NEXT GENERATION SCIENCE STANDARDS

Inspire Biology is designed to meet 100% of the Next Generation Science Standards through both print and digital resources. The Student Edition, accessible in print and online, can be used as a research tool by students as they investigate concepts and collect evidence. Interactive Digital Content, labs, and projects that support the Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts, as well as CCSS Mathematics and ELA/Literacy, are available online.

Correlation of *Inspire Biology* to the NGSS

HS-LS1	From Molecules to Organisms: Structures and Processes	
HS-LS1-1.	**Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.** *[Assessment Boundary: Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis.]*	**Online:** Applying Practices: *Transcription and Translation* STEM Unit Project 3

SEP Science and Engineering Practices

Constructing Explanations and Designing Solutions • Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) 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.	**Online:** *Science and Engineering Practices Handbook:* Practice 6

DCI Disciplinary Core Ideas

LS1.A: Structure and Function • Systems of specialized cells within organisms help them perform the essential functions of life.	**Student Edition:** 7, 10 Q2, 242–243, 513–517, 520, 539, 548, 552, 598–602, 603–608, 609–613, 610 Get It?, 619–624, 631–634, 645–653, 654 Q5, 655–658, 660–663, 670–674, 681–687, 693–698, 725–733
• All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (Note: This Disciplinary Core Idea is also addressed by HS-LS3-1.)	**Student Edition:** 156–157, 167, 186, 222, 231, 244 Q1, 288–295, 296–298, 299–305, 305 Q1, 306–314, 330–331

CCC Crosscutting Concepts

Structure and Function • Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.	**Online:** *Science and Engineering Practices Handbook*

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CCSS ELA/Literacy	
RST.11-12.1, WHST.9–12.2.a–e	**Online:** Applying Practices: *Transcription and Translation* STEM Unit Project 3

HS-LS1	From Molecules to Organisms: Structures and Processes	
HS-LS1-2.	**Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.** *[Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] [Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.]*	**Online:** Applying Practices: *Hierarchical Organization in Plants* STEM Unit Project 5 STEM Unit Project 6
SEP Science and Engineering Practices		
Developing and Using Models • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.		**Online:** *Science and Engineering Practices Handbook:* Practice 2
DCI Disciplinary Core Ideas		
LS1.A: Structure and Function • Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.		**Student Edition:** 7, 8, 10 Q2, 504, 531 Q3, 539, 543, 598–602, 599 Get It?, 603–608, 609–613, 619–624,624 Q2, 631–634, 645–653, 655–658, 660–663, 670–674, 681–687, 693–698, 725–733
CCC Crosscutting Concepts		
Systems and System Models • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.		**Online:** *Science and Engineering Practices Handbook*
CCSS ELA/Literacy		
SL.11-12.5		**Online:** Applying Practices: *Hierarchical Organization in Plants* STEM Unit Project 5 STEM Unit Project 6

HS-LS1	From Molecules to Organisms: Structures and Processes	
HS-LS1-3.	**Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.** *[Clarification Statement: Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels.] [Assessment Boundary: Assessment does not include the cellular processes involved in the feedback mechanism.]*	**Online:** Applying Practices: *Investigate Osmosis* STEM Unit Project 2 STEM Unit Project 6

SEP Science and Engineering Practices

Planning and Carrying Out Investigations • Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.	**Online:** *Science and Engineering Practices Handbook:* Practice 3
Connections to Nature of Science **Scientific Investigations Use a Variety of Methods** • Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings.	**Online:** *Science and Engineering Practices Handbook:* Practice 3 **Student Edition:** 11–16

DCI Disciplinary Core Ideas

LS1.A: Structure and Function • Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system.	**Student Edition:** 10, 605, 605 Get it?, 608, 681–687, 684 Get It?, 687 Q1, 694, 695, 697, 698, 698 Q5, 710 Q6

CCC Crosscutting Concepts

Stability and Change • Feedback (negative or positive) can stabilize or destabilize a system.	**Online:** *Science and Engineering Practices Handbook* **Student Edition:** 10

CCSS ELA/Literacy

WHST.9–12.7, WHST.11-12.8	**Online:** Applying Practices: *Investigate Osmosis* STEM Unit Project 2 STEM Unit Project 6

HS-LS1	From Molecules to Organisms: Structures and Processes	
HS-LS1-4.	**Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.** *[Assessment Boundary: Assessment does not include specific gene control mechanisms or rote memorization of the steps of mitosis.]*	**Online:** Applying Practices: *Mitosis and Cellular Differentiation* STEM Unit Project 2
SEP Science and Engineering Practices		
Developing and Using Models • Use a model based on evidence to illustrate the relationships between systems or between components of a system.		**Online:** *Science and Engineering Practices Handbook:* Practice 2
DCI Disciplinary Core Ideas		
LS1.B: Growth and Development of Organisms • In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism.		**Student Edition:** 220–230, 242–243, 244 Q4, 542–543, 700
CCC Crosscutting Concepts		
Systems and System Models • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.		**Online:** Science and Engineering Practices Handbook **Student Edition:** 45
CCSS Mathematics		
MP.4, F-IF.7.a-e, F-BF.1.a-c		**Online:** Applying Practices: *Mitosis and Cellular Differentiation* STEM Unit Project 2
CCSS ELA/Literacy		
SL.11-12.5		**Online:** Applying Practices: *Mitosis and Cellular Differentiation* STEM Unit Project 2

HS-LS1	From Molecules to Organisms: Structures and Processes	
HS-LS1-5.	**Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.** *[Clarification Statement: Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Examples of models could include diagrams, chemical equations, and conceptual models.] [Assessment Boundary: Assessment does not include specific biochemical steps.]*	**Online:** Applying Practices: *Modeling Photosynthesis* STEM Unit Project 2
SEP Science and Engineering Practices		
Developing and Using Models • Use a model based on evidence to illustrate the relationships between systems or between components of a system.		**Online:** *Science and Engineering Practices Handbook:* Practice 2
DCI Disciplinary Core Ideas		
LS1.C: Organization for Matter and Energy Flow in Organisms • The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen.		**Student Edition:** 35, 41, 187, 200, 202–208, 208 Q1, 214, 506
CCC Crosscutting Concepts		
Energy and Matter • Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.		**Online:** *Science and Engineering Practices Handbook* **Student Edition:** 39–44, 139–140, 198
CCSS ELA/Literacy		
SL.11-12.5		**Online:** Applying Practices: *Modeling Photosynthesis* STEM Unit Project 2

HS-LS1	From Molecules to Organisms: Structures and Processes	
HS-LS1-6.	**Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.** *[Clarification Statement: Emphasis is on using evidence from models and simulations to support explanations.] [Assessment Boundary: Assessment does not include the details of the specific chemical reactions or identification of macromolecules.]*	**Online:** Applying Practices: *Exploring Macromolecules* STEM Unit Project 2
SEP Science and Engineering Practices		
Constructing Explanations and Designing Solutions • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) 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.		**Online:** *Science and Engineering Practices Handbook:* Practice 6
DCI Disciplinary Core Ideas		
LS1.C: Organization for Matter and Energy Flow in Organisms • The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells.		**Student Edition:** 151–157, 157 Q6, 202, 207–208, 208 Q2
• As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.		**Student Edition:** 35–38, 39–44, 39 figure 17 caption question, 129, 198, 200–201, 202–208, 208 Q2, 210–214, 675–677
CCC Crosscutting Concepts		
Energy and Matter • Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.		**Online:** *Science and Engineering Practices Handbook* **Student Edition:** 39–44, 139–140, 198
CCSS ELA/Literacy		
WHST.9–12.9		**Online:** Applying Practices: *Exploring Macromolecules* STEM Unit Project 2

HS-LS1	From Molecules to Organisms: Structures and Processes	
HS-LS1-7.	**Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.** *[Clarification Statement: Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration.] [Assessment Boundary: Assessment should not include identification of the steps or specific processes involved in cellular respiration.]*	**Online:** Applying Practices: *Modeling Cellular Respiration* STEM Unit Project 2
SEP Science and Engineering Practices		
Developing and Using Models • Use a model based on evidence to illustrate the relationships between systems or between components of a system.		**Online:** *Science and Engineering Practices Handbook: Practice 2*
DCI Disciplinary Core Ideas		
LS1.C: Organization for Matter and Energy Flow in Organisms • As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.		**Student Edition:** 35–38, 39–44, 39 figure 17 caption question, 129, 198, 200–201, 202–208, 208 Q2, 210–214, 675–677
• As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment.		**Student Edition:** 140, 200, 209–214, 214 Q1
CCC Crosscutting Concepts		
Energy and Matter • Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems.		**Online:** *Science and Engineering Practices Handbook* **Student Edition:** 39–44, 139–140, 198
CCSS ELA/Literacy		
SL.11-12.5		**Online:** Applying Practices: *Modeling Cellular Respiration* STEM Unit Project 2

HS-LS2	Ecosystems: Interactions, Energy, and Dynamics	
HS-LS2-1.	**Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.** *[Clarification Statement: Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate, and competition. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from simulations or historical data sets.] [Assessment Boundary: Assessment does not include deriving mathematical equations to make comparisons.]*	**Online:** Applying Practices: *Carrying Capacity of Nectar-Feeding Bats* STEM Unit Project 1
SEP Science and Engineering Practices		
Using Mathematics and Computational Thinking • Use mathematical and/or computational representations of phenomena or design solutions to support explanations.		**Online:** *Science and Engineering Practices Handbook:* Practice 5
DCI Disciplinary Core Ideas		
LS2.A: Interdependent Relationships in Ecosystems • Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.		**Student Edition:** 28–30, 32–34, 34 Q1, 77–85, 85 Q2, 86–87, 91–92
CCC Crosscutting Concepts		
Scale, Proportion, and Quantity • The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.		**Online:** *Science and Engineering Practices Handbook*
CCSS Mathematics		
MP.2, MP.4, N-Q.1-3		**Online:** Applying Practices: *Carrying Capacity of Nectar-Feeding Bats* STEM Unit Project 1
CCSS ELA/Literacy		
RST.11-12.1, WHST.9–12.2.a–e		**Online:** Applying Practices: *Carrying Capacity of Nectar-Feeding Bats* STEM Unit Project 1

HS-LS2	Ecosystems: Interactions, Energy, and Dynamics	
HS-LS2-2.	**Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.** *[Clarification Statement: Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data.] [Assessment Boundary: Assessment is limited to provided data.]*	**Online:** Applying Practices: *Biodiversity in Leaf Litter* STEM Unit Project 1

SEP Science and Engineering Practices	
Using Mathematics and Computational Thinking • Use mathematical representations of phenomena or design solutions to support and revise explanations.	**Online:** *Science and Engineering Practices Handbook:* Practice 5
Scientific Knowledge is Open to Revision in Light of New Evidence • Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence.	**Online:** *Science and Engineering Practices Handbook:* Practice 6, Practice 7 **Student Edition:** 13–15

DCI Disciplinary Core Ideas	
LS2.A: Interdependent Relationships in Ecosystems • Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.	**Student Edition:** 28–30, 32–34, 34 Q1, 77–85, 85 Q2, 86–87, 91–92
LS2.C: Ecosystem Dynamics, Functioning, and Resilience • A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.	**Student Edition:** 50–53, 53 Get It?, 53 Q3, Q6, 105–112, 115–120

CCC Crosscutting Concepts	
Scale, Proportion, and Quantity • Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale.	**Online:** *Science and Engineering Practices Handbook*

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CCSS Mathematics	
MP.2, MP.4, N-Q.1-3	**Online:** Applying Practices: *Biodiversity in Leaf Litter* STEM Unit Project 1
CCSS ELA/Literacy	
RST.11-12.1, WHST.9–12.2.a–e	**Online:** Applying Practices: *Biodiversity in Leaf Litter* STEM Unit Project 1

HS-LS2	**Ecosystems: Interactions, Energy, and Dynamics**	
HS-LS2-3.	**Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.** *[Clarification Statement: Emphasis is on conceptual understanding of the role of aerobic and anaerobic respiration in different environments.] [Assessment Boundary: Assessment does not include the specific chemical processes of either aerobic or anaerobic respiration.]*	**Online:** Applying Practices: *The Cycling of Matter and Flow of Energy in Aerobic and Anaerobic Conditions* STEM Unit Project 1
SEP Science and Engineering Practices		
Constructing Explanations and Designing Solutions • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) 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.		**Online:** *Science and Engineering Practices Handbook:* Practice 6
Connections to Nature of Science **Scientific Knowledge is Open to Revision in Light of New Evidence** • Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence.		**Online:** *Science and Engineering Practices Handbook:* Practice 6, Practice 7 **Student Edition:** 13–15
DCI Disciplinary Core Ideas		
LS2.B: Cycles of Matter and Energy Transfer in Ecosystems • Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes.		**Student Edition:** 35–39, 198, 200–201, 202–208, 201 Q 6, 209–214, 456

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CCC Crosscutting Concepts	
Energy and Matter • Energy drives the cycling of matter within and between systems.	**Online:** *Science and Engineering Practices Handbook* **Student Edition:** 39–44, 139–140, 198
CCSS ELA/Literacy	
RST.11–12.1, WHST.9–12.2.a–e, WHST.9–12.5	**Online:** Applying Practices: *The Cycling of Matter and Flow of Energy in Aerobic and Anaerobic Conditions* STEM Unit Project 1

HS–LS2	Ecosystems: Interactions, Energy, and Dynamics	
HS–LS2–4.	**Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.** *[Clarification Statement: Emphasis is on using a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and that matter and energy are conserved as matter cycles and energy flows through ecosystems. Emphasis is on atoms and molecules such as carbon, oxygen, hydrogen and nitrogen being conserved as they move through an ecosystem.] [Assessment Boundary: Assessment is limited to proportional reasoning to describe the cycling of matter and flow of energy.]*	**Online:** Applying Practices: *Ecological Pyramids* STEM Unit Project 1
SEP Science and Engineering Practices		
Using Mathematics and Computational Thinking • Use mathematical representations of phenomena or design solutions to support claims.		**Online:** *Science and Engineering Practices Handbook:* Practice 5
DCI Disciplinary Core Ideas		
LS2.B: Cycles of Matter and Energy Transfer in Ecosystems • Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved.		**Student Edition:** 35–38, 38 Q3, Q5–6, 39–44, 198, 200, 481

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CCC Crosscutting Concepts	
Energy and Matter • Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems.	**Online:** *Science and Engineering Practices Handbook* **Student Edition:** 39–44, 139–140, 198
CCSS Mathematics	
MP.2, MP.4, N-Q.1-3	**Online:** Applying Practices: *Ecological Pyramids* STEM Unit Project 1

HS-LS2	Ecosystems: Interactions, Energy, and Dynamics	
HS-LS2-5.	**Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.** *[Clarification Statement: Examples of models could include simulations and mathematical models.] [Assessment Boundary: Assessment does not include the specific chemical steps of photosynthesis and respiration.]*	**Online:** **Applying Practices:** *Modeling the Carbon Cycle* STEM Unit Project 2
SEP Science and Engineering Practices		
Developing and Using Models • Develop a model based on evidence to illustrate the relationships between systems or components of a system.		**Online:** *Science and Engineering Practices Handbook:* Practice 2
DCI Disciplinary Core Ideas		
LS2.B: Cycles of Matter and Energy Transfer in Ecosystems • Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes.		**Student Edition:** 39, 41, 44 Q6, 67, 200
PS3.D: Energy in Chemical Processes • The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis.		**Student Edition:** 35, 198, 200, 201 Q1, 202–208
CCC Crosscutting Concepts		
Systems and System Models • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.		**Online:** *Science and Engineering Practices Handbook*

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HS-LS2	Ecosystems: Interactions, Energy, and Dynamics	
HS-LS2-6.	**Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.** *[Clarification Statement: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise.]*	**Online:** Applying Practices: *Local Ecosystem Dynamics* STEM Unit Project 1

SEP Science and Engineering Practices	
Engaging in Argument from Evidence • Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.	**Online:** *Science and Engineering Practices Handbook:* Practice 7
Connections to Nature of Science **Scientific Knowledge is Open to Revision in Light of New Evidence** • Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in revision of an explanation.	**Online:** *Science and Engineering Practices Handbook:* Practice 1, Practice 7, Practice 8

DCI Disciplinary Core Ideas	
LS2.C: Ecosystem Dynamics, Functioning, and Resilience • A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.	**Student Edition:** 50–53, 53 Get It?, 53 Q3 Q6, 105–112, 115–120

CCC Crosscutting Concepts	
Stability and Change • Much of science deals with constructing explanations of how things change and how they remain stable.	**Online:** *Science and Engineering Practices Handbook*

CCSS Mathematics	
MP.2, S-ID.1, S-IC.1, S-IC.6	**Online:** *Applying Practices: Local Ecosystem Dynamics* STEM Unit Project 1

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CCSS ELA/Literacy	
RST.11-12.1, RST.11-12.7, RST.9-10.8, RST.11-12.8.a–e	**Online:** Applying Practices: *Local Ecosystem Dynamics* STEM Unit Project 1

HS-LS2	**Ecosystems: Interactions, Energy, and Dynamics**	
HS-LS2-7.	**Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*** *[Clarification Statement: Examples of human activities can include urbanization, building dams, and dissemination of invasive species.]*	**Online:** Applying Practices: *Microbeads, Mega–Problem* STEM Unit Project 1
SEP Science and Engineering Practices		
Constructing Explanations and Designing Solutions • Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.		**Online:** *Science and Engineering Practices Handbook:* Practice 6
DCI Disciplinary Core Ideas		
LS2.C: Ecosystem Dynamics, Functioning, and Resilience • Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species.		**Student Edition:** 6, 55, 56, 70, 104, 105–112, 110 Get It?, 112 Q12, 113–120, 573, 575, 577, 580
LS4.D: Biodiversity and Humans • Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). (secondary to HS-LS2-7)		**Student Edition:** 98–100, 104 Q2, 105–106, 385, 388
• Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (secondary to HS-LS2-7) (Note: This Disciplinary Core Idea is also addressed by HS-LS4-6.)		**Student Edition:** 6, 55, 56, 70, 101–104, 104 Q1, 105–112, 113–120, 573, 575, 577, 580
ETS1.B: Developing Possible Solutions • When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. (secondary to HS-LS2-7)		**Online:** *Science and Engineering Practices Handbook:* Practice 6 **Student Edition:** 115–120, 120 Q4

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CCC Crosscutting Concepts	
Stability and Change • Much of science deals with constructing explanations of how things change and how they remain stable.	**Online:** *Science and Engineering Practices Handbook*
CCSS Mathematics	
MP.2, N-Q.1-3	**Online:** Applying Practices: *Microbeads, Mega-Problem* STEM Unit Project 1
CCSS ELA/Literacy	
RST.11-12.7, RST.9-10.8, RST.11-12.8.a–e, WHST.9–12.7	**Online:** Applying Practices: *Microbeads, Mega-Problem* STEM Unit Project 1

HS-LS2	Ecosystems: Interactions, Energy, and Dynamics	
HS-LS2-8.	**Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.** *[Clarification Statement: Emphasis is on: (1) distinguishing between group and individual behavior, (2) identifying evidence supporting the outcomes of group behavior, and (3) developing logical and reasonable arguments based on evidence. Examples of group behaviors could include flocking, schooling, herding, and cooperative behaviors such as hunting, migrating, and swarming.]*	**Online:** Applying Practices: *Investigating Group Behavior* STEM Unit Project 1 STEM Unit Project 5
SEP Science and Engineering Practices		
Engaging in Argument from Evidence • Evaluate the evidence behind currently accepted explanations to determine the merits of arguments.		**Online:** *Science and Engineering Practices Handbook:* Practice 7
DCI Disciplinary Core Ideas		
LS2.D: Social Interactions and Group Behavior • Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives.		**Student Edition:** 583–590, 589 Get It?, 590 Q3
CCC Crosscutting Concepts		
Cause and Effect • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.		**Online:** *Science and Engineering Practices Handbook*

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CCSS ELA/Literacy	
RST.11-12.1, RST.11-12.7, RST.9-10.8, RST.11-12.8.a–e	**Online:** Applying Practices: *Investigating Group Behavior* STEM Unit Project 1 STEM Unit Project 5

HS-LS3	**Heredity: Inheritance and Variation of Traits**	
HS-LS3-1.	**Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.** *[Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]*	**Online:** Applying Practices: *Meiosis* STEM Unit Project 2
SEP Science and Engineering Practices		
Asking Questions and Defining Problems • Ask questions that arise from examining models or a theory to clarify relationships.		**Online:** *Science and Engineering Practices Handbook:* Practice 1
DCI Disciplinary Core Ideas		
LS1.A: Structure and Function • All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. (secondary to HS-LS3-1) (Note: This Disciplinary Core Idea is also addressed by HS-LS1-1.)		**Student Edition:** 156–157, 167, 186, 222, 231, 244 Q1, 288–295, 296–298, 299–305, 305 Q1, 306–314, 330–331
LS3.A: Heredity: Inheritance of Traits • Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function.		**Student Edition:** 222, 231, 288–295, 296–298, 296 Fig 9 Caption question, 301, 305 Q3, 308, 309 Get It?, 314 Q5, 330, 331, 338, 338 Q5
CCC Crosscutting Concepts		
Cause and Effect • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.		**Online:** *Science and Engineering Practices Handbook*
CCSS ELA/Literacy		
RST.11-12.1, RST.11-12.9		**Online:** Applying Practices: *Meiosis* STEM Unit Project 2

NEXT GENERATION SCIENCE STANDARDS

HS-LS3	**Heredity: Inheritance and Variation of Traits**	
HS-LSS3-2.	**Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.** *[Clarification Statement: Emphasis is on using data to support arguments for the way variation occurs.] [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]*	**Online:** Applying Practices: *Investigating Genetic Variation* STEM Unit Project 3
SEP Science and Engineering Practices		
Engaging in Argument from Evidence • *Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence.*		**Online:** *Science and Engineering Practices Handbook:* Practice 6
DCI Disciplinary Core Ideas		
LS3.B: Variation of Traits • In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited.		**Student Edition:** 233–236, 261, 309–314, 312 Get It?, 314 Q2, Q4, 384
• Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors.		**Student Edition:** 281–282, 282 Q5
CCC Crosscutting Concepts		
Cause and Effect • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.		**Online:** *Science and Engineering Practices Handbook*
CCSS Mathematics		
MP.2		**Online:** Applying Practices: *Investigating Genetic Variation* STEM Unit Project 3
CCSS ELA/Literacy		
RST.11-12.1, RST.11-12.9, WHST.9–12.1.a–e		**Online:** Applying Practices: *Investigating Genetic Variation* STEM Unit Project 3

HS-LS3	Heredity: Inheritance and Variation of Traits	
HS-LS3-3.	**Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.** *[Clarification Statement: Emphasis is on the use of mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits.] [Assessment Boundary: Assessment does not include Hardy-Weinberg calculations.]*	**Online:** Applying Practices: *Punnett Squares* STEM Unit Project 3
SEP Science and Engineering Practices		
Analyzing and Interpreting Data • Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.		**Online:** *Science and Engineering Practices Handbook:* Practice 4
DCI Disciplinary Core Ideas		
LS3.B: Variation of Traits • Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors.		**Student Edition:** 281–282, 282 Q5
CCC Crosscutting Concepts		
Scale, Proportion, and Quantity • Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).		**Online:** *Science and Engineering Practices Handbook*
Connections to Nature of Science **Science is a Human Endeavor** • Technological advances have influenced the progress of science and science has influenced advances in technology.		**Online:** *Science and Engineering Practices Handbook*
• Science and engineering are influenced by society and society is influenced by science and engineering.		Online: Science and Engineering Practices Handbook
CCSS Mathematics		
MP.2		**Online:** Applying Practices: *Punnett Squares* STEM Unit Project 3

HS-LS4	Biological Evolution: Unity and Diversity	
HS-LS4-1.	**Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.** *[Clarification Statement: Emphasis is on a conceptual understanding of the role each line of evidence has relating to common ancestry and biological evolution. Examples of evidence could include similarities in DNA sequences, anatomical structures, and order of appearance of structures in embryological development.]*	**Online:** *Applying Practices: Evidence for Evolution* STEM Unit Project 4 STEM Unit Project 5

SEP Science and Engineering Practices	
Obtaining, Evaluating, and Communicating Information • Communicate scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).	**Online:** *Science and Engineering Practices Handbook:* Practice 8
Connections to Nature of Science **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** • A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.	**Online:** *Science and Engineering Practices Handbook:* Practice 6 **Student Edition:** 11

DCI Disciplinary Core Ideas	
LS4.A: Evidence of Common Ancestry and Diversity • Genetic information, like the fossil record, provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence.	**Student Edition:** 331, 360 Get It?, 362 Q4, 373–378, 380 Q3 and Q4, 404, 434–436, 436 CCC activity

CCC Crosscutting Concepts	
Patterns • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.	**Online:** *Science and Engineering Practices Handbook*
Connections to Nature of Science **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** • Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future.	**Online:** *Science and Engineering Practices Handbook* **Student Edition:** 11–16

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CCSS Mathematics	
MP.2	**Online:** Applying Practices: *Evidence for Evolution* STEM Unit Project 4 STEM Unit Project 5
CCSS ELA/Literacy	
RST.11-12.1, WHST.9–12.2.a–e, WHST.9–12.9, SL.11-12.4	**Online:** Applying Practices: *Evidence for Evolution* STEM Unit Project 4 STEM Unit Project 5

HS-LS4	**Biological Evolution: Unity and Diversity**	
HS-LS4-2.	**Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.** *[Clarification Statement: Emphasis is on using evidence to explain the influence each of the four factors has on number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Examples of evidence could include mathematical models such as simple distribution graphs and proportional reasoning.] [Assessment Boundary: Assessment does not include other mechanisms of evolution, such as genetic drift, gene flow through migration, and co-evolution.]*	**Online:** Applying Practices: *Pest Management and Natural Selection* STEM Unit Project 4
SEP Science and Engineering Practices		
Constructing Explanations and Designing Solutions • Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) 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.		**Online:** *Science and Engineering Practices Handbook:* Practice 6

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DCI Disciplinary Core Ideas	
LS4.B: Natural Selection • Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals.	**Student Edition:** 370–372, 372 Q3 and Q4, 384, 723
LS4.C: Adaptation • Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment.	**Student Edition:** 370–372, 372 Q3, 381–391
CCC Crosscutting Concepts	
Cause and Effect • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	**Online:** *Science and Engineering Practices Handbook*
CCSS Mathematics	
MP.2, MP.4	**Online:** Applying Practices: *Pest Management and Natural Selection* STEM Unit Project 4
CCSS ELA/Literacy	
RST.11-12.1, WHST.9–12.2.a–e, WHST.9–12.9, SL.11-12.4	**Online:** Applying Practices: *Pest Management and Natural Selection* STEM Unit Project 4

HS-LS4	Biological Evolution: Unity and Diversity	
HS-LS4-3.	**Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.** *[Clarification Statement: Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations.] [Assessment Boundary: Assessment is limited to basic statistical and graphical analysis. Assessment does not include allele frequency calculations.]*	**Online:** Applying Practices: *Could You Beat Natural Selection Using Camouflage?* STEM Unit Project 4

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SEP Science and Engineering Practices	
Analyzing and Interpreting Data • Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.	**Online:** *Science and Engineering Practices Handbook:* Practice 4
DCI Disciplinary Core Ideas	
LS4.B: Natural Selection • Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals.	**Student Edition:** 370–372, 372 Q3 and Q4, 384, 723
• The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population.	**Student Edition:** 370–372, 384–386, 391 Q4, 723
• Adaptation also means that the distribution of traits in a population can change when conditions change.	**Student Edition:** 378–380, 384–386, 391 Q4, 410, 458, 458 Get It?
CCC Crosscutting Concepts	
Patterns • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.	**Online:** *Science and Engineering Practices Handbook*
CCSS Mathematics	
MP.2	**Online:** Applying Practices: *Could You Beat Natural Selection Using Camouflage?* STEM Unit Project 4
CCSS ELA/Literacy	
RST.11-12.1, WHST.9–12.2.a–e, WHST.9–12.9	**Online:** Applying Practices: *Could You Beat Natural Selection Using Camouflage?* STEM Unit Project 4

HS-LS4	Biological Evolution: Unity and Diversity	
HS-LS4-4.	**Construct an explanation based on evidence for how natural selection leads to adaptation of populations.** *[Clarification Statement: Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other organisms) contribute to a change in gene frequency over time, leading to adaptation of populations.]*	**Online:** Applying Practices: *Can Scientists Model Natural Selection?* STEM Unit Project 4 STEM Unit Project 5
SEP Science and Engineering Practices		
Constructing Explanations and Designing Solutions • Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) 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.		**Online:** *Science and Engineering Practices Handbook:* Practice 6
DCI Disciplinary Core Ideas		
LS4.C: Adaptation • Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not.		**Student Edition:** 370–372, 372 Q4, 378–380, 384–386, 410, 723
CCC Crosscutting Concepts		
Cause and Effect • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.		**Online:** *Science and Engineering Practices Handbook*
Connections to Nature of Science **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** • Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future.		**Online:** *Science and Engineering Practices Handbook* **Student Edition:** 11–16
CCSS Mathematics		
MP.2		**Online:** Applying Practices: *Can Scientists Model Natural Selection?* STEM Unit Project 4 STEM Unit Project 5

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CCSS ELA/Literacy	
RST.11-12.1, WHST.9–12.2.a–e, WHST.9–12.9	**Online:** Applying Practices: *Can Scientists Model Natural Selection?* STEM Unit Project 4 STEM Unit Project 5

HS-LS4	Biological Evolution: Unity and Diversity	
HS-LS4-5.	**Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.** *[Clarification Statement: Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.]*	**Online:** Applying Practices: *Evaluating Impacts of Environmental Change on Populations* STEM Unit Project 5
SEP Science and Engineering Practices		
Engaging in Argument from Evidence • Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments.		**Online:** *Science and Engineering Practices Handbook:* Practice 7
DCI Disciplinary Core Ideas		
LS4.C: Adaptation • Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species.		**Student Edition:** 98; 105–112; 110 Get It?; 112 Q1, 2, 3; 378; 385; 484–486; 573; 575; 577; 580
• Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost.		**Student Edition:** 98, 105–112, 112 Q1, 378, 458, 458 Get It?, 573, 575, 577, 580
CCC Crosscutting Concepts		
Cause and Effect • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.		**Online:** *Science and Engineering Practices Handbook*

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CCSS Mathematics	
MP.2	**Online:** Applying Practices: *Evaluating Impacts of Environmental Change on Populations* STEM Unit Project 5
CCSS ELA/Literacy	
RST.11-12.8, WHST.9–12.9	**Online:** Applying Practices: *Evaluating Impacts of Environmental Change on Populations* STEM Unit Project 5

HS-LS4	**Biological Evolution: Unity and Diversity**	
HS-LS4-6.	**Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.*** *[Clarification Statement: Emphasis is on designing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of organisms for multiple species.]*	**Online:** Applying Practices: *Cleaning Up an Oil Spill* STEM Unit Project 1
SEP Science and Engineering Practices		
Using Mathematics and Computational Thinking • Create or revise a simulation of a phenomenon, designed device, process, or system.		**Online:** *Science and Engineering Practices Handbook:* Practice 5
DCI Disciplinary Core Ideas		
LS4.C: Adaptation • Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species.		**Student Edition:** 98; 105–112; 110 Get It?; 112 Q1, 2, 3; 378; 484–486; 573; 575; 577; 580
LS4.D: Biodiversity and Humans • Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (Note: This Disciplinary Core Idea is also addressed by HS-LS2-7.)		**Student Edition:** 6, 55, 56, 70, 101–104, 104 Q1, 105–112, 113–120, 573, 575, 577, 580

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DCI Disciplinary Core Ideas	
ETS1.B: Developing Possible Solutions • When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (secondary to HS-LS4-6)	**Online:** *Science and Engineering Practices Handbook:* Practice 1, Practice 6 **Student Edition:** 115–120, 120 Q4
• Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. (secondary to HS-LS4-6)	**Online:** *Science and Engineering Practices Handbook*: Practice 2, Practice 5, Practice 6 **Student Edition:** 26, 26 Get It?, p 30 CCC activity
CCC Crosscutting Concepts	
Cause and Effect • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	**Online:** *Science and Engineering Practices Handbook*
CCSS ELA/Literacy	
WHST.9–12.5, WHST.9–12.7	**Online:** Applying Practices: *Cleaning Up an Oil Spill* STEM Unit Project 1

HS-ETS1	Engineering Design	
HS-ETS1-1.	**Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.**	**Online:** Applying Practices: *Engineer a Better World: Analyze a Major Global Challenge* STEM Unit Project 1
SEP Science and Engineering Practices		
Asking Questions and Defining Problems • Analyze complex real-world problems by specifying criteria and constraints for successful solutions.		**Online:** *Science and Engineering Practices Handbook:* Practice 1
DCI Disciplinary Core Ideas		
ETS1.A: Defining and Delimiting Engineering Problems • Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.		*Science and Engineering Practices Handbook:* Practice 1, Practice 6

NEXT GENERATION SCIENCE STANDARDS

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DCI Disciplinary Core Ideas	
• Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.	**Online:** *Science and Engineering Practices Handbook:* Introduction, All Practices **Student Edition:** 6, 10 Q3, 87, 113-120, 215
CCC Crosscutting Concepts	
Connections to Engineering, Technology,and Applications of Science **Influence of Science, Engineering, and Technology on Society and the Natural World** • New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.	**Online:** *Science and Engineering Practices Handbook* **Student Edition:** 6, 15–16, 17, 45, 215, 315, 339, 499, 640, 665

HS-ETS1	Engineering Design	
HS-ETS1-2.	**Design a solution to a complex real-world problem by breaking it down into smaller, moremanageable problems that can be solved through engineering.**	**Online:** Applying Practices: *Engineer a Better World: Design a Solution* STEM Unit Project 1 STEM Unit Project 6
SEP Science and Engineering Practices		
Constructing Explanations and Designing Solutions • Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.		**Online:** *Science and Engineering Practices Handbook:* Practice 6
DCI Disciplinary Core Ideas		
ETS1.C: Optimizing the Design Solution • Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.		**Online:** *Science and Engineering Practices Handbook*: Practice 1, Practice 6

HS-ETS1	Engineering Design	
HS-ETS1-3.	**Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.**	**Online:** Applying Practices: *Engineer a Better World: Evaluate a Solution* STEM Unit Project 1 STEM Unit Project 2 STEM Unit Project 6

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SEP Science and Engineering Practices	
Constructing Explanations and Designing Solutions • Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.	**Online:** *Science and Engineering Practices Handbook:* Practice 6
DCI Disciplinary Core Ideas	
ETS1.B: Developing Possible Solutions • When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.	**Online:** *Science and Engineering Practices Handbook:* Practice 1, Practice 6 **Student Edition:** 15–20, 120 Q4
CCC Crosscutting Concepts	
Connections to Engineering, Technology,and Applications of Science **Influence of Science, Engineering, and Technology on Society and the Natural World** • New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.	**Online:** *Science and Engineering Practices Handbook* **Student Edition:** 6, 15–16, 17, 45, 215, 315, 339, 499, 640, 665

HS-ETS1	Engineering Design	
HS-ETS1-4 .	**Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.**	**Online:** Applying Practices: *Engineer a Better World: Use a Computer Simulation* STEM Unit Project 1
SEP Science and Engineering Practices		
Constructing Explanations and Designing Solutions • Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems.		**Online:** *Science and Engineering Practices Handbook:* Practice 5
DCI Disciplinary Core Ideas		
ETS1.B: Developing Possible Solutions • Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.		**Online:** *Science and Engineering Practices Handbook:* Practice 2, Practice 5, Practice 6 **Student Edition:** 26, 26 Get It?, 30 CCC activity
CCC Crosscutting Concepts		
Systems and System Models • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.		**Online:** *Science and Engineering Practices Handbook*

HS-ESS1	Earth's Place in the Universe	
HS-ESS1-5	**Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.** *[Clarification Statement: Emphasis is on the ability of plate tectonics to explain the ages of crustal rocks. Examples include evidence of the ages, oceanic crust increasing with distance from mid-ocean ridges (a result of plate spreading), and the ages of North American continental crust increasing with distance away from a central ancient core (a result of past plate interactions).]*	**Online:** Applying Practices: *How old are crustal rocks?* STEM Unit Project 4 Interactive Content placed at Module 13 Lesson 1
HS-ESS1-6	**Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.** *[Clarification Statement: Emphasis is on using available evidence within the solar system to reconstruct the early history of Earth, which formed along with the rest of the solar system 4.6 billion years ago. Examples of evidence include the absolute ages of ancient materials (obtained by radiometric dating of meteorites, moon rocks, and Earth's oldest minerals), the sizes and compositions of solar system objects, and the impact cratering record of planetary surfaces.]*	**Online:** Applying Practices: *Earth's Formation and Early History* STEM Unit Project 2 Interactive Content placed at Unit 2

HS-ESS2	Earth's Systems	
HS-ESS2-5	**Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.** *[Clarification Statement: Emphasis is on mechanical and chemical investigations with water and a variety of solid materials to provide the evidence for connections between the hydrologic cycle and system interactions commonly known as the rock cycle. Examples of mechanical investigations include stream transportation and deposition using a stream table, erosion using variations in soil moisture content, or frost wedging by the expansion of water as it freezes. Examples of chemical investigations include chemical weathering and recrystallization (by testing the solubility of different materials) or melt generation (by examining how water lowers the melting temperature of most solids).]*	**Online:** Applying Practices: *Effects of Water on Earth's Processes* STEM Unit Project 4 Interactive Content placed at Module 6 Lesson 3

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HS-ESS2-7	**Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.** *[Clarification Statement: Emphasis is on the dynamic causes, effects, and feedbacks between the biosphere and Earth's other systems, whereby geoscience factors control the evolution of life, which in turn continuously alters Earth's surface. Examples include how photosynthetic life altered the atmosphere through the production of oxygen, which in turn increased weathering rates and allowed for the evolution of animal life; how microbial life on land increased the formation of soil, which in turn allowed for the evolution of land plants; or how the evolution of corals created reefs that altered patterns of erosion and deposition along coastlines and provided habitats for the evolution of new life forms.]*	**Online:** Applying Practices: *The Coevolution of Living Things and the Atmosphere* STEM Unit Project 2 Interactive Content placed at Module 2 Lesson 1

HS-ESS3	Earth and Human Activity	
HS-ESS3-1	**Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.** *[Clarification Statement: Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting, and soil erosion), and severe weather (such as hurricanes, floods, and droughts). Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.]*	**Online:** Applying Practices: *Influence of Natural Resources, Hazards, and Changes in Climate* STEM Unit Project 4 Interactive Content placed at Module 15 Lesson 3
HS-ESS3-4	**Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*** *[Clarification Statement: Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).]*	**Online:** STEM Unit Project 2

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HS-ESS3-5	**Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.** *[Clarification Statement: Examples of evidence, for both data and climate model outputs, are for climate changes (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmosphere and ocean composition).] [Assessment Boundary: Assessment is limited to one example of a climate change and its associated impacts.]*	**Online:** Applying Practices: *Forecasting Climate Change* STEM Unit Project 2
HS-ESS3-6	**Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.** *[Clarification Statement: Examples of Earth systems to be considered are the hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere. An example of the far-reaching impacts from a human activity is how an increase in atmospheric carbon dioxide results in an increase in photosynthetic biomass on land and an increase in ocean acidification, with resulting impacts on sea organism health and marine populations.] [Assessment Boundary: Assessment does not include running computational representations but is limited to using the published results of scientific computational models.]*	**Online:** Applying Practices: *Exploring Relationships: Climate Change and Human Activity* STEM Unit Project 2 Interactive Content placed at Unit 2