.] [Assessment Boundary: Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.]

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Grade Three

Standards Arranged by Disciplinary Core Ideas

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. ▪ Analyze and interpret data to make sense of phenomena using logical reasoning. (3-LS4-1) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. ▪ Use evidence (e.g., observations, patterns) to construct an explanation. (3-LS4-2) **Engaging in Argument from Evidence** Engaging in argument from evidence in 3–5 builds on K–2 experiences and	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience** ▪ When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die. (secondary to 3-LS4-4) **LS4.A: Evidence of Common Ancestry and Diversity** ▪ Some kinds of plants and animals that once lived on Earth are no longer found anywhere. (Note: moved from K–2) (3-LS4-1) ▪ Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments. (3-LS4-1) **LS4.B: Natural Selection** ▪ Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and	**Cause and Effect** ▪ Cause and effect relationships are routinely identified and used to explain change. (3-LS4-2),(3-LS4-3) **Scale, Proportion, and Quantity** ▪ Observable phenomena exist from very short to very long time periods. (3-LS4-1) **Systems and System Models** ▪ A system can be described in terms of its components and their interactions. (3-LS4-4) --- ***Connections to Engineering, Technology, and Applications of Science*** **Interdependence of Engineering, Technology and Applications of Science on Society and the Natural World** ▪ Knowledge of relevant scientific concepts and research findings is important in engineering. (3-LS4-4) --- ***Connections to Nature of Science***

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progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). ▪ Construct an argument with evidence. (3-LS4-3) ▪ Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem. (3-LS4-4)	reproducing. (3-LS4-2) **LS4.C: Adaptation** ▪ For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. (3-LS4-3) **LS4.D: Biodiversity and Humans** ▪ Populations live in a variety of habitats, and change in those habitats affects the organisms living there. (3-LS4-4)	**Scientific Knowledge Assumes an Order and Consistency in Natural Systems** ▪ Science assumes consistent patterns in natural systems. (3-LS4-1)
Connections to other DCIs in third grade: **3.ESS2.D** (3-LS4-3); **3.ESS3.B** (3-LS4-4)		
Articulation of DCIs across grade-bands: **K.ESS3.A** (3-LS4-3)(3-LS4-4); **K.ETS1.A** (3-LS4-4); **1.LS3.B** (3-LS4-2);**2.LS2.A** (3-LS4-3),(3-LS4-4); **2.LS4.D** (3-LS4-3),(3-LS4-4); **4.ESS1.C** (3-LS4-1); **4.ESS3.B** (3-LS4-4); **4.ETS1.A** (3-LS4-4); **MS.LS2.A** (3-LS4-1),(3-LS4-2),(3-LS4-3),(3-LS4-4); **MS.LS2.C** (3-LS4-4); **MS.LS3.B** (3-LS4-2); **MS.LS4.A** (3-LS4-1); **MS.LS4.B** (3-LS4-2),(3-LS4-3); **MS.LS4.C** (3-LS4-3),(3-LS4-4); **MS.ESS1.C** (3-LS4-1),(3-LS4-3),(3-LS4-4); **MS.ESS2.B** (3-LS4-1); **MS.ESS3.C** (3-LS4-4)		
California Common Core State Standards Connections: *ELA/Literacy –* **RI.3.1.a–d** Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-LS4-1),(3-LS4-2),(3-LS4-3,(3-LS4-4) **RI.3.2.a–d** Determine the main idea of a text; recount the key details and explain how they support the main idea. (3-LS4-1),(3-LS4-2),(3-LS4-3),(3LS4-4) **RI.3.3** Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. (3-LS4-1),(3-LS4-2),(3-LS4-3),(3-LS4-4) **W.3.1** Write opinion pieces on topics or texts, supporting a point of view with reasons. (3-LS4-1),(3-LS4-3),(3-LS4-4) **W.3.2** Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (3-LS4-1),(3-LS4-2),(3-		

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	LS4-3),(3-LS4-4)
W.3.8	Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. (3-LS4-1)
SL.3.4	Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace. a. Plan and deliver an informative/explanatory presentation on a topic that: organizes ideas around major points of information, follows a logical sequence, includes supporting details, uses clear and specific vocabulary, and provides a strong conclusion. **CA** (3-LS4-2),(3-LS4-3),(3-LS4-4)
Mathematics –	
MP.2	Reason abstractly and quantitatively. (3-LS4-1),(3-LS4-2),(3-LS4-3),(3-LS4-4)
MP.4	Model with mathematics. (3-LS4-1),(3-LS4-2),(3-LS4-3),(3-LS4-4)
MP.5	Use appropriate tools strategically. (3-LS4-1)
3.MD.3	Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs. For example, draw a bar graph in which each square in the bar graph might represent 5 pets. (3-LS4-2),(3-LS4-3)
3.MD.4	Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters. (3-LS4-1)

Grade Three

Standards Arranged by Disciplinary Core Ideas

3-ESS2 Earth's Systems

3-ESS2 Earth's Systems

Students who demonstrate understanding can:

3-ESS2-1. **Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.** [Clarification Statement: Examples of data could include average temperature, precipitation, and wind direction.] [Assessment Boundary: Assessment of graphical displays is limited to pictographs and bar graphs. Assessment does not include climate change.]

3-ESS2-2. **Obtain and combine information to describe climates in different regions of the world.**

The performance expectations above were 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 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.

- Represent data in tables and various graphical displays (bar graphs, pictographs) to reveal patterns that indicate relationships. (3-ESS2-1)

Obtaining, Evaluating, and Communicating Information

Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and

Disciplinary Core Ideas

ESS2.D: Weather and Climate

- Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next. (3-ESS2-1)
- Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years. (3-ESS2-2)

Crosscutting Concepts

Patterns

- Patterns of change can be used to make predictions. (3-ESS2-1),(3-ESS2-2)

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accuracy of ideas and methods. ▪ Obtain and combine information from books and other reliable media to explain phenomena. (3-ESS2-2)		
Connections to other DCIs in third grade: N/A		
Articulation of DCIs across grade-bands: **K.ESS2.D** (3-ESS2-1); **4.ESS2.A** (3-ESS2-1); **5.ESS2.A** (3-ESS2-1); **MS.ESS2.C** (3-ESS2-1),(3-ESS2-2); **MS.ESS2.D** (3-ESS2-1),(3-ESS2-2)		
California Common Core State Standards Connections: *ELA/Literacy –* **RI.3.1** Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-ESS2-2) **RI.3.9** Compare and contrast the most important points and key details presented in two texts on the same topic. (3-ESS2-2) **W.3.8** Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. (3-ESS2-2) *Mathematics –* **MP.2** Reason abstractly and quantitatively. (3-ESS2-1),(3-ESS2-2) **MP.4** Model with mathematics. (3-ESS2-1),(3-ESS2-2) **MP.5** Use appropriate tools strategically. (3-ESS2-1) **3.MD.2** Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem. (3-ESS2-1) **3.MD.3** Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in bar graphs. (3-ESS2-1)		

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Grade Three

Standards Arranged by Disciplinary Core Ideas

3-ESS3 Earth and Human Activity

3-ESS3 Earth and Human Activity		
Students who demonstrate understanding can: **3-ESS3-1. Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.*** [Clarification Statement: Examples of design solutions to weather-related hazards could include barriers to prevent flooding, wind resistant roofs, and lighting rods.]		
The performance expectations 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**
Engaging in Argument from Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). ▪ Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem. (3-ESS3-1)	**ESS3.B: Natural Hazards** ▪ A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts. (3-ESS3-1) (Note: This Disciplinary Core Idea is also addressed by 4-ESS3-2.)	**Cause and Effect** ▪ Cause and effect relationships are routinely identified, tested, and used to explain change. (3-ESS3-1) ----------***Connections to Engineering, Technology, and Applications of Science*** **Influence of Engineering, Technology, and Science on Society and the Natural World** ▪ Engineers improve existing technologies or develop new ones to increase their benefits (e.g., better artificial limbs), decrease known risks (e.g., seatbelts in cars), and meet societal demands (e.g., cell phones). (3-ESS3-1) ----------

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Grade Three

Standards Arranged by Disciplinary Core Ideas

		Connections to Nature of Science
		Science is a Human Endeavor ▪ Science affects everyday life. (3-ESS3-1)
Connections to other DCIs in third grade: N/A		
Articulation of DCIs across grade-bands: **K.ESS3.B** (3-ESS3-1); **K.ETS1.A** (3-ESS3-1); **4.ESS3.B** (3-ESS3-1); **4.ETS1.A** (3-ESS3-1); **MS.ESS3.B** (3-ESS3-1)		
California Common Core State Standards Connections: *ELA/Literacy –* **W.3.1.a–d** Write opinion pieces on topics or texts, supporting a point of view with reasons. (3-ESS3-1) **W.3.7** Conduct short research projects that build knowledge about a topic. (3-ESS3-1) *Mathematics –* **MP.2** Reason abstractly and quantitatively. (3-ESS3-1) **MP.4** Model with mathematics. (3-ESS3-1)		

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Grade Three

Standards Arranged by Disciplinary Core Ideas

3-PS2 Motion and Stability: Forces and Interactions

3-PS2 Motion and Stability: Forces and Interactions
Students who demonstrate understanding can: **3-PS2-1.** **Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.** [Clarification Statement: Examples could include an unbalanced force on one side of a ball can make it start moving; and, balanced forces pushing on a box from both sides will not produce any motion at all.] [Assessment Boundary: Assessment is limited to one variable at a time: number, size, or direction of forces. Assessment does not include quantitative force size, only qualitative and relative. Assessment is limited to gravity being addressed as a force that pulls objects down.] **3-PS2-2.** **Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.** [Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a see-saw.] [Assessment Boundary: Assessment does not include technical terms such as period and frequency.] **3-PS2-3.** **Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.** [Clarification Statement: Examples of an electric force could include the force on hair from an electrically charged balloon and the electrical forces between a charged rod and pieces of paper; examples of a magnetic force could include the force between two permanent magnets, the force between an electromagnet and steel paperclips, and the force exerted by one magnet versus the force exerted by two magnets. Examples of cause and effect relationships could include how the distance between objects affects strength of the force and how the orientation of magnets affects the direction of the magnetic force.] [Assessment Boundary: Assessment is limited to forces produced by objects that can be manipulated by students, and electrical interactions are limited to static electricity.] **3-PS2-4.** **Define a simple design problem that can be solved by applying scientific ideas about magnets.*** [Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.]
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Grade Three

Standards Arranged by Disciplinary Core Ideas

Science and Engineering Practices

Asking Questions and Defining Problems

Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.

- Ask questions that can be investigated based on patterns such as cause and effect relationships. (3-PS2-3)
- Define a simple problem that can be solved through the development of a new or improved object or tool. (3-PS2-4)

Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-PS2-1)
- Make observations and/or

Disciplinary Core Ideas

PS2.A: Forces and Motion

- Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) (3-PS2-1)
- The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.) (3-PS2-2)

PS2.B: Types of Interactions

- Objects in contact exert forces on each other. (3-PS2-1)

Crosscutting Concepts

Patterns

- Patterns of change can be used to make predictions. (3-PS2-2)

Cause and Effect

- Cause and effect relationships are routinely identified. (3-PS2-1)
- Cause and effect relationships are routinely identified, tested, and used to explain change. (3-PS2-3)

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology

- Scientific discoveries about the natural world can often lead to new and improved technologies, which are developed through the engineering design process. (3-PS2-4)

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measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (3-PS2-2) **----------** ***Connections to Nature of Science*** **Science Knowledge is Based on Empirical Evidence** ▪ Science findings are based on recognizing patterns. (3-PS2-2) **Scientific Investigations Use a Variety of Methods** ▪ Science investigations use a variety of methods, tools, and techniques. (3-PS2-1)	▪ Electric, and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other. (3-PS2-3),(3-PS2-4)	

Connections to other DCIs in third grade: N/A

Articulation of DCIs across grade-bands: **K.PS2.A** (3-PS2-1); **K.PS2.B** (3-PS2-1); **K.PS3.C** (3-PS2-1); **K.ETS1.A** (3-PS2-4); **1.ESS1.A** (3-PS2-2); **4.PS4.A** (3-PS2-2); **4.ETS1.A** (3-PS2-4); **5.PS2.B** (3-PS2-1); **MS.PS2.A** (3-PS2-1),(3-PS2-2); **MS.PS2.B** (3-PS2-3),(3-PS2-4); **MS.ESS1.B** (3-PS2-1),(3-PS2-2); **MS.ESS2.C** (3-PS2-1)

California Common Core State Standards Connections:
ELA/Literacy –

RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-PS2-1),(3-PS2-3)

RI.3.3 Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. (3-PS2-3)

RI.3.8 Describe the logical connection between particular sentences and paragraphs in a text (e.g., comparison, cause/effect,

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	first/second/third in a sequence). (3-PS2-3)
W.3.7	Conduct short research projects that build knowledge about a topic. (3-PS2-1),(3-PS2-2)
W.3.8	Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. (3-PS2-1),(3-PS2-2)
SL.3.3	Ask and answer questions about information from a speaker, offering appropriate elaboration and detail. (3-PS2-3)
Mathematics –	
MP.2	Reason abstractly and quantitatively. (3-PS2-1)
MP.5	Use appropriate tools strategically. (3-PS2-1)
3.MD.2	Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem. (3-PS2-1)

Grade Three

Standards Arranged by Disciplinary Core Ideas

3–5-ETS1 Engineering Design

3–5-ETS1 Engineering Design

Students who demonstrate understanding can:

3–5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3–5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3–5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

The performance expectations 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
Asking Questions and Defining Problems Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships. ▪ Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. (3–5-ETS1-1) **Planning and Carrying Out**	**ETS1.A: Defining and Delimiting Engineering Problems** ▪ Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3–5-ETS1-1)	**Influence of Engineering, Technology, and Science on Society and the Natural World** ▪ People's needs and wants change over time, as do their demands for new and improved technologies. (3–5-ETS1-1) ▪ Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3–5-ETS-2)

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Grade Three

Standards Arranged by Disciplinary Core Ideas

Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. ▪ Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3–5-ETS1-3) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. ▪ Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. (3–5-ETS1-2)	**ETS1.B: Developing Possible Solutions** ▪ Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3–5-ETS1-2) ▪ At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3–5-ETS1-2) ▪ Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3–5-ETS1-3) **ETS1.C: Optimizing the Design Solution** ▪ Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3–5-ETS1-3)	

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Connections to other DCIs in this grade-band:
Connections to 3–5-ETS1.A: Defining and Delimiting Engineering Problems include:
Fourth Grade: 4-PS3-4
Connections to 3–5-ETS1.B: Designing Solutions to Engineering Problems include:
Fourth Grade: 4-ESS3-2
Connections to 3–5-ETS1.C: Optimizing the Design Solution include:
Fourth Grade: 4-PS4-3

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

California Common Core State Standards Connections:
ELA/Literacy –

RI.5.1	Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (3–5-ETS1-2)
RI.5.7	Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (3–5-ETS2)
RI.5.9	Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (3–5-ETS-2)
W.5.7	Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (3–5-ETS1-1),(3–5-ETS1-3)
W.5.8	Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (3–5-ETS1-1),(3–5-ETS1-3)
W.5.9.a,b	Draw evidence from literary or informational texts to support analysis, reflection, and research. (3–5-ETS1-1),(3–5-ETS1-3)

Mathematics –

MP.2	Reason abstractly and quantitatively. (3–5-ETS1-1),(3–5-ETS1-2),(3–5-ETS1-3)
MP.4	Model with mathematics. (3–5-ETS1-1),(3–5-ETS1-2),(3–5-ETS1-3)

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Grade Three

Standards Arranged by Disciplinary Core Ideas

MP.5	Use appropriate tools strategically. (3–5-ETS1-1),(3–5-ETS1-2),(3–5-ETS1-3)
3.OA.1-4	Represent and solve problems involving multiplication and division. (3–5-ETS1-1),(3–5-ETS1-2)
3.OA.5-6	Understand properties of multiplication and the relationship between multiplication and division. (3–5-ETS1-1),(3–5-ETS1-2)
3.OA.7	Multiply and divide within 100. (3–5-ETS1-1),(3–5-ETS1-2)
3.OA.8-9	Solve problems involving the four operations, and identify and explain patterns in arithmetic. (3–5-ETS1-1),(3–5-ETS1-2)
4.OA.1-3	Use the four operations with whole numbers to solve problems. (3–5-ETS1-1),(3–5-ETS1-2)
4.OA.4	Gain familiarity with factors and multiples. (3–5-ETS1-1),(3–5-ETS1-2)
4.OA.5	Generate and analyze patterns. (3–5-ETS1-1),(3–5-ETS1-2)
5.OA.1-2.1	Write and interpret numerical expressions. (3–5-ETS1-1),(3–5-ETS1-2)
5.OA.3	Analyze patterns and relationships. (3–5-ETS1-1),(3–5-ETS1-2)

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Next Generation Science Standards for California Public Schools, Kindergarten through Grade Twelve

Grade Four
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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4-LS1 From Molecules to Organisms: Structures and Processes

4-LS1 From Molecules to Organisms: Structures and Processes		
Students who demonstrate understanding can: **4-LS1-1.** **Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.** [Clarification Statement: Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin. ****Each structure has specific functions within its associated system.**] [Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.] **4-LS1-2.** **Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.** [Clarification Statement: Emphasis is on systems of information transfer.] [Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.]		
The performance expectations 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**
Engaging in Argument from Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).	**LS1.A: Structure and Function** ▪ Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1) **LS1.D: Information Processing** ▪ Different sense receptors are	**Systems and System Models** ▪ A system can be described in terms of its components and their interactions. (4-LS1-1), (4-LS1-2)

▪ Construct an argument with evidence, data, and/or a model. (4-LS1-1) ▪ Use a model to test interactions concerning the functioning of a natural system. (4-LS1-2)	specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions. (4-LS1-2)	
Connections to other DCIs in fourth grade: N/A		
Articulation of DCIs across grade-bands: **1.LS1.A** (4-LS1-1); **1.LS1.D** (4-LS1-1); **3.LS3.B** (4-LS1-1); **MS.LS1.A** (4-LS1-1),(4-LS1-2); **MS.LS1.D** (4-LS1-2)		
California Common Core State Standards Connections: *ELA/Literacy –* **W.4.1.a–d** Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (4-LS1-1) **SL.4.5** Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. (4-LS1-2) *Mathematics –* **4.G.3** Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry. (4-LS1-1)		

Grade Four
Standards Arranged by Disciplinary Core Ideas

4-ESS1 Earth's Place in the Universe

4-ESS1 Earth's Place in the Universe

Students who demonstrate understanding can:

4-ESS1-1. **Identify evidence from patterns in rock formations and fossils in rock formations and fossils in rock layers for changes in a landscape over time to support an explanation for changes in a landscape over time.** [Clarification Statement: Examples of evidence from patterns could include rock layers with shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.] [Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.]

The performance expectations above were 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 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Identify the evidence that supports particular points in an explanation. (4-ESS1-1)

Disciplinary Core Ideas

ESS1.C: The History of Planet Earth

- Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. (4-ESS1-1)

Crosscutting Concepts

Patterns

- Patterns can be used as evidence to support an explanation. (4-ESS1-1)

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes consistent patterns in natural systems. (4-ESS1-1)

Connections to other DCIs in fourth grade: N/A

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Grade Four
Standards Arranged by Disciplinary Core Ideas

Articulation of DCIs across grade-bands: **2.ESS1.C** (4-ESS1-1); **3.LS4.A** (4-ESS1-1); **MS.LS4.A** (4-ESS1-1); **MS.ESS1.C** (4-ESS1-1) **MS.ESS2.A** (4-ESS1-1); **MS.ESS2.B** (4-ESS1-1)

California Common Core State Standards Connections:

ELA/Literacy –

W.4.7	Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-ESS1-1)
W.4.8.a–d	Recall relevant information from experiences or gather relevant information from print and digital sources; take notes, **paraphrase**, and categorize information, and provide a list of sources. **CA** (4-ESS1-1)
W.4.9	Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-ESS1-1)

Mathematics –

MP.2	Reason abstractly and quantitatively. (4-ESS1-1)
MP.4	Model with mathematics. (4-ESS1-1)
4.MD.1	Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. (4-ESS1-1)

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Grade Four
Standards Arranged by Disciplinary Core Ideas

4-ESS2 Earth's Systems

4-ESS2 Earth's Systems

Students who demonstrate understanding can:

4-ESS2-1. **Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.** [Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.] [Assessment Boundary: Assessment is limited to a single form of weathering or erosion.]

4-ESS2-2. **Analyze and interpret data from maps to describe patterns of Earth's features.** [Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.]

The performance expectations 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
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. ▪ Make observations and/or measurements to produce data to serve as the basis for evidence for an	**ESS2.A: Earth Materials and Systems** ▪ Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. (4-ESS2-1) **ESS2.B: Plate Tectonics and Large-Scale System Interactions** ▪ The locations of mountain ranges, deep ocean trenches, ocean floor structures,	**Patterns** ▪ Patterns can be used as evidence to support an explanation. (4-ESS2-2) **Cause and Effect** ▪ Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS2-1)

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explanation of a phenomenon. (4-ESS2-1) **Analyzing and Interpreting Data** Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. ▪ Analyze and interpret data to make sense of phenomena using logical reasoning. (4-ESS2-2)	earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. (4-ESS2-2) **ESS2.E: Biogeology** ▪ Living things affect the physical characteristics of their regions. (4-ESS2-1)	

Connections to other DCIs in fourth grade: N/A

Articulation of DCIs across grade-bands: **2.ESS1.C** (4-ESS2-1); **2.ESS2.A** (4-ESS2-1); **2.ESS2.B** (4-ESS2-2); **2.ESS2.C** (4-ESS2-2); **5.ESS2.A** (4-ESS2-1); **5.ESS2.C** (4-ESS2-2); **MS.ESS1.C** (4-ESS2-2); **MS.ESS2.A** (4-ESS2-2); **MS.ESS2.B** (4-ESS2-2)

California Common Core State Standards Connections:

ELA/Literacy –

RI.4.7 Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. (4-ESS2-2)

W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-ESS2-1)

W.4.8.a–d Recall relevant information from experiences or gather relevant information from print and digital sources; take notes, **paraphrase**, and categorize information, and provide a list of sources. **CA** (4-ESS1-1),(4-ESS2-1)

Mathematics –

MP.2 Reason abstractly and quantitatively. (4-ESS2-1)

MP.4 Model with mathematics. (4-ESS2-1)

MP.5 Use appropriate tools strategically. (4-ESS2-1)

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Grade Four
Standards Arranged by Disciplinary Core Ideas

4.MD.1	Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. (4-ESS2-1)
4.MD.2	Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale. (4-ESS2-1),(4-ESS2-2)

Grade Four
Standards Arranged by Disciplinary Core Ideas

4-ESS3 Earth and Human Activity

4-ESS3 Earth and Human Activity

Students who demonstrate understanding can:

4-ESS3-1. **Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.** [Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels.]

4-ESS3-2. **Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.*** [Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.] [Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.]

Science and Engineering Practices

Obtaining, Evaluating, and Communicating Information

Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluate the merit and accuracy of ideas and methods.

- Obtain and combine information from books and other reliable media to explain phenomena. (4-ESS3-1)

Constructing Explanations and Designing Solutions

Constructing explanations and designing

Disciplinary Core Ideas

ESS3.A: Natural Resources

- Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. (4-ESS3-1)

ESS3.B: Natural Hazards

- A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. (4-ESS3-2)

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships are routinely identified and used to explain change. (4-ESS3-1)
- Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS3-2)

Connections to Engineering, Technology, and Applications of Science

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solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. ▪ Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-ESS3-2)	(Note: This Disciplinary Core Idea can also be found in 3.WC.) **ETS1.B: Designing Solutions to Engineering Problems** ▪ Testing a solution involves investigating how well it performs under a range of likely conditions. (secondary to 4-ESS3-2)	**Interdependence of Science, Engineering, and Technology** ▪ Knowledge of relevant scientific concepts and research findings is important in engineering. (4-ESS3-1) **Influence of Engineering, Technology, and Science on Society and the Natural World** ▪ Over time, people's needs and wants change, as do their demands for new and improved technologies. (4-ESS3-1) ▪ Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. (4-ESS3-2)
Connections to other DCIs in fourth grade: **4.ETS1.C** (4-ESS3-2)		
Articulation of DCIs across grade-bands: **K.ETS1.A** (4-ESS3-2); **2.ETS1.B** (4-ESS3-2); **2.ETS1.C** (4-ESS3-2); **5.ESS3.C** (4-ESS3-1); **MS.PS3.D** (4-ESS3-1); **MS.ESS2.A** (4-ESS3-1),(4-ESS3-2); **MS.ESS3.A** (4-ESS3-1); **MS.ESS3.B** (4-ESS3-2); **MS.ESS3.C** (4-ESS3-1); **MS.ESS3.D** (4-ESS3-1); **MS.ETS1.B** (4-ESS3-2)		
California Common Core State Standards Connections: *ELA/Literacy –* **RI.4.1** Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-ESS3-2) **RI.4.9** Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-ESS3-2) **W.4.7** Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-ESS3-1) **W.4.8.a–d** Recall relevant information from experiences or gather relevant information from print and digital sources; take notes, **paraphrase**, and categorize information, and provide a list of sources. **CA** (4-ESS3-1)		

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Grade Four
Standards Arranged by Disciplinary Core Ideas

W.4.9.a,b	Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-ESS3-1)
Mathematics –	
MP.2	Reason abstractly and quantitatively. (4-ESS3-1),(4-ESS3-2)
MP.4	Model with mathematics. (4-ESS3-1),(4-ESS3-2)
4.OA.1	Interpret a multiplication equation as a comparison, e.g., interpret 35 = 5 × 7 as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations. (4-ESS3-1),(4-ESS3-2)

Grade Four
Standards Arranged by Disciplinary Core Ideas

4-PS3 Energy

4-PS3 Energy

Students who demonstrate understanding can:

4-PS3-1. **Use evidence to construct an explanation relating the speed of an object to the energy of that object.** **[**Clarification Statement: Examples of evidence relating speed and energy could include change of shape on impact or other results of collisions.]** [Assessment Boundary: Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.]

4-PS3-2. **Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.** [Assessment Boundary: Assessment does not include quantitative measurements of energy.]

4-PS3-3. **Ask questions and predict outcomes about the changes in energy that occur when objects collide.** [Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.] [Assessment Boundary: Assessment does not include quantitative measurements of energy.]

4-PS3-4. **Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.*** [Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.] [Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.]

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships. ▪ Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect	**PS3.A: Definitions of Energy** ▪ The faster a given object is moving, the more energy it possesses. (4-PS3-1) ▪ Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-2),(4-PS3-3) **PS3.B: Conservation of Energy and**	**Energy and Matter** ▪ Energy can be transferred in various ways and between objects. (4-PS3-1), (4-PS3-2),(4-PS3-3),(4-PS3-4) **----------** ***Connections to Engineering, Technology,***

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relationships. (4-PS3-3) **Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. ▪ Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (4-PS3-2) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. ▪ Use evidence (e.g., measurements, observations, patterns) to construct an explanation. (4-PS3-1) ▪ Apply scientific ideas to solve design problems. (4-PS3-4)	**Energy Transfer** ▪ Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (4-PS3-2),(4-PS3-3) ▪ Light also transfers energy from place to place. (4-PS3-2) ▪ Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (4-PS3-2),(4-PS3-4) **PS3.C: Relationship Between Energy and Forces** ▪ When objects collide, the contact forces transfer energy so as to change the objects' motions. (4-PS3-3) **PS3.D: Energy in Chemical Processes and Everyday Life** ▪ The expression "produce energy"	***and Applications of Science*** **Influence of Engineering, Technology, and Science on Society and the Natural World** ▪ Engineers improve existing technologies or develop new ones. (4-PS3-4) **----------** ***Connections to Nature of Science*** **Science is a Human Endeavor** ▪ Most scientists and engineers work in teams. (4-PS3-4) ▪ Science affects everyday life. (4-PS3-4)

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	typically refers to the conversion of stored energy into a desired form for practical use. (4-PS3-4) **ETS1.A: Defining Engineering Problems** ▪ Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (secondary to 4-PS3-4)	

Connections to other DCIs in fourth grade: N/A

Articulation of DCIs across grade-bands: **K.PS2.B** (4-PS3-3); **K.ETS1.A** (4-PS3-4); **2.ETS1.B** (4-PS3-4); **3.PS2.A** (4-PS3-3); **5.PS3.D** (4-PS3-4); **5.LS1.C** (4-PS3-4); **MS.PS2.A** (4-PS3-3); **MS.PS2.B** (4-PS3-2); **MS.PS3.A** (4-PS3-1),(4-PS3-2),(4-PS3-3),(4-PS3-4); **MS.PS3.B** (4-PS3-2),(4-PS3-3),(4-PS3-4); **MS.PS3.C** (4-PS3-3); **MS.PS4.B** (4-PS3-2); **MS.ETS1.B** (4-PS3-4); **MS.ETS1.C** (4-PS3-4)

California Common Core State Standards Connections:
ELA/Literacy –

RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-PS3-1)

RI.4.3 Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text. (4-PS3-1)

RI.4.9 Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-PS3-1)

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Grade Four
Standards Arranged by Disciplinary Core Ideas

W.4.2.a–d	Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (4-PS3-1)
W.4.7	Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-PS3-2),(4-PS3-3),(4-PS3-4)
W.4.8.a–d	Recall relevant information from experiences or gather relevant information from print and digital sources; take notes, **paraphrase**, and categorize information, and provide a list of sources. **CA** (4-PS3-1),(4-PS3-2),(4-PS3-3),(4-PS3-4)
W.4.9	Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-PS3-1)
Mathematics –	
4.OA.3	Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding. (4-PS3-4)

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Grade Four
Standards Arranged by Disciplinary Core Ideas

4-PS4 Waves and their Applications in Technologies for Information Transfer

4-PS4 Waves and their Applications in Technologies for Information Transfer

Students who demonstrate understanding can:

4-PS4-1. **Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.** [Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.] [Assessment Boundary: Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.]

4-PS4-2. **Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.** [Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.]

4-PS4-3. **Generate and compare multiple solutions that use patterns to transfer information.*** [Clarification Statement: Examples of solutions could include drums sending coded information through sound waves, using a grid of 1's and 0's representing black and white to send information about a picture, and using Morse code to send text.]

Science and Engineering Practices

Developing and Using Models

Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.

- Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4-1)
- Develop a model to describe phenomena. (4-PS4-2)

Constructing Explanations and Designing Solutions

Disciplinary Core Ideas

PS4.A: Wave Properties

- Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets the beach. (Note: This grade band endpoint was moved from K–2.) (4-PS4-1)
- Waves of the same type can differ in

Crosscutting Concepts

Patterns

- Similarities and differences in patterns can be used to sort, classify and analyze simple rates of change for natural phenomena.. (4-PS4-1)
- Similarities and differences in patterns can be used to sort and classify designed products. (4-PS4-3)

Cause and Effect

- Cause and effect relationships are routinely identified. (4-PS4-2)

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Grade Four
Standards Arranged by Disciplinary Core Ideas

<table>
<tr>
<td>Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.
▪ Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-PS4-3)

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence
▪ Science findings are based on recognizing patterns. (4-PS4-1)</td>
<td>amplitude (height of the wave) and wavelength (spacing between wave peaks). (4-PS4-1)
PS4.B: Electromagnetic Radiation
▪ An object can be seen when light reflected from its surface enters the eyes. (4-PS4-2)
PS4.C: Information Technologies and Instrumentation
▪ Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. (4-PS4-3)
ETS1.C: Optimizing the Design Solution
▪ Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (secondary to 4-PS4-3)</td>
<td>----------
Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology
▪ Knowledge of relevant scientific concepts and research findings is important in engineering. (4-PS4-3)</td>
</tr>
<tr><td colspan="3">Connections to other DCIs in fourth grade: 4.PS3.A (4-PS4-1); 4.PS3.B (4-PS4-1); 4.ETS1.A (4-PS4-3)</td></tr>
<tr><td colspan="3">Articulation of DCIs across grade-bands: K.ETS1.A (4-PS4-3); 1.PS4.B (4-PS4-2); 1.PS4.C (4-PS4-3); 2.ETS1.B (4-PS4-3); 2.ETS1.C (4-PS4-3); 3.PS2.A (4-PS4-3); MS.PS4.A (4-PS4-1); MS.PS4.B (4-PS4-2); MS.PS4.C (4-PS4-3); MS.LS1.D (4-PS4-2); MS.ETS1.B (4-PS4-3)</td></tr>
<tr><td colspan="3">California Common Core State Standards Connections:
ELA/Literacy –</td></tr>
</table>

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Grade Four
Standards Arranged by Disciplinary Core Ideas

RI.4.1	Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-PS4-3)
RI.4.9	Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-PS4-3)
SL.4.5	Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. (4-PS4-1),(4-PS4-2)
Mathematics –	
MP.4	Model with mathematics. (4-PS4-1),(4-PS4-2)
4.G.1	Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. (4-PS4-1),(4-PS4-2)

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Grade Four
Standards Arranged by Disciplinary Core Ideas

3–5-ETS1 Engineering Design

3–5-ETS1 Engineering Design

Students who demonstrate understanding can:

3–5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3–5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3–5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

The performance expectations 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
Asking Questions and Defining Problems Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships. ▪ Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. (3–5-ETS1-1)	**ETS1.A: Defining and Delimiting Engineering Problems** ▪ Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3–5-	**Influence of Engineering, Technology, and Science on Society and the Natural World** ▪ People's needs and wants change over time, as do their demands for new and improved technologies. (3–5-ETS1-1) ▪ Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3–5-ETS-2)

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Grade Four
Standards Arranged by Disciplinary Core Ideas

Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. ▪ Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3–5-ETS1-3) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. ▪ Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. (3–5-ETS1-2)	ETS1-1) **ETS1.B: Developing Possible Solutions** ▪ Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3–5-ETS1-2) ▪ At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3–5-ETS1-2) ▪ Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3–5-ETS1-3) **ETS1.C: Optimizing the Design Solution** ▪ Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3–5-ETS1-3)	

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Connections to other DCIs in this grade-band:
Connections to 3–5-ETS1.A: Defining and Delimiting Engineering Problems include:
Fourth Grade: 4-PS3-4
Connections to 3–5-ETS1.B: Designing Solutions to Engineering Problems include:
Fourth Grade: 4-ESS3-2
Connections to 3–5-ETS1.C: Optimizing the Design Solution include:
Fourth Grade: 4-PS4-3

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

California Common Core State Standards Connections:
ELA/Literacy –

RI.5.1	Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (3–5-ETS-2)
RI.5.7	Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (3–5-ETS2)
RI.5.9	Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (3–5-ETS-2)
W.5.7	Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (3–5-ETS1-1),(3–5-ETS1-3)
W.5.8	Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (3–5-ETS1-1),(3–5-ETS1-3)
W.5.9.a,b	Draw evidence from literary or informational texts to support analysis, reflection, and research. (3–5-ETS1-1),(3–5-ETS1-3)

Mathematics –

MP.2	Reason abstractly and quantitatively. (3–5-ETS1-1),(3–5-ETS1-2),(3–5-ETS1-3)

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Grade Four
Standards Arranged by Disciplinary Core Ideas

MP.4	Model with mathematics. (3–5-ETS1-1),(3–5-ETS1-2),(3–5-ETS1-3)
MP.5	Use appropriate tools strategically. (3–5-ETS1-1),(3–5-ETS1-2),(3–5-ETS1-3)
3.OA.1-4	Represent and solve problems involving multiplication and division. (3–5-ETS1-1),(3–5-ETS1-2)
3.OA.5-6	Understand properties of multiplication and the relationship between multiplication and division. (3–5-ETS1-1),(3–5-ETS1-2)
3.OA.7	Multiply and divide within 100. (3–5-ETS1-1),(3–5-ETS1-2)
3.OA.8-9	Solve problems involving the four operations, and identify and explain patterns in arithmetic. (3–5-ETS1-1),(3–5-ETS1-2)
4.OA.1-3	Use the four operations with whole numbers to solve problems. (3–5-ETS1-1),(3–5-ETS1-2)
4.OA.4	Gain familiarity with factors and multiples. (3–5-ETS1-1),(3–5-ETS1-2)
4.OA.5	Generate and analyze patterns. (3–5-ETS1-1),(3–5-ETS1-2)
5.OA.1-2.1	Write and interpret numerical expressions. (3–5-ETS1-1),(3–5-ETS1-2)
5.OA.3	Analyze patterns and relationships. (3–5-ETS1-1),(3–5-ETS1-2)

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Next Generation Science Standards for California Public Schools, Kindergarten through Grade Twelve

Grade Five
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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5-LS1 From Molecules to Organisms: Structures and Processes

5-LS1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

5-LS1-1. **Support an argument that plants get the materials they need for growth chiefly from air and water.** [Clarification Statement: Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.]

The performance expectations 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
Engaging in Argument from Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). ▪ Support an argument with evidence, data, or a model. (5-LS1-1)	**LS1.C: Organization for Matter and Energy Flow in Organisms** ▪ Plants acquire their material for growth chiefly from air and water. (5-LS1-1)	**Energy and Matter** ▪ Matter is transported into, out of, and within systems. (5-LS1-1)

Connections to other DCIs in fifth grade: **5.PS1.A** (5-LS1-1)

Articulation of DCIs across grade-bands: **K.LS1.C** (5-LS1-1); **2.LS2.A** (5-LS1-1); **MS.LS1.C** (5-LS1-1)

California Common Core State Standards Connections:
ELA/Literacy –

RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-LS1-1)

Grade Five
Standards Arranged by Disciplinary Core Ideas

RI.5.9	Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-LS1-1)
W.5.1.a–d	Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (5-LS1-1)
Mathematics –	
MP.2	Reason abstractly and quantitatively. (5-LS1-1)
MP.4	Model with mathematics. (5-LS1-1)
MP.5	Use appropriate tools strategically. (5-LS1-1)
5.MD.1	Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems. (5-LS1-1)

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Grade Five
Standards Arranged by Disciplinary Core Ideas

5-LS2 Ecosystems: Interactions, Energy, and Dynamics

5-LS2 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

5-LS2-1. **Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.** [Clarification Statement: Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food. Examples of systems could include organisms, ecosystems, and the Earth.] [Assessment Boundary: Assessment does not include molecular explanations.]

The performance expectations above were 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 3–5 builds on K–2 models and progresses to building and revising simple models and using models to represent events and design solutions.

- Develop a model to describe phenomena. (5-LS2-1)

Connections to Nature of Science

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- Science explanations describe the mechanisms for natural events. (5-LS2-1)

Disciplinary Core Ideas

LS2.A: Interdependent Relationships in Ecosystems

- The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which

Crosscutting Concepts

Systems and System Models

- A system can be described in terms of its components and their interactions. (5-LS2-1)

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	multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. (5-LS2-1) **LS2.B: Cycles of Matter and Energy Transfer in Ecosystems** ▪ Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment. (5-LS2-1)	

Connections to other DCIs in fifth grade: **5.PS1.A** (5-LS2-1); **5.ESS2.A** (5-LS2-1)

Articulation of DCIs across grade-bands: **2.PS1.A** (5-LS2-1); **2.LS4.D** (5-LS2-1); **4.ESS2.E** (5-LS2-1); **MS.PS3.D** (5-LS2-1); **MS.LS1.C** (5-LS2-1); **MS.LS2.A** (5-LS2-1); **MS.LS2.B** (5-LS2-1)

California Common Core State Standards Connections:

ELA/Literacy –

RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-LS2-1)

SL.5.5 Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-LS2-1)

Mathematics –

MP.2 Reason abstractly and quantitatively. (5-LS2-1)

MP.4 Model with mathematics. (5-LS2-1)

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

Grade Five
Standards Arranged by Disciplinary Core Ideas

5-ESS1 Earth's Place in the Universe

5-ESS1 Earth's Place in the Universe

Students who demonstrate understanding can:

5-ESS1-1. **Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth. [**Clarification Statement: Absolute brightness of stars is the result of a variety of factors. Relative distance from Earth is one factor that affects apparent brightness and is the one selected to be addressed by the performance expectation.]** [Assessment Boundary: Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage).]

5-ESS1-2. **Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.** [Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.] [Assessment Boundary: Assessment does not include causes of seasons.]

The performance expectations above were 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 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.

- Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. (5-ESS1-2)

Disciplinary Core Ideas

ESS1.A: The Universe and its Stars

- The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth. (5-ESS1-1)

ESS1.B: Earth and the Solar System

- The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These

Crosscutting Concepts

Patterns

- Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena. (5-ESS1-2)

Scale, Proportion, and Quantity

- Natural objects exist from the very small to the immensely large. (5-ESS1-1)

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Engaging in Argument from Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). ▪ Support an argument with evidence, data, or a model. (5-ESS1-1)	include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year. (5-ESS1-2)	

Connections to other DCIs in fifth grade: N/A

Articulation of DCIs across grade-bands: **1.ESS1.A** (5-ESS1-2); **1.ESS1.B** (5-ESS1-2); **3.PS2.A** (5-ESS1-2); **MS.ESS1.A** (5-ESS1-1),(5-ESS1-2); **MS.ESS1.B** (5-ESS1-1),(5-ESS1-2);

California Common Core State Standards Connections:

RI.5.1.a–d	Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-ESS1-1)
RI.5.7	Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS1-1)
RI.5.8	Explain how an author uses reasons and evidence to support particular points in a text, identifying which reasons and evidence support which point(s). (5-ESS1-1)
RI.5.9	Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS1-1)
W.5.1.a–d	Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (5-ESS1-1)
SL.5.5	Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-ESS1-2)

Mathematics –

MP.2	Reason abstractly and quantitatively. (5-ESS1-1),(5-ESS1-2)
MP.4	Model with mathematics. (5-ESS1-1),(5-ESS1-2)

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Grade Five
Standards Arranged by Disciplinary Core Ideas

5.NBT.2	Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10. (5-ESS1-1)
5.G.2	Represent real-world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. (5-ESS1-2)

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Grade Five
Standards Arranged by Disciplinary Core Ideas

5-ESS2 Earth's Systems

5-ESS2 Earth's Systems

Students who demonstrate understanding can:

5-ESS2-1. **Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.** [Clarification Statement: ****The geosphere, hydrosphere (including ice), atmosphere, and biosphere are each a system and each system is a part of the whole Earth System.** Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.] [Assessment Boundary: Assessment is limited to the interactions of two systems at a time.]

5-ESS2-2. **Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.** [Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.]

The performance expectations 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
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. ▪ Develop a model using an example to describe a scientific principle. (5-ESS2-1) **Using Mathematics and Computational Thinking** Mathematical and computational thinking	**ESS2.A: Earth Materials and Systems** ▪ Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and	**Scale, Proportion, and Quantity** ▪ Standard units are used to measure and describe physical quantities such as weight and volume. (5-ESS2-2) **Systems and System Models** ▪ A system can be described in terms of its components and their interactions. (5-ESS2-1)

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in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. ▪ Describe and graph quantities such as area and volume to address scientific questions. (5-ESS2-2)	influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. (5-ESS2-1) **ESS2.C: The Roles of Water in Earth's Surface Processes** ▪ Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (5-ESS2-2)	

Connections to other DCIs in fifth grade: N/A

Articulation of DCIs across grade-bands: **2.ESS2.A** (5-ESS2-1); **2.ESS2.C** (5-ESS2-2); **3.ESS2.D** (5-ESS2-1); **4.ESS2.A** (5-ESS2-1); **MS.ESS2.A** (5-ESS2-1); **MS.ESS2.C** (5-ESS2-1),(5-ESS2-2); **MS.ESS2.D** (5-ESS2-1); **MS.ESS3.A** (5-ESS2-2)

California Common Core State Standards Connections:

ELA/Literacy –

RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS2-1),(5-ESS2-2)

W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS2-2)

SL.5.5 Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-ESS2-1),(5-ESS2-2)

Mathematics –

MP.2 Reason abstractly and quantitatively. (5-ESS2-1),(5-ESS2-2)

MP.4 Model with mathematics. (5-ESS2-1),(5-ESS2-2)

5.G.2 Represent real-world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. (5-ESS2-1)

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Grade Five
Standards Arranged by Disciplinary Core Ideas

5-ESS3 Earth and Human Activity

5-ESS3 Earth and Human Activity

Students who demonstrate understanding can:

5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

The performance expectations 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
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. ▪ Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. (5-ESS3-1)	**ESS3.C: Human Impacts on Earth Systems** ▪ Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (5-ESS3-1)	**Systems and System Models** ▪ A system can be described in terms of its components and their interactions. (5-ESS3-1) --- ***Connections to Nature of Science*** **Science Addresses Questions About the Natural and Material World.** ▪ Science findings are limited to questions that can be answered with empirical evidence. (5-ESS3-1)

Connections to other DCIs in fifth grade: N/A

Articulation of DCIs across grade-bands: **MS.ESS3.A** (5-ESS3-1); **MS.ESS3.C** (5-ESS3-1); **MS.ESS3.D** (5-ESS3-1)

California Common Core State Standards Connections:
ELA/Literacy –

RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text.

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	(5-ESS3-1)
RI.5.7	Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.(5-ESS3-1)
RI.5.9.a,b	Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS3-1)
W.5.8	Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS3-1)
W.5.9.a,b	Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-ESS3-1)
Mathematics –	
MP.2	Reason abstractly and quantitatively. (5-ESS3-1)
MP.4	Model with mathematics. (5-ESS3-1)

Grade Five
Standards Arranged by Disciplinary Core Ideas

5-PS1 Matter and Its Interactions

5-PS1 Matter and Its Interactions

Students who demonstrate understanding can:

5-PS1-1. **Develop a model to describe that matter is made of particles too small to be seen.** [Clarification Statement: Examples of evidence supporting a model could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.] [Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.]

5-PS1-2. **Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.** [Clarification Statement: Examples of reactions or changes could include phase changes, dissolving, and mixing that forms new substances.] [Assessment Boundary: Assessment does not include distinguishing mass and weight.]

5-PS1-3. **Make observations and measurements to identify materials based on their properties.** [Clarification Statement: Examples of materials to be identified could include baking soda and other powders, metals, minerals, and liquids. Examples of properties could include color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility; density is not intended as an identifiable property.] [Assessment Boundary: Assessment does not include density or distinguishing mass and weight.]

5-PS1-4. **Conduct an investigation to determine whether the mixing of two or more substances results in new substances. [**Clarification Statement: Examples of combinations that do not produce new substances could include sand and water. Examples of combinations that do produce new substances could include baking soda and vinegar or milk and vinegar.]**

The performance expectations 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
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using	**PS1.A: Structure and Properties of Matter** ▪ Matter of any type can be subdivided into particles that are too small to see,	**Cause and Effect** ▪ Cause and effect relationships are routinely identified, tested, and used to explain change. (5-PS1-4)

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models to represent events and design solutions. ▪ Develop a model to describe phenomena. (5-PS1-1) **Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. ▪ Conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (5-PS1-4) ▪ Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (5-PS1-3) **Using Mathematics and Computational Thinking** Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical	but even then the matter still exists and can be detected by other means. A model shows that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects. (5-PS1-1) ▪ The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. (5-PS1-2) ▪ Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.) (5-PS1-3) **PS1.B: Chemical Reactions** ▪ When two or more different substances are mixed, a new substance with different properties may be formed. (5-PS1-4) ▪ No matter what reaction or change in properties occurs, the total weight of the	**Scale, Proportion, and Quantity** ▪ Natural objects exist from the very small to the immensely large. (5-PS1-1) ▪ Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. (5-PS1-2),(5-PS1-3) **----------** ***Connections to Nature of Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** ▪ Science assumes consistent patterns in natural systems. (5-PS1-2)

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properties and using computation and mathematics to analyze data and compare alternative design solutions. ▪ Measure and graph quantities such as weight to address scientific and engineering questions and problems. (5-PS1-2)	substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.) (5-PS1-2)	

Connections to other DCIs in fifth grade: N/A

Articulation of DCIs across grade-bands: **2.PS1.A** (5-PS1-1),(5-PS1-2),(5-PS1-3); **2.PS1.B** (5-PS1-2),(5-PS1-4); **MS.PS1.A** (5-PS1-1),(5-PS1-2),(5-PS1-3),(5-PS1-4); **MS.PS1.B** (5-PS1-2),(5-PS1-4)

California Common Core State Standards Connections:
ELA/Literacy –

RI.5.7	Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-PS1-1)
W.5.7	Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (5-PS1-2),(5-PS1-3),(5-PS1-4)
W.5.8	Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-PS1-2),(5-PS1-3),(5-PS1-4)
W.5.9.a,b	Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-PS1-2),(5-PS1-3),(5-PS1-4)

Mathematics –

MP.2	Reason abstractly and quantitatively. (5-PS1-1),(5-PS1-2),(5-PS1-3)
MP.4	Model with mathematics. (5-PS1-1),(5-PS1-2),(5-PS1-3)
MP.5	Use appropriate tools strategically. (PS1-2),(PS1-3)
5.NBT.2	Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10. (5-PS1-1)

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Grade Five
Standards Arranged by Disciplinary Core Ideas

5.NF.7.a-c	Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions. (5-PS1-1)
5.MD.1	Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real-world problems. (5-PS1-2)
5.MD.3.a,b	Recognize volume as an attribute of solid figures and understand concepts of volume measurement. (5-PS1-1)
5.MD.4	Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units. (5-PS1-1)

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Grade Five
Standards Arranged by Disciplinary Core Ideas

5-PS2 Motion and Stability: Forces and Interactions

5-PS2 Motion and Stability: Forces and Interactions

Students who demonstrate understanding can:

5-PS2-1 **Support an argument that the gravitational force exerted by Earth on objects is directed down.** [Clarification Statement: "Down" is a local description of the direction that points toward the center of the spherical Earth.] [Assessment Boundary: Assessment does not include mathematical representation of gravitational force.]

The performance expectations 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
Engaging in Argument from Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). ▪ Support an argument with evidence, data, or a model. (5-PS2-1)	**PS2.B: Types of Interactions** ▪ The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center. (5-PS2-1)	**Cause and Effect** ▪ Cause and effect relationships are routinely identified and used to explain change. (5-PS2-1)

Connections to other DCIs in fifth grade: N/A

Articulation of DCIs across grade-bands: **3.PS2.A** (5-PS2-1); **3.PS2.B** (5-PS2-1); **MS.PS2.B** (5-PS2-1)**; MS.ESS1.B** (5-PS2-1); **MS.ESS2.C** (5-PS2-1)

California Common Core State Standards Connections:

ELA/Literacy –

RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-PS2-1)

RI.5.9.a,b Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.

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	(5-PS2-1)
W.5.1.a–d	Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (5-PS2-1)

Grade Five
Standards Arranged by Disciplinary Core Ideas

5-PS3 Energy

5-PS3 Energy

Students who demonstrate understanding can:

5-PS3-1. **Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.** [Clarification Statement: Examples of models could include diagrams, and flow charts.]

The performance expectations 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
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. ▪ Use models to describe phenomena. (5-PS3-1)	**PS3.D: Energy in Chemical Processes and Everyday Life** ▪ The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water). (5-PS3-1) **LS1.C: Organization for Matter and Energy Flow in Organisms** ▪ Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion. (secondary to 5-PS3-1)	**Energy and Matter** ▪ Energy can be transferred in various ways and between objects. (5-PS3-1)

Connections to other DCIs in fifth grade: N/A

Articulation of DCIs across grade-bands: **K.LS1.C** (5-PS3-1); **2.LS2.A** (5-PS3-1); **4.PS3.A** (5-PS3-1); **4.PS3.B** (5-PS3-1); **4.PS3.D** (5-PS3-1); **MS.PS3.D** (5-PS3-1); **MS.PS4.B** (5-PS3-1); **MS.LS1.C** (5-PS3-1); **MS.LS2.B** (5-PS3-1)

California Common Core State Standards Connections:

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Grade Five
Standards Arranged by Disciplinary Core Ideas

ELA/Literacy –	
RI.5.7	Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-PS3-1)
SL.5.5	Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-PS3-1)

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Grade Five
Standards Arranged by Disciplinary Core Ideas

3–5-ETS1 Engineering Design

3–5-ETS1 Engineering Design

Students who demonstrate understanding can:

3–5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3–5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3–5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

The performance expectations 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
Asking Questions and Defining Problems Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships. ▪ Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. (3–5-ETS1-1)	**ETS1.A: Defining and Delimiting Engineering Problems** ▪ Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3–5-ETS1-1)	**Influence of Engineering, Technology, and Science on Society and the Natural World** ▪ People's needs and wants change over time, as do their demands for new and improved technologies. (3–5-ETS1-1) ▪ Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3–5-ETS-2)

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Grade Five
Standards Arranged by Disciplinary Core Ideas

Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. ▪ Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3–5-ETS1-3) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. ▪ Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. (3–5-ETS1-2)	**ETS1.B: Developing Possible Solutions** ▪ Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3–5-ETS1-2) ▪ At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3–5-ETS1-2) ▪ Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3–5-ETS1-3) **ETS1.C: Optimizing the Design Solution** ▪ Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3–5-ETS1-3)	
Connections to other DCIs in this grade-band:		

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Connections to 3–5-ETS1.A: Defining and Delimiting Engineering Problems include:
Fourth Grade: 4-PS3-4
Connections to 3–5-ETS1.B: Designing Solutions to Engineering Problems include:
Fourth Grade: 4-ESS3-2
Connections to 3–5-ETS1.C: Optimizing the Design Solution include:
Fourth Grade: 4-PS4-3

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

California Common Core State Standards Connections:

ELA/Literacy –

RI.5.1	Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (3–5-ETS1-2)
RI.5.7	Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (3–5-ETS1-2)
RI.5.9	Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (3–5-ETS1-2)
W.5.7	Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (3–5-ETS1-1),(3–5-ETS1-3)
W.5.8	Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (3–5-ETS1-1),(3–5-ETS1-3)
W.5.9.a,b	Draw evidence from literary or informational texts to support analysis, reflection, and research. (3–5-ETS1-1), (3–5-ETS1-3)

Mathematics –

MP.2	Reason abstractly and quantitatively. (3–5-ETS1-1),(3–5-ETS1-2),(3–5-ETS1-3)
MP.4	Model with mathematics. (3–5-ETS1-1),(3–5-ETS1-2),(3–5-ETS1-3)

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Grade Five
Standards Arranged by Disciplinary Core Ideas

MP.5	Use appropriate tools strategically. (3–5-ETS1-1),(3–5-ETS1-2),(3–5-ETS1-3)
3.OA.1-4	Represent and solve problems involving multiplication and division. (3–5-ETS1-1),(3–5-ETS1-2)
3.OA.5-6	Understand properties of multiplication and the relationship between multiplication and division. (3–5-ETS1-1),(3–5-ETS1-2)
3.OA.7	Multiply and divide within 100. (3–5-ETS1-1),(3–5-ETS1-2)
3.OA.8-9	Solve problems involving the four operations, and identify and explain patterns in arithmetic. (3–5-ETS1-1),(3–5-ETS1-2)
4.OA.1-3	Use the four operations with whole numbers to solve problems. (3–5-ETS1-1),(3–5-ETS1-2)
4.OA.4	Gain familiarity with factors and multiples. (3–5-ETS1-1),(3–5-ETS1-2)
4.OA.5	Generate and analyze patterns. (3–5-ETS1-1),(3–5-ETS1-2)
5.OA.1-2.1	Write and interpret numerical expressions. (3–5-ETS1-1),(3–5-ETS1-2)
5.OA.3	Analyze patterns and relationships. (3–5-ETS1-1),(3–5-ETS1-2)

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Next Generation Science Standards for California Public Schools, Kindergarten through Grade Twelve

Grade Six – Integrated Course
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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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-LS1-4. **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 expectations 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
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	**LS1.A: Structure and Function** ▪ All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular)	**Cause and Effect** ▪ Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS1-8) ▪ Phenomena may have more than one

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more abstract phenomena and design systems.

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

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.

- 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

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)
- 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)

cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS1-4),(MS-LS1-5)

Scale, Proportion, and Quantity

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

Systems and System Models

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

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)

Connections to Engineering, Technology, and Applications of Science

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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) **Obtaining, Evaluating, and Communicating Information** Obtaining, evaluating, and communicating information in 6–8 builds on K–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)	**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) **----------** ***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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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-LS1-8)		
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);		
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** 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.6–8.7** 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. (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)

Grade Six – Integrated Course
Standards Arranged by Disciplinary Core Ideas

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 expectations 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**
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-LS3-2)	**LS1.B: Growth and Development of Organisms** ▪ Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. (secondary to MS-LS3-2) **LS3.A: Inheritance of Traits** ▪ Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3-2) **LS3.B: Variation of Traits** ▪ In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring.	**Cause and Effect** ▪ Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS3-2)

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	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)	
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)		
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 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.5.a-d** Summarize numerical data sets in relation to their context. (MS-LS3-2)		

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Grade Six – Integrated Course
Standards Arranged by Disciplinary Core Ideas

MS-ESS2 Earth's Systems

MS-ESS2 Earth's Systems		
Students who demonstrate understanding can: **MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.** [Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.] [Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.] **MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.** [Clarification Statement: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation).] [Assessment Boundary: Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.] **MS-ESS2-6. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.** [Clarification Statement: Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models can be diagrams, maps and globes, or digital representations.] [Assessment Boundary: Assessment does not include the dynamics of the Coriolis effect.]		
The performance expectations 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**
Developing and Using Models	**ESS2.C: The Roles of Water in Earth's Surface Processes**	**Cause and Effect** ▪ Cause and effect relationships may

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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-ESS2-6) ▪ Develop a model to describe unobservable mechanisms. (MS-ESS2-4) **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. ▪ Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. (MS-ESS2-5)	▪ Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (MS-ESS2-4) ▪ The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. (MS-ESS2-5) ▪ Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4) ▪ Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (MS-ESS2-6) **ESS2.D: Weather and Climate** ▪ Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS-ESS2-6) ▪ Because these patterns are so complex,	be used to predict phenomena in natural or designed systems. (MS-ESS2-5) **Systems and System Models** ▪ Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. (MS-ESS2-6) **Energy and Matter** ▪ Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. (MS-ESS2-4)

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	weather can only be predicted probabilistically. (MS-ESS2-5) ▪ The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. (MS-ESS2-6)	

Connections to other DCIs in this grade-band: **MS.PS1.A** (MS-ESS2-4),(MS-ESS2-5); **MS.PS2.A** (MS-ESS2-5),(MS-ESS2-6); **MS.PS2.B** (MS-ESS2-4); **MS.PS3.A** (MS-ESS2-4),(MS-ESS2-5); **MS.PS3.B** (MS-ESS2-5),(MS-ESS2-6); **MS.PS3.D** (MS-ESS2-4);

Articulation of DCIs across grade-bands: **3.PS2.A** (MS-ESS2-4),(MS-ESS2-6); **3.ESS2.D** (MS-ESS2-5),(MS-ESS2-6); **4.PS3.B** (MS-ESS2-4); **5.PS2.B** (MS-ESS2-4); **5.ESS2.A** (MS-ESS2-5),(MS-ESS2-6); **5.ESS2.C** (MS-ESS2-4); **HS.PS2.B** (MS-ESS2-4),(MS-ESS2-6); **HS.PS3.B** (MS-ESS2-4),(MS-ESS2-6); **HS.PS4.B** (MS-ESS2-4); **HS.ESS1.B** (MS-ESS2-6); **HS.ESS2.A** (MS-ESS2-4),(MS-ESS2-6); **HS.ESS2.C** (MS-ESS2-4),(MS-ESS2-5); **HS.ESS2.D** (MS-ESS2-4),(MS-ESS2-5),(MS-ESS2-6);

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-ESS2-5)
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-ESS2-5)
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-ESS2-5)
SL.8.5	Integrate multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. (MS-ESS2-6)

Mathematics –

MP.2	Reason abstractly and quantitatively. (MS-ESS2-5)
6.NS.5	Understand that positive and negative numbers are used together to describe quantities having opposite

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	directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-ESS2-5)

Grade Six – Integrated Course
***Standards Arranged by* Disciplinary Core Ideas**

MS-ESS3 Earth and Human Activity

MS-ESS3 Earth and Human Activity		
Students who demonstrate understanding can: **MS-ESS3-3.** **Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.*** [Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).] **MS-ESS3–5.** **Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.** [Clarification Statement: Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures.]		
The performance expectations 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**
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, clarify arguments and models. ▪ Ask questions to identify and clarify	**ESS3.C: Human Impacts on Earth Systems** ▪ Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living	**Cause and Effect** ▪ Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. (MS-ESS3-3) **----------** ***Connections to Engineering, Technology,***

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evidence of an argument. (MS-ESS3–5) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. ▪ Apply scientific principles to design an object, tool, process or system. (MS-ESS3-3)	things. (MS-ESS3-3) **ESS3.D: Global Climate Change** ▪ Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3–5)	***and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** ▪ The uses 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-ESS3-3)
Connections to other DCIs in this grade-band: **MS.PS3.A** (MS-ESS3–5); **MS.LS2.A** (MS-ESS3-3); **MS.LS2.C** (MS-ESS3-3); **MS.LS4.D** (MS-ESS3-3)		
Articulation of DCIs across grade-bands: **3.LS2.C** (MS-ESS3-3); **3.LS4.D** (MS-ESS3-3); **5.ESS3.C** (MS-ESS3-3); **HS.PS3.B** (MS-ESS3–5); **HS.PS4.B** (MS-ESS3–5); **HS.LS2.C** (MS-ESS3-3); **HS.LS4.C** (MS-ESS3-3); **HS.LS4.D** (MS-ESS3-3); **HS.ESS2.A** (MS-ESS3–5); **HS.ESS2.C** (MS-ESS3-3); **HS.ESS2.D** (MS-ESS3-3),(MS-ESS3–5); **HS.ESS2.E** (MS-ESS3-3); **HS.ESS3.C** (MS-ESS3-3),(MS-ESS3–5); **HS.ESS3.D** (MS-ESS3-3),(MS-ESS3–5)		
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-ESS3–5) **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-ESS3-3)		

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Grade Six – Integrated Course
Standards Arranged by Disciplinary Core Ideas

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-ESS3-3)
Mathematics –	
MP.2	Reason abstractly and quantitatively. (MS-ESS3–5)
6.RP.1	Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-ESS3-3)
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-ESS3-3),(MS-ESS3–5)

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Grade Six – Integrated Course
Standards Arranged by Disciplinary Core Ideas

MS-PS3 Energy

MS-PS3 Energy

Students who demonstrate understanding can:

MS-PS3-3. **Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.*** [Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]

MS-PS3-4. **Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.** [Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]

MS-PS3–5. **Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.** [Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.] [Assessment Boundary: Assessment does not include calculations of energy.]

The performance expectations 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
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5	**PS3.A: Definitions of Energy** ▪ Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a	**Scale, Proportion, and Quantity** ▪ Proportional relationships (e.g., speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the

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experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions. ▪ Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. (MS-PS3-4) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. ▪ Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system. (MS-PS3-3) **Engaging in Argument from Evidence** Engaging in argument from evidence in 6–8 builds on K–5 experiences and	system depends on the types, states, and amounts of matter present. (MS-PS3-3),(MS-PS3-4) **PS3.B: Conservation of Energy and Energy Transfer** ▪ When the motion energy of an object changes, there is inevitably some other change in energy at the same time. (MS-PS3–5) ▪ The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. (MS-PS3-4) ▪ Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (MS-PS3-3) **ETS1.A: Defining and Delimiting an Engineering Problem** ▪ 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 is likely to limit possible solutions. (secondary to MS-PS3-3)	magnitude of properties and processes. (MS-PS3-4) **Energy and Matter** ▪ Energy may take different forms (e.g., energy in fields, thermal energy, energy of motion). (MS-PS3–5) ▪ The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS3-3)

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progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed worlds. ▪ Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon. (MS-PS3–5) **----------** ***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-PS3-4),(MS-PS3–5)	**ETS1.B: Developing Possible Solutions** ▪ A solution needs to be tested, and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. (secondary to MS-PS3-3)	
Connections to other DCIs in this grade-band: **MS.PS1.A** (MS-PS3-4); **MS.PS1.B** (MS-PS3-3); **MS.PS2.A** (MS-PS3-4),(MS-PS3–5); **MS.ESS2.A** (MS-PS3-3); **MS.ESS2.C** (MS-PS3-3),(MS-PS3-4); **MS.ESS2.D** (MS-PS3-3),(MS-PS3-4); **MS.ESS3.D** (MS-PS3-4)		
Articulation across grade-bands: **4.PS3.B** (MS-PS3-3); **4.PS3.C** (MS-PS3-4),(MS-PS3–5); **HS.PS1.B** (MS-PS3-4); **HS.PS3.A** (MS-PS3-4),(MS-PS3–5); **HS.PS3.B**,(MS-PS3-3),(MS-PS3-4),(MS-PS3–5)		
California 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		

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	explanations or descriptions (MS-PS3–5)
RST.6–8.3	Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS3-3),(MS-PS3-4)
WHST.6–8.1.a–e	Write arguments focused on *discipline-specific content*. (MS-PS3–5)
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-PS3-3),(MS-PS3-4)
Mathematics –	
MP.2	Reason abstractly and quantitatively. (MS-PS3-4),(MS-PS3–5)
6.RP.1	Understand the concept of ratio and use ratio language to describe a ratio relationship between two quantities. (MS-PS3–5)
6.SP.5.a-d	Summarize numerical data sets in relation to their context. (MS-PS3-4)

Grade Six – Integrated Course
Standards Arranged by Disciplinary Core Ideas

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 expectations 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
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, clarify arguments and models. ▪ Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints,	**ETS1.A: Defining and Delimiting Engineering Problems** ▪ 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) **ETS1.B: Developing Possible Solutions**	**Influence of Science, Engineering, and Technology on Society and the Natural World** ▪ 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

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including scientific knowledge that may limit possible solutions. (MS-ETS1-1) **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 generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4) **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	▪ 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) ▪ 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	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 natural and designed world. ▪ Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ETS1-2)	ultimately to an optimal solution. (MS-ETS1-4)	
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)		
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-ETS1-1),(MS-ETS1-1) **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-ETS1-1)		

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Grade Six – Integrated Course
Standards Arranged by Disciplinary Core Ideas

WHST.6–8.9	Draw evidence from informational texts to support analysis, reflection, and research. (MS-ETS1-2)
SL.8.5	Integrate multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. (MS-ETS1-4)
Mathematics –	
MP.2	Reason abstractly and quantitatively. (MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3),(MS-ETS1-4)

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Next Generation Science Standards for California Public Schools, Kindergarten through Grade Twelve

Grade Seven – Integrated Course
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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MS-LS1 From Molecules to Organisms: Structures and Processes

MS-LS1 From Molecules to Organisms: Structures and Processes		
Students who demonstrate understanding can: **MS-LS1-6.** **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.]		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
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. (MS-LS1-7)	**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. (MS-LS1-6)	**Energy and Matter** ▪ 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)

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-LS1-6) **----------** ***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)	▪ 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) **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 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)	
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);		

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Grade Seven – Integrated Course
Standards Arranged by Disciplinary Core Ideas

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 expectations 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

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Grade Seven – Integrated Course
Standards Arranged by Disciplinary Core Ideas

Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. ▪ Develop a model to describe phenomena. (MS-LS2-3) **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	**LS2.A: Interdependent Relationships in Ecosystems** ▪ Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1) ▪ In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (MS-LS2-1) ▪ Growth of organisms and population increases are limited by access to resources. (MS-LS2-1) ▪ 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	**Patterns** ▪ Patterns can be used to identify cause and effect relationships. (MS-LS2-2) **Cause and Effect** ▪ Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS2-1) **Energy and Matter** ▪ The transfer of energy can be tracked as energy flows through a natural system. (MS-LS2-3) **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

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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)

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)

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)

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)
- Biodiversity describes the variety of

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)

	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) **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)	
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)		
California Common Core State Standards Connections: *ELA/Literacy –*		

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Grade Seven – Integrated Course
Standards Arranged by Disciplinary Core Ideas

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 to support the claims. (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 components and visual displays in presentations to clarify claims and findings and emphasize salient points. (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

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

Grade Seven – Integrated Course
Standards Arranged by Disciplinary Core Ideas

MS-ESS2 Earth's Systems

MS-ESS2 Earth's Systems

Students who demonstrate understanding can:

MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. [Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.] [Assessment Boundary: Assessment does not include the identification and naming of minerals.]

MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. [Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.]

MS-ESS2-3. Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. [Clarification Statement: Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches).] [Assessment Boundary: Paleomagnetic anomalies in oceanic and continental crust are not assessed.]

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Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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	**ESS1.C: The History of Planet Earth** ▪ Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches.	**Patterns** ▪ Patterns in rates of change and other numerical relationships can provide information about natural and human

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predict more abstract phenomena and design systems. ▪ Develop and use a model to describe phenomena. (MS-ESS2-1) **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-ESS2-3) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. ▪ Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe nature operate today as they did in the	(HS.ESS1.C GBE) (secondary to MS-ESS2-3) **ESS2.A: Earth's Materials and Systems** ▪ All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. (MS-ESS2-1) ▪ The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. (MS-ESS2-2) **ESS2.B: Plate Tectonics and Large-Scale System Interactions** ▪ Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart. (MS-ESS2-3) **ESS2.C: The Roles of Water in Earth's**	designed systems. (MS-ESS2-3) **Scale Proportion and Quantity** ▪ Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS2-2) **Stability and Change** ▪ Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale. (MS-ESS2-1)

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<table>
<tr>
<td>past and will continue to do so in the future. (MS-ESS2-2)

———————

Connections to Nature of Science

Scientific Knowledge is Open to Revision in Light of New Evidence
▪ Science findings are frequently revised and/or reinterpreted based on new evidence. (MS-ESS2-3)</td>
<td>Surface Processes
▪ Water’s movements—both on the land and underground—cause weathering and erosion, which change the land’s surface features and create underground formations. (MS-ESS2-2)</td>
<td></td>
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<tr>
<td colspan="3">Connections to other DCIs in this grade-band: MS.PS1.A (MS-ESS2-1); MS.PS1.B (MS-ESS2-1),(MS-ESS2-2); MS.PS3.B (MS-ESS2-1); MS.LS2.B (MS-ESS2-1),(MS-ESS2-2); MS.LS2.C (MS-ESS2-1); MS.LS4.A (MS-ESS2-3); MS.ESS3.C (MS-ESS2-1)</td>
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<tr>
<td colspan="3">Articulation of DCIs across grade-bands: 3.LS4.A (MS-ESS2-3); 3.ESS3.B (MS-ESS2-3); 4.PS3.B (MS-ESS2-1); 4.ESS1.C (MS-ESS2-2),(MS-ESS2-3); 4.ESS2.A (MS-ESS2-1),(MS-ESS2-2); 4.ESS2.B (MS-ESS2-3); 4.ESS2.E (MS-ESS2-2); 4.ESS3.B (MS-ESS2-3); 5.ESS2.A (MS-ESS2-1),(MS-ESS2-2); HS.PS1.B (MS-ESS2-1);; HS.PS3.B (MS-ESS2-1); HS.PS3.D (MS-ESS2-2); HS.LS1.C (MS-ESS2-1); HS.LS2.B (MS-ESS2-1),(MS-ESS2-2); HS.LS4.A (MS-ESS2-3); HS.LS4.C (MS-ESS2-3); HS.ESS1.C (MS-ESS2-2),(MS-ESS2-3); HS.ESS2.A (MS-ESS2-1),(MS-ESS2-2),(MS-ESS2-3); HS.ESS2.B (MS-ESS2-2),(MS-ESS2-3); HS.ESS2.C (MS-ESS2-1),(MS-ESS2-2); HS.ESS2.D (MS-ESS2-2); HS.ESS2.E (MS-ESS2-1),(MS-ESS2-2); HS.ESS3.D (MS-ESS2-2)</td>
</tr>
<tr>
<td colspan="3">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-ESS2-2),(MS-ESS2-3)
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-ESS2-3)
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-ESS2-3)</td>
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Grade Seven – Integrated Course
Standards Arranged by Disciplinary Core Ideas

WHST.6–8.2.a–f	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. (MS-ESS2-2)
SL.8.5	Integrate multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. (MS-ESS2-1),(MS-ESS2-2)
Mathematics –	
MP.2	Reason abstractly and quantitatively. (MS-ESS2-2),(MS-ESS2-3)
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-ESS2-2),(MS-ESS2-3)
7.EE.4.a,b	Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. (MS-ESS2-2),(MS-ESS2-3)

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Grade Seven – Integrated Course
Standards Arranged by Disciplinary Core Ideas

MS-ESS3 Earth and Human Activity

MS-ESS3 Earth and Human Activity

Students who demonstrate understanding can:

MS-ESS3-1. **Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.** [Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).]

MS-ESS3-2. **Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.** [Clarification Statement: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts).]

The performance expectations 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
Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and	**ESS3.A: Natural Resources** ▪ Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals,	**Patterns** ▪ Graphs, charts, and images can be used to identify patterns in data. (MS-ESS3-2) **Cause and Effect**

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<table>
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<td>basic statistical techniques of data and error analysis.
▪ Analyze and interpret data to determine similarities and differences in findings. (MS-ESS3-2)
Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.
▪ Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-ESS3-1)</td>
<td>fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. (MS-ESS3-1)
ESS3.B: Natural Hazards
▪ Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. (MS-ESS3-2)</td>
<td>▪ Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS3-1)

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World
▪ 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-ESS3-1)
▪ The uses 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-ESS3-2)</td>
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<tr>
<td colspan="3">Connections to other DCIs in this grade-band: MS.PS1.A (MS-ESS3-1); MS.PS1.B (MS-ESS3-1); MS.ESS2.D (MS-ESS3-1)</td>
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<tr>
<td colspan="3">Articulation of DCIs across grade-bands: 3.ESS3.B (MS-ESS3-2); 4.PS3.D (MS-ESS3-1); 4.ESS3.A (MS-ESS3-1); 4.ESS3.B (MS-ESS3-2); HS.PS3.B (MS-ESS3-1); HS.LS1.C (MS-ESS3-1); HS.ESS2.A (MS-ESS3-1); HS.ESS2.B (MS-ESS3-1),(MS-ESS3-2);</td>
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HS.ESS2.C (MS-ESS3-1); **HS.ESS2.D** (MS-ESS3-2); **HS.ESS3.A** (MS-ESS3-1); **HS.ESS3.B** (MS-ESS3-2); **HS.ESS3.D** (MS-ESS3-2)	
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-ESS3-1),(MS-ESS3-2)
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-ESS3-2)
WHST.6–8.2.a–f	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. (MS-ESS3-1)
WHST.6–8.9	Draw evidence from informational texts to support analysis, reflection, and research. (MS-ESS3-1)
Mathematics –	
MP.2	Reason abstractly and quantitatively. (MS-ESS3-2)
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-ESS3-1),(MS-ESS3-2)
7.EE.4.a,b	Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. (MS-ESS3-1),(MS-ESS3-2)

Grade Seven – Integrated Course
Standards Arranged by Disciplinary Core Ideas

MS-PS1 Matter and its Interactions

MS-PS1 Matter and Its Interactions
Students who demonstrate understanding can:
MS-PS1-1. **Develop models to describe the atomic composition of simple molecules and extended structures.** [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.] [Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete description of all individual atoms in a complex molecule or extended structure is not required.]
MS-PS1-2. **Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.** [Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.] [Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.]
MS-PS1-3. **Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.** [Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.] [Assessment Boundary: Assessment is limited to qualitative information.]
MS-PS1-4. **Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.** [Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.]
MS-PS1-5. **Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.** [Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.] [Assessment Boundary: Assessment does not

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include the use of atomic masses, balancing symbolic equations, or intermolecular forces.]

MS-PS1-6. **Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.*** [Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride.] [Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.]

The performance expectations 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
Developing and Using Models Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. ▪ Develop a model to predict and/or describe phenomena. (MS-PS1-1),(MS-PS1-4) ▪ Develop a model to describe unobservable mechanisms. (MS-PS1-5) **Analyzing and Interpreting Data** Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and	**PS1.A: Structure and Properties of Matter** ▪ Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS-PS1-1) ▪ Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-2),(MS-PS1-3) ▪ Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4) ▪ In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to	**Patterns** ▪ Macroscopic patterns are related to the nature of microscopic and atomic-level structure. (MS-PS1-2) **Cause and Effect** ▪ Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4) **Scale, Proportion, and Quantity** ▪ Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-PS1-1) **Energy and Matter** ▪ Matter is conserved because atoms

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error analysis.
- Analyze and interpret data to determine similarities and differences in findings. (MS-PS1-2)

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.
- Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. (MS-PS1-6)

Obtaining, Evaluating, and Communicating Information

Obtaining, evaluating, and communicating information in 6–8 builds on K–5 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

collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4)
- Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1)
- The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (MS-PS1-4)

PS1.B: Chemical Reactions
- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-2),(MS-PS1-3),(MS-PS1-5)
- The total number of each type of atom is conserved, and thus the mass does not change. (MS-PS1-5)
- Some chemical reactions release energy, others store energy. (MS-PS1-6)

PS3.A: Definitions of Energy
- The term “heat” as used in everyday language refers both to thermal energy (the

are conserved in physical and chemical processes. (MS-PS1-5)
- The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS1-6)

Structure and Function
- Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (MS-PS1-3)

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-PS1-3)

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

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publication and methods used, and describe how they are supported or not supported by evidence. (MS-PS1-3) **----------** ***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-PS1-2) **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** ▪ Laws are regularities or mathematical descriptions of natural phenomena. (MS-PS1-5)	motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. (secondary to MS-PS1-4) ▪ The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material. (secondary to MS-PS1-4) **ETS1.B: Developing Possible Solutions** ▪ A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (secondary to MS-PS1-6) **ETS1.C: Optimizing the Design Solution**	▪ The uses 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-PS1-3)

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	▪ 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 the characteristics may be incorporated into the new design. (secondary to MS-PS1-6) ▪ 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. (secondary to MS-PS1-6)	

Connections to other DCIs in this grade-band: **MS.PS3.D** (MS-PS1-2),(MS-PS1-6); **MS.LS1.C** (MS-PS1-2),(MS-PS1-5); **MS.LS2.A** (MS-PS1-3); **MS.LS2.B** (MS-PS1-5); **MS.LS4.D** (MS-PS1-3); **MS.ESS2.A** (MS-PS1-2),(MS-PS1-5); **MS.ESS2.C** (MS-PS1-1),(MS-PS1-4); **MS.ESS3.A** (MS-PS1-3); **MS.ESS3.C** (MS-PS1-3)

Articulation across grade-bands: **5.PS1.A** (MS-PS1-1); **5.PS1.B** (MS-PS1-2),(MS-PS1-5); **HS.PS1.A** (MS-PS1-1),(MS-PS1-3),(MS-PS1-4),(MS-PS1-6); **HS.PS1.B** (MS-PS1-2),(MS-PS1-4),(MS-PS1-5),(MS-PS1-6); **HS.PS3.A** (MS-PS1-4),(MS-PS1-6); **HS.PS3.B** (MS-PS1-6); **HS.PS3.D** (MS-PS1-6); **HS.LS2.A** (MS-PS1-3); **HS.LS4.D** (MS-PS1-3); **HS.ESS1.A** (MS-PS1-1); **HS.ESS3.A** (MS-PS1-3)

California 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-PS1-2),(MS-PS1-3)

RST.6–8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS1-6)

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Grade Seven – Integrated Course
Standards Arranged by Disciplinary Core Ideas

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-PS1-1),(MS-PS1-2),(MS-PS1-4),(MS-PS1-5)
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-PS1-6)
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-PS1-3)
Mathematics –	
MP.2	Reason abstractly and quantitatively. (MS-PS1-1),(MS-PS1-2), (MS-PS1-5)
MP.4	Model with mathematics. (MS-PS1-1), (MS-PS1-5)
6.RP.3	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-PS1-1),(MS-PS1-2),(MS-PS1-5)
6.NS.5	Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-PS1-4)
6.SP.4	Display numerical data in plots on a number line, including dot plots, histograms, and box plots. (MS-PS1-2)
6.SP.5.a-d	Summarize numerical data sets in relation to their context (MS-PS1-2)

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Grade Seven – Integrated Course
Standards Arranged by Disciplinary Core Ideas

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 expectations 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**
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, clarify arguments and models. ▪ 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	**ETS1.A: Defining and Delimiting Engineering Problems** ▪ 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) **ETS1.B: Developing Possible Solutions**	**Influence of Science, Engineering, and Technology on Society and the Natural World** ▪ 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

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limit possible solutions. (MS-ETS1-1) **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 generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4) **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.	▪ 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) ▪ 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-	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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▪ Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ETS1-2)	ETS1-4)	

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)

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-ETS1-1),(MS-ETS1-1)
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-ETS1-1)
WHST.6–8.9	Draw evidence from informational texts to support analysis, reflection, and research. (MS-ETS1-2)

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Grade Seven – Integrated Course
Standards Arranged by Disciplinary Core Ideas

SL.8.5	Integrate multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. (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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Next Generation Science Standards for California Public Schools, Kindergarten through Grade Twelve

Grade Eight – Integrated Course
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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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.]

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Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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)	**LS3.A: Inheritance of Traits** ▪ Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. (MS-LS3-1)	**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 and designed structures/systems can be analyzed to determine how they function. (MS-LS3-1)

Grade Eight – Integrated Course
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	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. (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)		
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 components and visual displays in presentations to clarify claims and findings and emphasize salient points. (MS-LS3-1)		

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Grade Eight – Integrated Course
Standards Arranged by Disciplinary Core Ideas

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

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over time.] [Assessment Boundary: Assessment does not include Hardy Weinberg calculations.]

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Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. ▪ Analyze displays of data to identify linear and nonlinear relationships. (MS-LS4-3) ▪ Analyze and interpret data to determine similarities and differences in findings. (MS-LS4-1) **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. (MS-LS4-6) **Constructing Explanations and**	**LS4.A: Evidence of Common Ancestry and Diversity** ▪ The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. (MS-LS4-1) ▪ 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) ▪ Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy. (MS-LS4-3)	**Patterns** ▪ 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) **Cause and Effect** ▪ Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4),(MS-LS4-5),(MS-LS4-6) **----------** ***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

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Grade Eight – Integrated Course
Standards Arranged by Disciplinary Core Ideas

Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. ▪ Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-2) ▪ Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena. (MS-LS4-4) **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)	**LS4.B: Natural Selection** ▪ 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) **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)	discoveries have led to the development of entire industries and engineered systems. (MS-LS4-5) **----------** ***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-LS4-1),(MS-LS4-2) **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)

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Grade Eight – Integrated Course
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---------- ***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)		

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)

California 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),(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 to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (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

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	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, 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. (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.a-d	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)

Grade Eight – Integrated Course
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MS-ESS1 Earth's Place in the Universe

MS-ESS1 Earth's Place in the Universe
Students who demonstrate understanding can: **MS-ESS1-1. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.** [Clarification Statement: Examples of models can be physical, graphical, or conceptual.] **MS-ESS1-2. Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.** [Clarification Statement: Emphasis for the model is on gravity as the force that holds together the solar system and Milky Way galaxy and controls orbital motions within them. Examples of models can be physical (such as the analogy of distance along a football field or computer visualizations of elliptical orbits) or conceptual (such as mathematical proportions relative to the size of familiar objects such as their school or state).] [Assessment Boundary: Assessment does not include Kepler's Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth.] **MS-ESS1-3. Analyze and interpret data to determine scale properties of objects in the solar system.** [Clarification Statement: Emphasis is on the analysis of data from Earth-based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects. Examples of scale properties include the sizes of an object's layers (such as crust and atmosphere), surface features (such as volcanoes), and orbital radius. Examples of data include statistical information, drawings and photographs, and models.] [Assessment Boundary: Assessment does not include recalling facts about properties of the planets and other solar system bodies.] **MS-ESS1-4. Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.** [Clarification Statement: Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range from being very recent (such as the last Ice Age or the earliest fossils of homo sapiens) to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains and ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions.] [Assessment Boundary: Assessment does not include recalling the names of specific periods or epochs and events within them.]
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Grade Eight – Integrated Course
Standards Arranged by Disciplinary Core Ideas

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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-ESS1-1),(MS-ESS1-2) **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-ESS1-3) **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,	**ESS1.A: The Universe and Its Stars** ▪ Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1) ▪ Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. (MS-ESS1-2) **ESS1.B: Earth and the Solar System** ▪ The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. (MS-ESS1-2),(MS-ESS1-3) ▪ This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. (MS-ESS1-1) ▪ The solar system appears to have	**Patterns** ▪ Patterns can be used to identify cause-and-effect relationships. (MS-ESS1-1) **Scale, Proportion, and Quantity** ▪ Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS1-3),(MS-ESS1-4) **Systems and System Models** ▪ Models can be used to represent systems and their interactions – such as inputs, processes and outputs – and energy, matter, and information flows within systems. (MS-ESS1-2) **----------** ***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

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Grade Eight – Integrated Course
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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-ESS1-4)	formed from a disk of dust and gas, drawn together by gravity. (MS-ESS1-2) **ESS1.C: The History of Planet Earth** ▪ The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale. (MS-ESS1-4)	industries and engineered systems. (MS-ESS1-3) **----------** ***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-ESS1-1), (MS-ESS1-2)
Connections to other DCIs in this grade-band: **MS.PS2.A** (MS-ESS1-1),(MS-ESS1-2); **MS.PS2.B** (MS-ESS1-1),(MS-ESS1-2); **MS.LS4.A** (MS-ESS1-4); **MS.LS4.C** (MS-ESS1-4); **MS.ESS2.A** (MS-ESS1-3)		
Articulation of DCIs across grade-bands: **3.PS2.A** (MS-ESS1-1),(MS-ESS1-2); **3.LS4.A** (MS-ESS1-4); **3.LS4.C** (MS-ESS1-4); **3.LS4.D** (MS-ESS1-4); **4.ESS1.C** (MS-ESS1-4); **5.PS2.B** (MS-ESS1-1),(MS-ESS1-2); **5.ESS1.A** (MS-ESS1-2); **5.ESS1.B** (MS-ESS1-1),(MS-ESS1-2),(5-ESS1-3); **HS.PS1.C** (MS-ESS1-4); **HS.PS2.A** (MS-ESS1-1),(MS-ESS1-2); **HS.PS2.B** (MS-ESS1-1),(MS-ESS1-2); **HS.LS4.A** (MS-ESS1-4); **HS.LS4.C** (MS-ESS1-4); **HS.ESS1.A** (MS-ESS1-2); **HS.ESS1.B** (MS-ESS1-1),(MS-ESS1-2),(MS-ESS1-3); **HS.ESS1.C** (MS-ESS1-4); **HS.ESS2.A** (MS-ESS1-3),(MS-ESS1-4)		
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-ESS1-3),(MS-ESS1-4) **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-ESS1-3) **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-ESS1-4) **SL.8.5** Integrate multimedia components and visual displays in presentations to clarify claims and findings and		

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	emphasize salient points. (MS-ESS1-1),(MS-ESS1-2)
Mathematics –	
MP.2	Reason abstractly and quantitatively. (MS-ESS1-3)
MP.4	Model with mathematics. (MS-ESS1-1),(MS-ESS1-2)
6.RP.1	Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-ESS1-1),(MS-ESS1-2).(MS-ESS1-3)
7.RP.2.a-d	Recognize and represent proportional relationships between quantities. (MS-ESS1-1),(MS-ESS1-2).(MS-ESS1-3)
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-ESS1-2),(MS-ESS1-4)
7.EE.4.a,b	Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. (MS-ESS1-2),(MS-ESS1-4)

Grade Eight – Integrated Course
Standards Arranged by Disciplinary Core Ideas

MS-ESS3 Earth and Human Activity

MS-ESS3 Earth and Human Activity		
Students who demonstrate understanding can: **MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.** [Clarification Statement: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.]		
The performance expectations above were 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). ▪ 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-ESS3-4)	**Disciplinary Core Ideas** **ESS3.C: Human Impacts on Earth Systems** ▪ Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (MS-ESS3-4)	**Crosscutting Concepts** **Cause and Effect** ▪ Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS3-4) **----------** ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** ▪ All human activity draws on natural resources and has both short and long-

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		term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ESS3-4) **----------** ***Connections to Nature of Science*** **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-ESS3-4)
Connections to other DCIs in this grade-band: **MS.LS2.A** (MS-ESS3-4); **MS.LS2.C** (MS-ESS3-4); **MS.LS4.D** (MS-ESS3-4)		
Articulation of DCIs across grade-bands: **3.LS2.C** (MS-ESS3-4); **3.LS4.D** (MS-ESS3-4); **5.ESS3.C** (MS-ESS3-4); **HS.LS2.A** (MS-ESS3-4); **HS.LS2.C** (MS-ESS3-4); **HS.LS4.C** (MS-ESS3-4); **HS.LS4.D** (MS-ESS3-4); **HS.ESS2.E** (MS-ESS3-4); **HS.ESS3.A** (MS-ESS3-4); **HS.ESS3.C** (MS-ESS3-4);		
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-ESS3-4) **WHST.6–8.1.a-f** Write arguments focused on *discipline-specific content*. (MS-ESS3-4) **WHST.6–8.9** Draw evidence from informational texts to support analysis, reflection, and research. (MS-ESS3-4) *Mathematics –* **6.RP.1** Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-ESS3-4) **7.RP.2.a-d** Recognize and represent proportional relationships between quantities. (MS-ESS3-4) **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		

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	number in a specified set. (MS-ESS3-4)
7.EE.4.a,b	Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. (MS-ESS3-4)

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MS-PS2 Motion and Stability: Forces and Interactions

MS-PS2 Motion and Stability: Forces and Interactions
Students who demonstrate understanding can:
MS-PS2-1. **Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.*** [Clarification Statement: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.] [Assessment Boundary: Assessment is limited to vertical or horizontal interactions in one dimension.]
MS-PS2-2. **Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.** [Clarification Statement: Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units.] [Assessment Boundary: Assessment is limited to forces and changes in motion in one-dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry.]
MS-PS2-3. **Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.** [Clarification Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor.] [Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.]
MS-PS2-4. **Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.** [Clarification Statement: Examples of evidence for arguments could include data generated from simulations or digital tools; and charts displaying mass, strength of interaction, distance from the Sun, and orbital periods of objects within the solar system.] [Assessment Boundary: Assessment does not include Newton's Law of Gravitation or Kepler's Laws.]
MS-PS2-5. **Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.** [Clarification Statement: Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, and electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations.]

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[Assessment Boundary: Assessment is limited to electric and magnetic fields, and is limited to qualitative evidence for the existence of fields.]

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Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in grades 6–8 builds from grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. ▪ Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. (MS-PS2-3) **Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support	**PS2.A: Forces and Motion** ▪ For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law). (MS-PS2-1) ▪ The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. (MS-PS2-2) ▪ All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these	**Cause and Effect** ▪ Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS2-3),(MS-PS2-5) **Systems and System Models** ▪ Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems. (MS-PS2-1),(MS-PS2-4), **Stability and Change** ▪ Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales. (MS-PS2-2) **----------** ***Connections to Engineering, Technology, and Applications of Science***

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explanations or design solutions. ▪ Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. (MS-PS2-2) ▪ Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation. (MS-PS2-5) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. ▪ Apply scientific ideas or principles to design an object, tool, process or system. (MS-PS2-1) **Engaging in Argument from Evidence** Engaging in argument from evidence in 6–	choices must also be shared. (MS-PS2-2) **PS2.B: Types of Interactions** ▪ Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. (MS-PS2-3) ▪ Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun. (MS-PS2-4) ▪ Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively). (MS-PS2-5)	**Influence of Science, Engineering, and Technology on Society and the Natural World** ▪ The uses 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. (MS-PS2-1)

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8 builds from 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. ▪ Construct and present oral and written arguments 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-PS2-4) **----------** ***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-PS2-2),(MS-PS2-4)		
Connections to other DCIs in this grade-band: **MS.PS3.A** (MS-PS2-2); **MS.PS3.B** (MS-PS2-2); **MS.PS3.C** (MS-PS2-1); **MS.ESS1.A** (MS-PS2-4); **MS.ESS1.B** (MS-PS2-4); **MS.ESS2.C** (MS-PS2-2),(MS-PS2-4)		
Articulation across grade-bands: **3.PS2.A** (MS-PS2-1),(MS-PS2-2); **3.PS2.B** (MS-PS2-3),(MS-PS2-5); **5.PS2.B** (MS-PS2-4); **HS.PS2.A** (MS-PS2-1),(MS-PS2-2); **HS.PS2.B** (MS-PS2-3),(MS-PS2-4),(MS-PS2-5); **HS.PS3.A** (MS-PS2-5); **HS.PS3.B** (MS-PS2-2),(MS-PS2-5); **HS.PS3.C** (MS-PS2-5); **HS.ESS1.B** (MS-PS2-4)		
California Common Core State Standards Connections: *ELA/Literacy –*		

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Grade Eight – Integrated Course
Standards Arranged by Disciplinary Core Ideas

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-PS2-1),(MS-PS2-3)
RST.6–8.3	Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS2-1),(MS-PS2-2),(MS-PS2-5)
WHST.6–8.1.a-e	Write arguments focused on *discipline-specific content*. (MS-PS2-4)
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-PS2-1),(MS-PS2-2),(MS-PS2-5)
Mathematics –	
MP.2	Reason abstractly and quantitatively. (MS-PS2-1),(MS-PS2-2),(MS-PS2-3)
6.NS.5	Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-PS2-1)
6.EE.2.a-c	Write, read, and evaluate expressions in which letters stand for numbers. (MS-PS2-1),(MS-PS2-2)
7.EE.3-4	Solve real-life and mathematical problems using numerical and algebraic expressions and equations. (MS-PS2-1), (MS-PS2-2)

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Grade Eight – Integrated Course
Standards Arranged by Disciplinary Core Ideas

MS-PS3 Energy

MS-PS3 Energy

Students who demonstrate understanding can:

MS-PS3-1. **Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.** [Clarification Statement: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a wiffle ball versus a tennis ball.]

MS-PS3-2. **Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.** [Clarification Statement: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.] [Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions.]

The performance expectations 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
Developing and Using Models Modeling in 6–8 builds on K–5 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. (MS-PS3-2)	**PS3.A: Definitions of Energy** ▪ Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed. (MS-PS3-1) ▪ A system of objects may also contain stored (potential) energy, depending on their relative positions. (MS-PS3-2)	**Scale, Proportion, and Quantity** ▪ Proportional relationships (e.g., speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. (MS-PS3-1)

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Grade Eight – Integrated Course
Standards Arranged by Disciplinary Core Ideas

Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. ▪ Construct and interpret graphical displays of data to identify linear and nonlinear relationships. (MS-PS3-1)	**PS3.C: Relationship Between Energy and Forces** ▪ When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. (MS-PS3-2)	**Systems and System Models** ▪ Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems. (MS-PS3-2)
Connections to other DCIs in this grade-band: **MS.PS2.A** (MS-PS3-1);		
Articulation across grade-bands: **4.PS3.B** (MS-PS3-1); **HS.PS2.B** (MS-PS3-2); **HS.PS3.A** (MS-PS3-1); **HS.PS3.B** (MS-PS3-1),(MS-PS3-2) **HS.PS3.C** (MS-PS3-2)		

California 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-PS3-1)
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-PS3-1)
SL.8.5	Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-PS3-2)

Mathematics –

MP.2	Reason abstractly and quantitatively. (MS-PS3-1)
6.RP.1	Understand the concept of ratio and use ratio language to describe a ratio relationship between two quantities. (MS-PS3-1)
6.RP.2	Understand the concept of a unit rate a/b associated with a ratio $a:b$ with $b \neq 0$, and use rate language in the context of a ratio relationship. (MS-PS3-1)

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Grade Eight – Integrated Course
Standards Arranged by Disciplinary Core Ideas

7.RP.2.a-d	Recognize and represent proportional relationships between quantities. (MS-PS3-1)
8.EE.1	Know and apply the properties of integer exponents to generate equivalent numerical expressions. (MS-PS3-1)
8.EE.2	Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational. (MS-PS3-1)
8.F.3	Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. (MS-PS3-1)

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Grade Eight – Integrated Course
Standards Arranged by Disciplinary Core Ideas

MS-PS4 Waves and Their Applications in Technologies for Information Transfer

MS-PS4 Waves and Their Applications in Technologies for Information Transfer

Students who demonstrate understanding can:

MS-PS4-1. **Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.** [Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.] [Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.]

MS-PS4-2. **Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.** [Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.] [Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves.]

MS-PS4-3. **Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.** [Clarification Statement: Emphasis is on a basic understanding that waves can be used for communication purposes. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in wifi devices, and conversion of stored binary patterns to make sound or text on a computer screen.] [Assessment Boundary: Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device.]

The performance expectations 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
Developing and Using Models Modeling in 6–8 builds on K–5 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	**PS4.A: Wave Properties** ▪ A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS-PS4-1) ▪ A sound wave needs a medium	**Patterns** ▪ Graphs and charts can be used to identify patterns in data. (MS-PS4-1) **Structure and Function** ▪ Structures can be designed to serve particular functions by taking into

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phenomena. (MS-PS4-2)

Using Mathematics and Computational Thinking
Mathematical and computational thinking at the 6–8 level builds on K–5 and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments.

- Use mathematical representations to describe and/or support scientific conclusions and design solutions. (MS-PS4-1)

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

- Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims and findings. (MS-PS4-3)

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence

through which it is transmitted. (MS-PS4-2)

PS4.B: Electromagnetic Radiation

- When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. (MS-PS4-2)
- The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. (MS-PS4-2)
- A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. (MS-PS4-2)
- However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2)

PS4.C: Information Technologies and Instrumentation

- Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.

account properties of different materials, and how materials can be shaped and used. (MS-PS4-2)

- Structures can be designed to serve particular functions. (MS-PS4-3)

Connections to Engineering, Technology, and Applications of Science

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

- Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations. (MS-PS4-3)

Connections to Nature of Science

Science is a Human Endeavor

- Advances in technology influence the progress of science and science has influenced advances in technology. (MS-PS4-3)

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▪ Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS4-1)	(MS-PS4-3)	

Connections to other DCIs in this grade-band: **MS.LS1.D** (MS-PS4-2)

Articulation across grade-bands: **4.PS3.A** (MS-PS4-1); **4.PS3.B** (MS-PS4-1); **4.PS4.A** (MS-PS4-1); **4.PS4.B** (MS-PS4-2); **4.PS4.C** (MS-PS4-3); **HS.PS4.A** (MS-PS4-1),(MS-PS4-2),(MS-PS4-3); **HS.PS4.B** (MS-PS4-1),(MS-PS4-2); **HS.PS4.C** (MS-PS4-3); **HS.ESS1.A** (MS-PS4-2)

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-PS4-3)
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-PS4-3)
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-PS4-3)
WHST.6–8.9	Draw evidence from informational texts to support analysis, reflection, and research. (MS-PS4-3)
SL.8.5	Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-PS4-1),(MS-PS4-2)

Mathematics –

MP.2	Reason abstractly and quantitatively. (MS-PS4-1)
MP.4	Model with mathematics. (MS-PS4-1)
6.RP.1	Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-PS4-1)
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-PS4-1)
7.RP.2.a-d	Recognize and represent proportional relationships between quantities. (MS-PS4-1)
8.F.3	Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. (MS-PS4-1)

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Grade Eight – Integrated Course
Standards Arranged by Disciplinary Core Ideas

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 expectations above were developed using the following elements from the NRC document *A Framework for K–12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems

Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.

- 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

Disciplinary Core Ideas

ETS1.A: Defining and Delimiting Engineering Problems

- 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)

ETS1.B: Developing Possible Solutions

Crosscutting Concepts

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

- 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

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limit possible solutions. (MS-ETS1-1) **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 generate data to test ideas about designed systems, including those representing inputs and outputs (MS-ETS1-4) **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.	▪ 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) ▪ 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	by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1)

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▪ Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ETS1-2)	ultimately to an optimal solution. (MS-ETS1-4)	

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)

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	Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize

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	salient points. (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)