Smithsonian | STC Science and Technology Concepts™ Middle School

Smithsonian's STCMS™

Correlation to the

CA Environmental Principles and Concepts

for Grades 6–8

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Appropriate Alignments among *Environmental Principles and Concepts (EP&Cs)* and *CA NGSS:* Grade Six, Seven & Eight

<table>
<tr><th colspan="4">MS-LS1 From Molecules to Organisms: Structures and Processes</th></tr>
<tr><th>Performance Expectations</th><th>Connections Between EP&Cs, CCCs, and SEPS</th><th>Clarifications and Connections Between DCIs and EP&Cs</th><th>STCMS</th></tr>
<tr>
<td>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</td>
<td>Principle II: The long-term functioning and health of terrestrial, freshwater, coastal and marine ecosystems are influenced by their relationships with human societies.
Principle IV: The exchange of matter between natural systems and human societies affects the long-term functioning of both.
Crosscutting Concepts
Cause and Effect
•Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS1-4), (MS-LS1-5)
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)
Energy and Matter
•Within a natural system, the transfer of energy drives the motion and/or cycling of matter. (MS-LS1-6)</td>
<td>Disciplinary Core Ideas
As students learn that:
LS1.B: Growth and Development of Organisms “Animals engage in characteristic behaviors that increase the odds of reproduction. (MS-LS1-4)”
and
LS1.B: “Genetic factors as well as local conditions affect the growth of the adult plant. (MS-LS1-5)”
and
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)”[b]
and
LS1.C: “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)”

Secondary DCI(s)
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)”</td>
<td>Genes and Molecular Machines
TE: L1 pp. 1a-15; L7 pp. 111a-129; L11 pp. 181a-186

Ecosystems and Their Interactions
TE: L1 pp. 1a-27; L10 pp. 221a-243; L11 pp. 243a-249</td>
</tr>
</table>

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-LS1-6.** Construct a scientific explanation based on evidence for the role of photosynthesis in	**Science and Engineering Practices** **Constructing Explanations and Designing Solutions** •Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-LS1-5, MS-LS1-6) **Engaging in Argument from Evidence** •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) **Constructing Explanations and Designing Solutions** •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	**Environmental Principle and Concept(s)** Students should be developing an understanding: **Principle II Concept c:** "that the expansion and operation of human communities influences the geographic extent, composition, biological diversity, and viability of natural systems." (LS1.B) and **Principle IV Concept b:** "that the byproducts of human activity are not readily prevented from entering natural systems and may be beneficial, neutral, or detrimental in their effect." (LS1.B)	

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.]	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)		

<table>
<tr><th colspan="4">MS-LS2 Ecosystems: Interactions, Energy, and Dynamics</th></tr>
<tr><th>Performance Expectations</th><th>Connections Between EP&Cs, CCCs, and SEPS</th><th>Clarifications and Connections Between DCIs and EP&Cs</th><th>STCMS</th></tr>
<tr>
<td rowspan="2">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-LS2-3. 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</td>
<td>Principle I: The continuation and health of individual human lives and of human communities and societies depend on the health of the natural systems that provide essential goods and ecosystem services.
Principle II: The long-term functioning and health of terrestrial, freshwater, coastal and marine ecosystems are influenced by their relationships with human societies.
Principle III: Natural systems proceed through cycles that humans depend upon, benefit from and can alter.
Principle IV: The exchange of matter between natural systems and human societies affects the long-term functioning of both.
Principle V: Decisions affecting resources and natural systems are based on a wide range of considerations and decision-making processes.
Crosscutting Concepts
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)</td>
<td>Disciplinary Core Ideas
As students learn that:
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) ***Supplemental DCI PS1.B”
and
LS2.B: Cycle of Matter and Energy Transfer in Ecosystems “… Transfers of matter into and out of the physical environment occur at every level… The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. (MS-LS2-3) ***Supplemental DCI PS1.B, ESS2.A”
and
LS2.C: Ecosystem Dynamics, Functioning, and Resilience “… Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (MS-LS2-4)”

Secondary DCI(s)
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)”
and
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)”
Environmental Principle and Concept(s)
Students should be developing an understanding:
Principle I Concept c: “that the quality, quantity and</td>
<td rowspan="2">Ecosystems and Their Interactions
TG: L 1 pp. 1a-27; L2 pp. 27a-49; L3 pp. 49a-71; L4 pp. 79a-97; L5 pp. 97a-125; L6 pp. 125a-147; L7 pp. 147a-179; L9 pp. 199a-221; L10 pp. 221a-243; L11 pp. 243a-249</td>
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</table>

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.]	**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[b]** **Influence of Science, Engineering, and Technology on Society and the Natural World** •The use of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (MS-LS2-5) - - - - - - - - - **Connections to Nature of Science** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** •Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-LS2-3)	reliability of the goods and ecosystem services provided by natural systems are directly affected by the health of those systems." (LS4.D) and **Principle II Concept b:** "that methods used to extract, harvest, transport and consume natural resources influence the geographic extent, composition, biological diversity, and viability of natural systems." (LS2.A) and **Principle III Concept a:** "natural systems proceed through cycles and processes that are required for their functioning." (LS2.B and LS2.C) and **Principle III Concept b:** "human practices depend upon and benefit from the cycles and processes that operate within natural systems." and **Principle III Concept c:** "human practices can alter the cycles and processes that operate within natural systems." and **Principle IV Concept c:** "that the capacity of natural systems to adjust to human-caused alterations depends on the nature of the system as well as the scope, scale, and duration of the activity and the nature of its byproducts." and **Principle V Concept a:** "the spectrum of what is considered in making decisions about resources and natural systems and how those factors influence decisions." (ETS1.B)	

	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) **Science and Engineering Practices** **Developing and Using Models** • Develop a model to describe phenomena. (MS-LS2-3) **Analyzing and Interpreting Data** • Analyze and interpret data to provide evidence for phenomena. (MS-LS2-1) **Engaging in Argument from Evidence** • 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)		

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<table>
<tr><th colspan="4">MS-LS4 Biological Evolution: Unity and Diversity</th></tr>
<tr><th>Performance Expectations</th><th>Connections Between EP&Cs, CCCs, and SEPS</th><th>Clarifications and Connections Between DCIs and EP&Cs</th><th>STCMS</th></tr>
<tr>
<td>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.</td>
<td>Principle II: The long-term functioning and health of terrestrial, freshwater, coastal and marine ecosystems are influenced by their relationships with human societies.
Crosscutting Concepts
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)
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-LS4-6)
- - - - - - - - -
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 and Engineering Practices
Analyzing and Interpreting Data</td>
<td>Disciplinary Core Ideas
As students learn that:
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)” and
LS4.B: Natural Selection “Natural selection leads to the predominance of certain traits in a population, and the suppression of others. (MS-LS4-4)”
Environmental Principle and Concept(s)
Students should be developing an understanding: that
Principle II Concept a:" “direct and indirect changes to natural systems due to the growth of human populations and their consumption rates influence the geographic extent, composition, biological diversity, and viability of natural systems.”
and
Principle II Concept c: “the expansion and operation of human communities influences the geographic extent, composition, biological diversity, and viability of natural systems.”</td>
<td>Earth’s Dynamic Systems
TE: L1 pp. 1a-13a; L6 pp. 111a-141; L8 pp. 165a-329; L9 pp. 241c-275a; L12 pp. 319c-329</td>
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</table>

[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-LS4-6.** Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. [Clarification Statement: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.] [Assessment Boundary: Assessment does not include Hardy Weinberg calculations	•Analyze and interpret data to determine similarities and differences in findings. (MS-LS4-1) **Using Mathematics and Computational Thinking** •Use mathematical representations to support scientific conclusions and design solutions. (MS-LS4-6) **Constructing Explanations and Designing Solutions** •Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-2) - - - - - - - - - **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)		

MS-ESS2 Earth's Systems			
Performance Expectations	**Connections Between EP&Cs, CCCs, and SEPS**	**Clarifications and Connections Between DCIs and EP&Cs**	**STCMS**
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.]	**Principle III:** Natural systems proceed through cycles that humans depend upon, benefit from and can alter. **Crosscutting Concepts** **Energy and Matter**[b] •Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. (MS-ESS2-4) **Cause and Effect** •Cause and effect relationships may 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) **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) **Patterns** •Graphs, charts, and images can be used to identify patterns in data. (MS-ESS3-2)	**Disciplinary Core Ideas** As students learn that: **ESS2.C: The Roles of Water in Earth's Surface Processes** "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) ***Supplemental DCI PS1.A" and **ESS2.C:** "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)" and **ESS2.C:** "Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4)" **Environmental Principle and Concept(s)** Students should be developing an understanding that: **Principle III Concept a:** "that natural systems proceed through cycles and processes that are required for their functioning." and **Principle III Concept b:** "that human practices depend upon and benefit from the cycles and processes that operate within natural systems." and **Principle III Concept c:** "that human practices can alter the	*Weather and Climate Systems* TE: L1 pp. vi-9; L3 pp. 23a-41; L12 pp. 199a-205

	Science and Engineering Practices **Developing and Using Models** • Develop a model to describe unobservable mechanisms. (MS-ESS2-4)	cycles and processes that operate within natural systems."	

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<table>
<tr><th colspan="4">MS-ESS3 Earth and Human Activity</th></tr>
<tr><th>Performance Expectations</th><th>Connections Between EP&Cs, CCCs, and SEPS</th><th>Clarifications and Connections Between DCIs and EP&Cs</th><th>STCMS</th></tr>
<tr>
<td rowspan="2">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</td>
<td>Principle I: The continuation and health of individual human lives and of human communities and societies depend on the health of the natural systems that provide essential goods and ecosystem services.
Principle II: The long-term functioning and health of terrestrial, freshwater, coastal and marine ecosystems are influenced by their relationships with human societies.</td>
<td>Disciplinary Core Ideas
As students learn that:
ESS3.A: Natural Resources "Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources; minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes; and that these resources are distributed unevenly around the planet as a result of past geologic processes. (MS-ESS3-1)"
and
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)"
and
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 rowspan="2">Earth's Dynamic Systems
TE: L1 pp. 1a-13a; L10 pp. 275c-295a; L12 319c-329

Weather and Climate Systems
TE: L1 pp. vi-9; L6 pp. 81a-101; L 7 pp. 101a-117b; L8 pp. 117c-139; L12 pp.199a-205

Ecosystems and Their Interactions
TE: L1 pp. 1a-27; L10 pp. 221a-243: L11 pp. 243a-249

Weather and Climate Systems
TE: L1 pp. vi-9; L11 pp. 175c-199; L12 pp. 199a-205</td>
</tr>
<tr>
<td>Crosscutting Concepts
Cause and Effect
• Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS3-1) (MS-ESS3-4)
• Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. (MS-ESS3-3)
Patterns
• Graphs, charts, and images can be used to identify patterns in data. (MS-ESS3-2)
- - - - - - - - -</td>
<td>Environmental Principle and Concept(s)
Students should be developing an understanding:
Principle I Concept c: "that the quality, quantity and reliability of the goods and ecosystem services provided by natural systems are directly affected by the health of those systems." (ESS3.A and ESS3.B)
and
Principle II Concept c: "that the expansion and operation of human communities influences the geographic extent, composition, biological diversity, and viability of natural systems." (ESS3.C)</td>
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</table>

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 earth-quakes, occur suddenly and with no notice, and thus are not yet predict-able. Examples of natural hazards can be taken from interior processes (such as earth-quakes 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).]	**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 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) (MS-ESS3-4) • 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) (MS-ESS3-3)		

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-ESS3-4.** 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	**Science and Engineering Practices** **Analyzing and Interpreting Data** •Analyze and interpret data to determine similarities and differences in findings. (MS-ESS3-2) **Constructing Explanations and Designing Solutions** •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) •Apply scientific principles to design an object, tool, process or system. (MS-ESS3-3) **Engaging in Argument from Evidence** •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)		

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.]			

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<table>
<tr><th colspan="4">MS-PS1 Matter and its Interactions</th></tr>
<tr><th>Performance Expectations</th><th>Connections Between EP&Cs, CCCs, and SEPS</th><th>Clarifications and Connections Between DCIs and EP&Cs</th><th>STCMS</th></tr>
<tr>
<td rowspan="2">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.]</td>
<td>Principle II: The long-term functioning and health of terrestrial, freshwater, coastal and marine ecosystems are influenced by their relationships with human societies.</td>
<td>Disciplinary Core Ideas
As students learn that:
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-PS1-3)
***Supplemental DCI ESS3.C, LS4.D”[b]</td>
<td rowspan="2">Matter and Its Interactions
TE: L1 pp. vi-16b; L10 pp.193a-218; L11 pp. 219a-226a</td>
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<tr>
<td>Crosscutting Concepts
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)
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
•The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS1-6)
- - - - - - - - -
Connections to Engineering, Technology, and Applications of Science</td>
<td>Environmental Principle and Concept(s)
Students should be developing an understanding:
Principle II Concept b: “that methods used to extract, harvest, transport and consume natural resources influence the geographic extent, composition, biological diversity, and viability of natural systems.”</td>
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	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** • 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) **Science and Engineering Practices** **Obtaining, Evaluating, and Communicating Information** • 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-PS1-3)		

MS-PS3 Energy

Performance Expectations	Connections Between EP&Cs, CCCs, and SEPS	Clarifications and Connections Between DCIs and EP&Cs	STCMS
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	**Principle IV:** The exchange of matter between natural systems and human societies affects the long-term functioning of both. **Crosscutting Concepts** **Energy and Matter** •The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS3-3) **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-PS3-4) **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) **Science and Engineering Practices** **Constructing Explanations and Designing Solutions** •Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system. (MS-PS3-3) **Planning and Carrying Out Investigations**	**Disciplinary Core Ideas** As students learn that: **PS3.B: Conservation of Energy and Energy Transfer** "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)" and **PS3.B:** "when the motion energy of an object changes, there is inevitably some other change in energy at the same time. (MS-PS3–5)" Secondary DCI(s) **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)" **Environmental Principle and Concept(s)** Students should be developing an understanding: **Principle IV Concept a:** "that the effects of human activities on natural systems are directly related to the quantities of resources consumed and to the quantity and characteristics of the resulting byproducts." and **Principle IV Concept c:** "that the capacity of natural systems to adjust to human-caused alterations depends on the nature of the system as well as the scope, scale, and duration of the activity and the nature of its byproducts."	*Electricity, Waves, and Information Transfer* TE: L5 pp. 91a-115a *Matter and Its Interactions* TE: L1 pp. vi-17b; L4 pp. 61c-83b; L8 pp. 163a-181b; L11 pp. 219a-226a *Electricity, Waves, and Information Transfer* TE: L 5 pp 91a-115a; L10 pp. 201c-219a *Weather and Climate Systems* TE: L1 pp. vi-9; L2 pp. 9a-23; L12 pp. 199a-205

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.]	• 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) - - - - - - - - - **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)		

Appropriate Alignments among *Environmental Principles and Concepts (EP&Cs)* and *CA NGSS:* Grade Six, Seven & Eight

<table>
<tr><th colspan="4">MS-ETS1 Engineering Design</th></tr>
<tr><th>Performance Expectations</th><th>Connections Between EP&Cs, CCCs, and SEPS</th><th>Clarifications and Connections Between DCIs and EP&Cs</th><th>STCMS</th></tr>
<tr>
<td rowspan="3">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.</td>
<td>Principle V: Decisions affecting resources and natural systems are based on a wide range of considerations and decision-making processes.</td>
<td>Disciplinary Core Ideas
As students recognize that:
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. (MS-ETS1-3)”</td>
<td rowspan="3">Matter and Its Interactions
TE: L8 pp. 163a-181b; L11 pp. 219a-226a

Energy, Forces, and Motion
TE: L1 pp. iv-13; L6 pp. 81a-103; L8 pp. 123a-141; L9 pp. 141a-153

Electricity, Waves, and Information Transfer
TE: L5 pp. 91a-115a; L8 pp. 157c-177

Earth’s Dynamic Systems
TE: L2 pp. 13c-39a</td>
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<td>Crosscutting Concepts
Structure and Function
•Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts; therefore, complex natural and designed structures/systems can be analyzed to determine how they function. (MS-LS3-1)</td>
<td>Environmental Principle and Concept(s)
Students should be developing an understanding:
Principle V Concept a: “the spectrum of what is considered in making decisions about resources and natural systems and how those factors influence decisions.”</td>
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<td>Science and Engineering Practices
Analyzing and Interpreting Data
•Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3)</td>
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