NATIONAL GEOGRAPHIC

TEACHER'S EDITION

BIOLOGY

NEXT GENERATION SCIENCE STANDARDS

HS-LS1 From Molecules to Organisms: Structures and Processes

Performance Expectation	
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.	**Student Edition:** 343, 345 (#14) **Online:** Chapter Assessment 5 (#13), 7 (#12, 14) Unit 4 Performance Task 1
Disciplinary Core Ideas	
LS1.A: Structure and Function Systems of specialized cells within organisms help them perform the essential functions of life.	**Student Edition:** 104–105, 159, 193–196, 199–201, 203, 227, 234, 250–255, 257–261, 279, 308–309 **Online:** Chapter Investigation 7B Chapter Assessments 7, 10
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.	**Student Edition**: 6, 26–27, 184–186, 193, 200–201, 316–324, 326–333, 335–341, 344–345, 382–389, 419 **Online:** Chapter Investigations 11A, 11B Chapter Assessments 1, 6, 7, 11
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.	**Student Edition:** 6, 70, 107, 119–123, 127, 130–131, 146–147, 192–193, 189–191, 200–201, 203, 229–231, 246–247, 348–350, 457–461, 465, 476–480 **Online:** Chapter Investigations 2A, 2B, 7A Chapter Assessments 5, 6, 7
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.	**Student Edition:** 113, 131–132, 146–147, 194–196, 200–201, 203, 245, 318–319 **Online:** Chapter Investigations 7A, 7B, 8B Chapter Assessments 5, 7

HS-LS1 From Molecules to Organisms: Structures and Processes

Performance Expectation	
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 Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.	**Student Edition:** 203 **Online:** Chapter Investigations 9A, 10A Unit 3 Performance Task 1 Unit 3 Performance Task 2
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:** 4–5, 178–179, 227, 250–256, 263–269, 271–273, 278–279, 282–284, 286–290, 308–309 **Online:** Chapter Investigations 9A, 10A Chapter Assessments 9, 10 Unit 3 Performance Task 1

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.	**Student Edition:** 26–27, 37, 39–42, 46, 50, 55, 57–59, 107, 110–111, 117–118, 146–147, 169–175, 184–186, 192, 200–201, 245, 287–291, 307, 311, 334, 345, 376–377, 416, 474–475, 482–483, 516 **Online:** Chapter Investigations 6A, 6B, 7B, 9A, 10A, 16A Chapter Assessments 5, 7
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.	**Student Edition:** 12–14, 41, 46, 55, 58–59, 184–186, 200–201, 287–290, 311, 482–483, 516 **Online:** Chapter Investigations 1A, 9A, 10A, 16B Chapter Assessments 7, 13 Unit 1 Performance Task 1 Unit 3 Performance Task 1 Unit 5 Performance Task 5

HS-LS1 From Molecules to Organisms: Structures and Processes

Performance Expectation	
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.	**Student Edition:** 279 (#13) **Online:** Chapter Investigations 9B, 10A Unit 3 Performance Task 2
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:** 12–14, 162–168, 178–179, 256–261, 271–275, 278–279, 292–295, 308–309 **Online:** Chapter Investigations 9B, 10A Chapter Assessments 1, 6, 9, 10 Unit 3 Performance Task 1 Unit 3 Performance Task 2
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.	**Student Edition:** 26–27, 57 **Online:** Chapter Investigations 1A, 3B, 5B, 8A, 8B, 9B, 10A Unit 3 Performance Task 2
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.	**Student Edition:** 12–15, 462–464 **Online:** Chapter Investigation 10A
Crosscutting Concepts	
Stability and Change Feedback (negative or positive) can stabilize or destabilize a system.	**Student Edition:** 162–163, 257–261, 292–294 **Online:** Chapter Investigations 9B, 10A Unit 3 Performance Task 1 Unit 3 Performance Task 2

HS-LS1 From Molecules to Organisms: Structures and Processes

Performance Expectation	
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:** Chapter Investigations 7A, 7B Unit 2 Performance Task 1
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:** 181–183, 189–191, 193–196, 200–201, 220–225, 263–269 **Online:** Chapter Investigations 7A, 7B Chapter Assessment 7 Unit 1 Performance Task 1
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.	**Student Edition:** 26–27, 37, 39–42, 46, 50, 55, 57–59, 107, 110–111, 117–118, 146–147, 169–175, 184–186, 192, 200–201, 245, 287–291, 307, 311, 334, 345, 376–377, 416, 474–475, 482–483, 516 **Online:** Chapter Investigations 6A, 6B, 7B, 9A, 10A, 16A Chapter Assessments 2, 5, 7
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.	**Student Edition:** 12–14, 41, 46, 55, 58–59, 184–186, 200–201, 287–290, 311, 482–483, 516 **Online:** Chapter Investigations 1A, 9A, 10A, 16B Chapter Assessments 5, 7, 13 Unit 1 Performance Task 1 Unit 3 Performance Task 1 Unit 5 Performance Task 5

HS-LS1 From Molecules to Organisms: Structures and Processes

Performance Expectation	
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:** Chapter Investigation 6B Unit 2 Performance Task 2
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:** 120, 169–170, 174–177, 178–179, 212–214, 219–220 **Online:** Chapter Investigation 6B Chapter Assessments 2, 6 Unit 2 Performance Task 2

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.	**Student Edition:** 26–27, 37, 39–42, 46, 50, 55, 57–59, 107, 110–111, 117–118, 146–147, 169–175, 184–186, 192, 200–201, 245, 287–291, 307, 311, 334, 345, 376–377, 416, 474–475, 482–483, 516 **Online:** Chapter Investigations 6A, 6B, 7B, 9A, 10A, 16A Chapter Assessments 2, 5, 7
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.	**Student Edition:** 34–37, 39–41, 46, 55, 58–59, 126–127, 146–147, 424–425 **Online:** Chapter Investigations 5A, 5B, 6A, 6B Chapter Assessments 2, 5

HS-LS1 From Molecules to Organisms: Structures and Processes

Performance Expectation	
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.	**Student Edition:** 147 (#14) **Online:** Chapter Investigations 5A, 5B Unit 2 Performance Task 3
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:** 120, 128–134, 146–147, 344–345 **Online:** Chapter Investigations 5A, 5B Chapter Assessment 2
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:** 112, 126–127, 136, 146–147, 175, 212–214, 219–220, 229–231 **Online:** Chapter Investigations 2A, 2B, 7A Chapter Assessments 5, 6, 7
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.	**Student Edition:** 6, 70, 107, 119–123, 127, 130–131, 146–147, 192–193, 189–191, 200–201, 203, 229–231, 246–247, 348–350, 457–461, 465, 476–480 **Online:** Chapter Investigations 2A, 2B, 7A Chapter Assessments 5, 6, 7
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.	**Student Edition:** 34–37, 39–41, 46, 55, 58–59, 126–127, 146–147, 424–425 **Online:** Chapter Investigations 5A, 5B, 6A, 6B Chapter Assessments 2, 5 Unit 1 Performance Task 1 Unit 2 Performance Task 2

HS-LS1 From Molecules to Organisms: Structures and Processes

Performance Expectation	
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:** 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:** Chapter Investigation 6A Unit 2 Performance Task 2
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:** 112, 146–147, 175, 212–214, 219–220, 229–231 **Online:** Chapter Investigation 5A Chapter Assessments 2, 5
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:** 169–175, 178–179 **Online:** Chapter Investigation 5A Chapter Assessment 6 Unit 2 Performance Task 2
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.	**Student Edition:** 26–27, 37, 39–42, 46, 50, 55, 58–59, 107, 110–111, 117–118, 146–147, 169–175, 184–186, 200–201, 287–291 **Online:** Chapter Investigations 6A 6B, 7B, 9A, 10A, 16A Chapter Assessments 2, 5, 7
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.	**Student Edition:** 36–37, 43–49, 58–59, 139, 146–147 **Online:** Chapter Investigation 6A Chapter Assessment 2 Unit 1 Performance Task 2

HS-LS2 Ecosystems: Interactions, Energy, and Dynamics

Performance Expectation	
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.	**Student Edition:** 105 (#6, 15) **Online:** Chapter Investigation 4A Unit 1 Performance Task 3
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:** 33, 58–59, 62, 64–65, 70, 77, 82–83, 86–87, 90–99, 103–105, 278–279, 500–501 **Online:** Chapter Investigations 2A, 2B Chapter Assessments 4, 12 Unit 1 Performance Task 3 Unit 1 Performance Task 4

Science and Engineering Practices	
Using Mathematics and Computational Thinking Use mathematical and/or computational representations of phenomena or design solutions to support explanations.	**Student Edition:** 44–46, 48, 50, 55, 58–59, 70–71, 80–81, 84–85, 88–96, 99, 102, 104–105, 114–116, 124, 144, 146–147, 159, 234, 378, 484–485, 517, 520 **Online:** Chapter Investigations 2A, 2B, 3A, 4A Chapter Assessments 2, 4, 5 Unit 1 Performance Task 1 Unit 1 Performance Task 2 Unit 1 Performance Task 3 Unit 4 Performance Task 3 Unit 5 Performance Task 2
Crosscutting Concepts	
Scale, Proportion, and Quantity The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.	**Student Edition:** 86–87, 93, 99, 234, 346, 418–419, 502–50 **Online:** Chapter Investigation 1A Chapter Assessment 5 Unit 1 Performance Task 3

HS-LS2 Ecosystems: Interactions, Energy, and Dynamics

Performance Expectation	
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.	**Student Edition:** 105 (#2, 6, 15) **Online:** Chapter Investigations 2A, 2B, 3A, 4A Unit 1 Performance Task 2 Unit 1 Performance Task 3 Unit 1 Performance Task 4
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:** 33, 58–59, 62, 64–65, 70, 77, 82–83, 86–87, 90–99, 103–105, 278–279, 500–501 **Online:** Chapter Investigations 2A, 2B Chapter Assessments 4, 12
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:** 28–29, 41, 46, 58–5, 60–64, 66–67, 70, 72–78, 80–81, 86–99, 103, 176, 179, 203, 206–207, 248–249, 256, 270, 276–277, 311, 344–345, 426 **Online:** Chapter Investigations 3A, 3B, 4A Chapter Assessments 3, 4 Unit 5 Performance Task 5
Science and Engineering Practices	
Using Mathematics and Computational Thinking Use mathematical representations of phenomena or design solutions to support and revise explanations.	**Student Edition:** 44–46, 48, 50, 55, 58–59, 70–71, 80–81, 84–85, 88–96, 99, 102, 104–105, 114–116, 124, 144, 146–147, 159, 234, 378, 484–485, 517, 520 **Online:** Chapter Investigations 2A, 2B, 3A, 4A Chapter Assessments 2, 4, 5 Unit 1 Performance Task 1 Unit 1 Performance Task 2 Unit 1 Performance Task 3 Unit 4 Performance Task 3 Unit 5 Performance Task 2

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.	**Student Edition:** 37, 41, 46, 54–55, 58–59, 88, 104–105, 234 **Online:** Chapter Investigations 1A, 2A, 2B, 3A, 4A

HS-LS2 Ecosystems: Interactions, Energy, and Dynamics

Performance Expectation	
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.	**Student Edition:** 107, 203 **Online:** Unit 1 Performance Task 2
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:** 36–40, 58–59, 107, 169–175, 203, 220–225, 227 **Online:** Unit 1 Performance Task 2
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.	**Student Edition:** 6, 70, 107, 119–123, 127, 130–131, 146–147, 192–193, 189–191, 200–201, 203, 229–231, 246–247, 348–350, 457–461, 465, 476–480 **Online:** Chapter Investigations 2A, 2B, 7A Chapter Assessments 5, 6, 7
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.	**Student Edition:** 4–5, 14–15, 26–27, 66, 78–79,104–105, 210, 218, 246–247, 281,458–465 **Online:** Chapter Investigation 8A Chapter Assessment 8
Crosscutting Concepts	
Energy and Matter Energy drives the cycling of matter within and between systems.	**Student Edition:** 36–37, 39–41, 49, 58–59, 107, 164–167, 169–175, 203, 21–214 **Online:** Unit 1 Performance Task 2

HS-LS2 Ecosystems: Interactions, Energy, and Dynamics

Performance Expectation	
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.	**Student Edition:** 56 (#6) **Online:** Chapter Assessment 2 (#14) Unit 1 Performance Task 1 Unit 1 Performance Task 2
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:** 38–40, 43–46, 48–49, 55, 57–59, 204–205, 220–225 **Online:** Chapter Assessment 2 Unit 1 Performance Task 1 Unit 1 Performance Task 2

Science and Engineering Practices	
Using Mathematics and Computational Thinking Use mathematical representations of phenomena or design solutions to support claims.	**Student Edition:** 44–46, 48, 50, 55, 58–59, 70–71, 80–81, 84–85, 88–96, 99, 102, 104–105, 114–116, 124, 144, 146–147, 159, 234, 378, 484–485, 517, 520 **Online:** Chapter Investigations 2A, 2B, 3A, 4A Chapter Assessments 2, 4, 5 Unit 1 Performance Task 1 Unit 1 Performance Task 2 Unit 1 Performance Task 3 Unit 4 Performance Task 3 Unit 5 Performance Task 2
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.	**Student Edition:** 36–37, 43–49, 58–59, 139, 146–147 **Online:** Chapter Assessment 2

HS-LS2 Ecosystems: Interactions, Energy, and Dynamics

Performance Expectation	
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.	**Student Edition:** 57, 179 (#15) **Online:** Unit 1 Performance Task 1
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:** 46, 51, 55, 58–59 **Online:** Chapter Assessment 2 Unit 1 Performance Task 1
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. (secondary)	**Student Edition:** 37, 39, 169, 174 **Online:** Chapter Assessment 2
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.	**Student Edition:** 26–27, 37, 39–42, 46, 50, 55, 57–59, 107, 110–111, 117–118, 146–147, 169–175, 184–186, 192, 200–201, 245, 287–291, 307, 311, 334, 345, 376–377, 416, 474–475, 482–483, 516 **Online:** Chapter Investigations 6A ,6B, 7B, 9A, 10A, 16A Chapter Assessments 2, 5, 7
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.	**Student Edition:** 12–14, 41, 46, 55, 58–59, 184–186, 200–201, 287–290, 311, 482–483, 516 **Online:** Chapter Investigations 1A, 9A, 10A, 16B Chapter Assessments 5, 7, 13 Unit 1 Performance Task 1 Unit 3 Performance Task 1 Unit 5 Performance Task 5

HS-LS2 Ecosystems: Interactions, Energy, and Dynamics

Performance Expectation	
HS-LS2-6. Evaluate 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.	**Student Edition:** 311 **Online:** Chapter Investigation 3B Unit 1 Performance Task 4
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:** 328–29, 41, 46, 58–5, 60–64, 66–67, 70, 72–78, 80–81, 86–99, 103, 176, 179, 203, 206–207, 248–249, 256, 270, 276–277, 311, 344–345, 426 **Online:** Chapter Investigations 3A, 3B, 4A Chapter Assessments 3, 4 Unit 5 Performance Task 5
Science and Engineering Practices	
Engaging in Argument from 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.	**Student Edition:** 65, 78, 80–81, 296–300 **Online:** Chapter Investigations 3B, 10B, 16A
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.	**Student Edition:** 12–15, 78, 518–519 **Online:** Chapter Investigation 3B
Crosscutting Concepts	
Stability and Change Much of science deals with constructing explanations of how things change and how they remain stable.	**Student Edition:** 30–31, 61, 65, 71–81, 124, 204–207, 424–425, 482–483, 518–519 **Online:** Chapter Investigations 3A, 3B Chapter Assessments 3, 16

HS-LS2 Ecosystems: Interactions, Energy, and Dynamics

Performance Expectation	
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.	**Student Edition:** 27 (#2), 417 **Online:** Chapter Investigation 16B Unit 1 Performance Task 5
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:** 30–31, 42, 54–55, 65, 71–73, 77, 80–81,102–103, 206–207, 277, 381, 492–493, 496–498, 500–508 **Online:** Chapter Investigation 16B Chapter Assessments 3, 16 Unit 5 Performance Task 5
LS4.D: Biodiversity and Humans Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). (secondary)	**Student Edition:** 370, 486–488, 492, 517–519
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) (Note: This Disciplinary Core Idea is also addressed by HS-LS4-6.)	**Student Edition:** 65, 68, 70, 72–73, 232–233, 492–508, 510–515

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)	**Student Edition:** 18–21, 24, 314, 407–415, 413, 421 **Online:** Chapter Investigations 4B, 10B, 13A, 13B, 16B Chapter Assessment 13
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.	**Student Edition:** 382–389, 513–514 **Online:** Chapter Investigations 4B, 10B, 13A, 13B
Crosscutting Concepts	
Stability and Change Much of science deals with constructing explanations of how things change and how they remain stable.	**Student Edition:** 30–31, 61, 65, 71–78, 80–81, 124, 204–207, 424–425 **Online:** Chapter Investigations 3A, 3B Chapter Assessment 3

HS-LS2 Ecosystems: Interactions, Energy, and Dynamics

Performance Expectation	
HS-LS2-8. Evaluate 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.	**Student Edition:** 308 (#10, Revisit 1), 311 **Online:** Chapter Investigation 10B Unit 3 Performance Task 3
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:** 296–304, 308–309, 311 **Online:** Chapter Investigation 10B Chapter Assessment 10 Unit 3 Performance Task 3
Science and Engineering Practices	
Engaging in Argument from Evidence Evaluate the evidence behind currently accepted explanations to determine the merits of arguments.	**Student Edition:** 65, 78, 80–81, 296–300 **Online:** Chapter Investigations 3B, 10B, 16A
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.	**Student Edition:** 12–15, 78 **Online:** Chapter Investigation 3B
Crosscutting Concepts	
Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	**Student Edition:** 54–55, 206–207, 295, 318–319, 364–365, 347, 378–379, 418–419, 458–464, 469–472, 476–479, 518–5196 **Online:** Chapter Investigations 9B, 10A, 11A, 11B, 15A, 15B, 16A Chapter Assessments 5, 12 Unit 4 Performance Task 2

HS-LS3 Heredity: Inheritance and Variation of Traits

Performance Expectation	
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.	**Student Edition:** **Online:** Chapter Investigations 11A, 11B Unit 4 Performance Task 1

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) (Note: This Disciplinary Core Idea is also addressed by HS-LS1-1.)	**Student Edition:** 6, 26–27, 184–186, 200–201, 316–324, 326–333, 335–341, 344–345, 382–389, 419 **Online:** Chapter Investigations 11A, 11B Chapter Assessments 1, 6, 7, 11
LS3.A: 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:** 8, 26–27, 187–188, 317–323, 326–334, 335–343, 344–345, 348–350, 379 **Online:** Chapter Investigations 11A, 11B Chapter Assessment 11
Science and Engineering Practices	
Asking Questions and Defining Problems Ask questions that arise from examining models or a theory to clarify relationships.	**Student Edition:** 26–27, 33, 41, 61, 81, 110–111, 113, 147, 168, 198, 209, 281, 306, 312–315, 343, 345, 347, 419, 455, 457, 483, 519 **Online:** Chapter Investigations 11A, 11B Chapter Assessment 1 Unit 3 Performance Task 1 Unit 3 Performance Task 2 Unit 5 Performance Task 1
Crosscutting Concepts	
Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	**Student Edition:** 54–55, 206–207, 295, 318–319, 364–365, 347, 378–379, 418–419, 458–464, 469–472, 476–479, 518–519 **Online:** Chapter Investigations 9B, 10A, 11A, 11B, 15A, 15B, 16A Chapter Assessments 5, 12 Unit 4 Performance Task 2

HS-LS3 Heredity: Inheritance and Variation of Traits

Performance Expectation	
HS-LS3-2. 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.	**Student Edition:** 377, 379 (Revisit #1) **Online:** Chapter 12 Assessment (#14) Unit 4 Performance Task 2
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:** 350–356, 358–361, 370, 376–379, 467–472, 476–479 **Online:** Chapter Investigation 12B Chapter Assessments 10, 12
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:** 365–375, 377–379, 467–472, 476–479 **Online:** Chapter Investigation 12B Chapter Assessments 11, 12 Unit 4 Performance Task 2

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.	**Student Edition:** 56, 246–247, 278–279, 311, 377, 398–402, 421, 509, 519, 521 **Online:** Chapter Investigations 3A, 8A, 8B, 12A, 12B, 14B, 16A Chapter Assessment 5 Unit 2 Performance Task 2 Unit 4 Performance Task 2
Crosscutting Concepts	
Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	**Student Edition:** 354–55, 206–207, 295, 318–319, 364–365, 347, 378–379, 418–419, 458–464, 469–472, 476–479, 518–519 **Online:** Chapter Investigations 9B, 10A, 11A, 11B, 15A, 15B, 16A Chapter Assessments 5, 12 Unit 4 Performance Task 2

HS-LS3 Heredity: Inheritance and Variation of Traits

Performance Expectation	
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.	**Student Edition:** 377 **Online:** Chapter Investigations 12A, 12B Chapter 12 Assessment (#8, 9, 13, 19, 20) Unit 4 Performance Task 3
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:** 365–375, 377–379, 467–472, 476–479 **Online:** Chapter Investigation 12B Chapter Assessments 11, 12 Unit 4 Performance Task 2
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.	**Student Edition:** 102, 369–370, 376, 467–472, 474–478, 482–483, 500–501 **Online:** Chapter Investigations 12A, 12B, 15A, 15B Unit 4 Performance Task 3 Unit 5 Performance Task 2
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).	**Student Edition:** 137–138, 369, 378–379, 418–419, 495–498 **Online:** Chapter Investigation 3A Chapter Assessment 5 Unit 4 Performance Task 3
Science Is a Human Endeavor Technological advances have influenced the progress of science and science has influenced advances in technology.	**Student Edition:** 3, 18–21, 177, 365, 378–379 **Online:** Chapter Assessment 8 Unit 4 Performance Task 3
Science and engineering are influenced by society and society is influenced by science and engineering.	**Student Edition:** 18–21, 102, 379 **Online:** Unit 4 Performance Task 3

HS-LS4 Biological Evolution: Unity and Diversity

Performance Expectation	
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.	**Student Edition:** 453 **Online:** Chapter Investigations 14A, 14B Unit 5 Performance Task 1
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:** 4–5, 210, 285, 426–434, 436–438, 442, 446–452, 454–455, 472, 480, 484, 517 **Online:** Chapter Investigations 14A, 14B Chapter Assessment 1
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).	**Student Edition:** 58–59, 78, 145–147, 199, 215–216, 245, 307, 432–433 **Online:** Chapter Investigations 14A, 14B Unit 2 Performance Task 1 Unit 3 Performance Task 1 Unit 4 Performance Task 4
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.	**Student Edition:** 430–431, 442, 452 **Online:** Chapter Investigations 14A, 14B Chapter Assessment 8
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.	**Student Edition:** 8, 22–23, 35–36, 67, 74, 133–134, 136, 146–147, 246–247, 347, 357, 371–374, 418–419, 428–429, 452, 458–461, 469–472 **Online:** Chapter Investigations 8A, 14B, 15A, 15B Chapter Assessments 5, 13 Unit 5 Performance Task 1
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.	**Student Edition:** 430–433, 436–442, 458–461, 465 **Online:** Chapter Investigations 8A, 14B, 15A, 15B Chapter Assessments 5, 13 Unit 5 Performance Task 1

HS-LS4 Biological Evolution: Unity and Diversity

Performance Expectation	
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.	**Student Edition:** 481 **Online:** Chapter Investigation 15B Unit 5 Performance Task 2

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:** 458–465, 472, 481–483 **Online:** Chapter Investigations 15A, 15B
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:** 457–464, 469–472, 474–475, 481–483, 489–491, 517, 519 **Online:** Chapter Investigation 15B Chapter Assessment 15
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.	**Student Edition:** 6, 70, 107, 119–123, 127, 130–131, 146–147, 192–193, 189–191, 200–201, 203, 229–231, 246–247, 348–350, 457–461, 465, 476–480 **Online:** Chapter Investigations 2A, 2B, 7A Chapter Assessments 5, 6 ,7
Crosscutting Concepts	
Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	**Student Edition:** 54–55, 206–207, 295, 318–319, 364–365, 347, 378–379, 418–419, 458–464, 469–472, 476–479, 518–519 **Online:** Chapter Investigations 9B, 10A, 11A, 11B, 15A, 15B, 16A Chapter Assessments 5, 12 Unit 4 Performance Task 2

HS-LS4 Biological Evolution: Unity and Diversity

Performance Expectation	
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.	**Student Edition:** 483 (#3, Revisit 1), 485 **Online:** Chapter Investigation 15A Unit 5 Performance Task 2 Unit 5 Performance Task 3
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:** 458–465, 472, 481–483 **Online:** Chapter Investigations 15A, 15B
The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population.	**Student Edition:** , 26–27, 296–304, 462–466, 474–475, 481, 483, 485 **Online:** Chapter Investigation 15A Chapter Assessments 1, 15
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:** 7, 68, 422–423, 456, 458–466, 469–472, 481–483, 485, 489–491, 517, 519 **Online:** Chapter Investigation 15A Chapter Assessments 1, 16
Adaptation also means that the distribution of traits in a population can change when conditions change.	**Student Edition:** 424–425, 457, 472, 481, 483, 485, 489, 517, 519 **Online:** Chapter Investigations 15A, 15B Chapter Assessment 1

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.	**Student Edition:** 369, 467–472, 476–478, 500–501 **Online:** Chapter Investigations 12A, 12B, 15A, 15B
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.	**Student Edition:** 8, 22–23, 35–36, 67, 74, 133–134, 136, 146–147, 246–247, 347, 357, 371–374, 418–419, 428–429, 452, 458–461, 469–472 **Online:** Chapter Investigations 8A, 14B, 15A, 15B Chapter Assessments 5, 13 Unit 5 Performance Task 1

HS-LS4 Biological Evolution: Unity and Diversity

Performance Expectation	
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.	**Student Edition:** 481, 483 (Revisit #1) **Online:** Chapter Investigation 15B Unit 5 Performance Task 3
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:** 7, 68, 422–423, 456, 458–466, 469–472, 481–483, 485, 489–491, 517, 519 **Online:**Chapter Investigation 15A Chapter Assessments 1, 16
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.	**Student Edition:** 6, 70, 107, 119–123, 127, 130–131, 146–147, 192–193, 189–191, 200–201, 203, 229–231, 246–247, 348–350, 457–461, 465, 476–480 **Online:** Chapter Investigations 2A, 2B, 7A Chapter Assessments 5, 6, 7
Crosscutting Concepts	
Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	**Student Edition:** 54–55, 206–207, 295, 318–319, 364–365, 347, 378–379, 418–419, 458–464, 469–472, 476–479, 518–519 **Online:** Chapter Investigations 9B, 10A, 11A, 11B, 15A, 15B, 16A Chapter Assessments 5, 12 Unit 4 Performance Task 2
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.	**Student Edition:** 430–433, 436–442, 465 **Online:** Chapter Investigations 14A, 14B

HS-LS4 Biological Evolution: Unity and Diversity

Performance Expectation	
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.	**Student Edition:** 521 **Online:** Chapter Investigation 16A Unit 5 Performance Task 4

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:** 77, 308–309, 457, 484, 486–493, 495–498, 509, 516, 518–519, 528–519, 521 **Online:** Chapter Investigation 16A Chapter 16 Assessment
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:** 77, 492–493, 495–498
Science and Engineering Practices	
Engaging in Argument from Evidence Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments.	**Student Edition:** 65, 78, 80–81, 296–300 **Online:** Chapter Investigations 3B, 10B, 16A
Crosscutting Concepts	
Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	**Student Edition:** 54–55, 206–207, 295, 318–319, 364–365, 347, 378–379, 418–419, 458–464, 469–472, 476–479, 518–519 **Online:** Chapter Investigations 9B, 10A, 11A, 11B, 15A, 15B, 16A Chapter Assessments 5, 12 Unit 4 Performance Task 2

HS-LS4 Biological Evolution: Unity and Diversity

Performance Expectation	
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 testing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of organisms for multiple species.	**Student Edition:** 27 (#2) **Online:** Chapter Investigation 16B Unit 5 Performance Task 5
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:** 77, 308–309, 457, 484, 486–493, 495–498, 509, 516, 518–519, 528–519, 521 **Online:** Chapter Investigation 16A Chapter 16 Assessment
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:** 65, 68, 70, 72–73, 232–233, 492–508, 509–519
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)	**Student Edition:** 18–21, 24, 314, 407–415, 413, 421 **Online:** Chapter Investigations 4B, 10B, 13A, 13B, 16B Chapter Assessment 13
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)	**Student Edition:** 12–14, 18–21, 403 **Online:** Chapter Investigation 16B Chapter Assessments 1, 14
Science and Engineering Practices	
Using Mathematics and Computational Thinking Create or revise a simulation of a phenomenon, designed device, process, or system.	**Student Edition:** 434 **Online:** Unit 5 Performance Task 1

Crosscutting Concepts	
Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	**Student Edition:** 54–55, 206–207, 295, 318–319, 364–365, 347, 378–379, 418–419, 458–464, 469–472, 476–479, 518–519 **Online:** Chapter Investigations 9B, 10A, 11A, 11B, 15A, 15B, 16A Chapter Assessments 5, 12 Unit 4 Performance Task 2

HS-ETS1 Engineering Design

Performance Expectation	
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:** Chapter Investigation 1B Unit 4 Performance Task 4
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.	**Student Edition:** 18–21, 26–27
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.	**Student Edition:** 26–27, 312–315, 403–405, 407–415, 421, 510–515 **Online:** Chapter Investigation 1B Unit 4 Performance Task 4
Science and Engineering Practices	
Asking Questions and Defining Problems Analyze complex real-world problems by specifying criteria and constraints for successful solutions.	**Student Edition:** 26–27, 103, 407–414 **Online:** Chapter Investigation 1B Chapter Assessment 1 Unit 5 Performance Task 5
Crosscutting Concepts	
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.	**Student Edition:** 18–21, 392–402, 404–405, 407–409, 500–501, 511–515 **Online:** Chapter Investigations 1B, 4B, 13A, 13B Chapter Assessments 13, 14 Unit 1 Performance Task 5 Unit 4 Performance Task 4

HS-ETS1 Engineering Design

Performance Expectation	
HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	**Online:** Chapter Investigation 16B Chapter 16 Assessment Unit 4 Performance Task 4
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.	**Student Edition:** 18–21, 513–515 **Online:** Chapter Investigation 6B Unit 4 Performance Task 4
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.	**Student Edition:** 25, 382–389, 509, 513–514, 518–519 **Online:** Chapter Investigations 4B, 10B, 13A, 13B Chapter Assessment 16 Unit 1 Performance Task 5 Unit 2 Performance Task 3 Unit 4 Performance Task 4 Unit 5 Performance Task 2

HS-ETS1 Engineering Design

Performance Expectation	
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.	**Student Edition:** 417 **Online:** Chapter Investigations 4B, 10B, 13A, 13B, 16B Chapter Assessment 13 (#14) Unit 1 Performance Task 5
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.	**Student Edition:** 18–21, 24, 314, 404–405, 407–415, 413, 421 **Online:** Chapter Investigations 4B, 10B, 13A, 13B, 16B Chapter Assessment 13 Unit 1 Performance Task 5
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.	**Student Edition:** 25, 382–389, 509, 513–514, 518–519 **Online:** Chapter Investigations 4B, 10B, 13A, 13B Chapter Assessment 16 Unit 1 Performance Task 5 Unit 2 Performance Task 3 Unit 4 Performance Task 4 Unit 5 Performance Task 2
Crosscutting Concepts	
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.	**Student Edition:** 18–21, 392–402, 404–405, 407–409, 500–501, 511–515 **Online:** Chapter Investigations 1B, 4B, 13A, 13B Chapter Assessments 13, 14 Unit 1 Performance Task 5 Unit 4 Performance Task 4

HS-ETS1 Engineering Design

Performance Expectation	
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:** Unit 5 Performance Task 5
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.	**Student Edition:** 12–14, 18–21, 403 **Online:** Chapter Investigation 16B Chapter Assessments 1, 14
Science and Engineering Practices	
Using Mathematics and Computational Thinking Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems.	**Student Edition:** 378 **Online:** Chapter Investigations 3A, 16B Unit 1 Performance Task 4
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.	**Student Edition:** 12–14, 41, 46, 55, 58–59, 184–186, 200–201, 287–290, 311, 482–483, 516 **Online:** Chapter Investigations 1A, 9A, 10A, 16B Chapter Assessments 5, 7, 13 Unit 1 Performance Task 1 Unit 3 Performance Task 1 Unit 5 Performance Task 5

NEXT GENERATION SCIENCE STANDARDS BY CHAPTER

Chapter or Section	NGSS Standards and Dimensions
Chapter 1: Introduction to Biology, pages 2–27	**Performance Expectations** HS-ETS1-1; HS-ETS1-2 **Disciplinary Core Ideas** LS1.A, LS2.D, LS3.A, LS4.A, LS4.B, LS4.C, ETS1.A, ETS1.B, ETS1.C **Science and Engineering Practices** Asking Questions and Defining Problems; Developing and Using Models; Planning and Carrying Out Investigations; Constructing Explanations and Designing Solutions; Engaging in Argument from Evidence. **Connections to Nature of Science** Scientific Investigations Use a Variety of Methods; Scientific Knowledge is Based on Empirical Evidence; Scientific Knowledge is Open to Revision in Light of New Evidence; Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena. **Crosscutting Concepts** Patterns; Systems and System Models; Structure and Function. **Connections to Nature of Science** Science is a Human Endeavor. **Connections to Engineering, Technology, and Applications of Science** Influence of Engineering, Technology, and Science on Society and the Natural World.
Online Assessments and Investigations for Chapter 1	**Performance Expectations** HS-ETS1-1 **Disciplinary Core Ideas** ETS1.A; ETS1.B; LS1.A; LS4.A; LS4.B; LS4.C **Science and Engineering Practices** Asking Questions and Defining Problems; Planning and Carrying Out Investigations; Analyzing and Interpreting Data; Engaging in Argument from Evidence; Scientific Investigations Use a Variety of Methods. **Crosscutting Concepts** Scale, Proportion, and Quantity; Systems and System Models. **Connections to Engineering, Technology, and Applications of Science** Influence of Engineering, Technology, and Science on Society and the Natural World.
Unit 1: Relationships in Ecosystems	
Chapter 2: Energy and Matter in Ecosystems, pages 32–59	**Performance Expectations** HS-LS2-2; HS-LS2-3; HS-LS2-4; HS-LS2-5 **Disciplinary Core Ideas** LS2.A; LS2.B; LS2.C; LS2.C **Science and Engineering Practices** Asking Questions and Defining Problems; Developing and Using Models; Planning and Carrying Out Investigations; Analyzing and Interpreting Data; Using Mathematics and Computational Thinking; Constructing Explanations and Designing Solutions; Engaging in Argument from Evidence. **Connections to Nature of Science** Scientific Knowledge is Open to Revision in Light of New Evidence. **Crosscutting Concepts** Cause and Effect; Scale, Proportion, and Quantity; Systems and System Models; Energy and Matter; Stability and Change.
Online Assessments and Investigations for Chapter 2	**Performance Expectations** HS-LS2-2; HS-LS2-3; HS-LS2-4; HS-LS2-5; HS-LS2-6 **Disciplinary Core Ideas** LS1.C; LS2.A; LS2.B; ESS2.D; ESS3.C; PS3.D **Science and Engineering Practices** Developing and Using Models; Using Mathematics and Computational Thinking; Constructing Explanations and Designing Solutions. **Crosscutting Concepts** Scale, Proportion, and Quantity; Energy and Matter.
Chapter 3: Biodiversity and Ecosystem Stability, pages 60–81	**Performance Expectations** HS-LS2-1; HS-LS2-6; HS-LS2-7 **Disciplinary Core Ideas** LS2.A; LS2.C; LS4.C; LS4.D; ESS2.E; ESS3.C **Science and Engineering Practices** Asking Questions and Defining Problems; Using Mathematics and Computational Thinking; Constructing Explanations and Designing Solutions; Engaging in Argument from Evidence. **Connections to Nature of Science** Scientific Knowledge Is Open To Revision In Light Of New Evidence; Scientific Knowledge is Based on Empirical Evidence. **Crosscutting Concepts** Patterns; Cause and Effect; Systems and System Models; Stability and Change. **Connections to Nature of Science** Science Addresses Questions About the Natural and Material World **Connections to Engineering, Technology, and Applications of Science** Interdependence of Science, Engineering, and Technology.
Online Assessments and Investigations for Chapter 3	**Performance Expectations** HS-LS2-1, HS-LS2-2, HS-LS2-6 **Disciplinary Core Ideas** LS2.C **Science and Engineering Practices** Planning and Carrying Out Investigations; Analyzing and Interpreting Data; Using Mathematics and Computational Thinking; Engaging in Argument from Evidence. **Connections to Nature of Science** Scientific Knowledge is Open to Revision in Light of New Evidence. **Crosscutting Concepts** Scale, Proportion, and Quantity; Stability and Change.
Chapter 4: Population Measurement and Growth, pages 82–105	**Performance Expectations** HS-LS2-1; HS-LS2-2 **Disciplinary Core Ideas** LS1.A; LS2.C **Science and Engineering Practices** Analyzing and Interpreting Data; Using Mathematics and Computational Thinking; Engaging in Argument from Evidence. **Connections to Nature of Science** Scientific Knowledge is Open to Revision in Light of New Evidence. **Crosscutting Concepts** Scale, Proportion, and Quantity.
Online Assessments and Investigations for Chapter 4	**Disciplinary Core Ideas** HS-LS2-2; HS-LS2-7; HS-ETS1-3 **Science and Engineering Practices** Using Mathematics and Computational Thinking; Constructing Explanations and Designing Solutions. **Crosscutting Concepts** Influence of Engineering, Technology, and Science on Society and the Natural World.
Unit 1 Performance Tasks	**Performance Expectations** HS-LS2-1; HS-LS2-2; HS-LS2-3; HS-LS2-4; HS-LS2-5; HS-LS2-6; HS-LS2-7; HS-ETS1-3; HS-ESS2-6 **Disciplinary Core Ideas** LS2.A; LS2.B; LS2.C; ESS2.C; ESS2.D; ETS1.B **Science and Engineering Practices** Developing and Using Models; Using Mathematics and Computational Thinking; Constructing Explanations and Designing Solutions. **Crosscutting Concepts** Scale, Proportion, and Quantity; Systems and System Models; Energy and Matter. **Connections to Engineering, Technology, and Applications of Science** Influence of Engineering, Technology, and Science on Society and the Natural World.

Unit 2: Cell Systems	
Chapter 5: Molecules in Living Systems, pages 112–147	**Performance Expectations** HS-LS1-6 **Disciplinary Core Ideas** LS1.C; PS1.A; PS1.B; PS2.B **Science and Engineering Practices** Asking Questions and Defining Problems; Developing and Using Models; Using Mathematics and Computational Thinking; Constructing Explanations and Designing Solutions; Engaging in Argument from Evidence. **Connections to Nature of Science** Scientific Investigations Use a Variety of Methods; Scientific Knowledge is Based on Empirical Evidence. **Crosscutting Concepts** Patterns; Cause and Effect; Scale, Proportion, and Quantity; Energy and Matter; Structure and Function; Stability and Change.
Online Assessments and Investigations for Chapter 5	**Performance Expectations** HS-LS1-6 **Disciplinary Core Ideas** LS1.C **Science and Engineering Practices** Developing and Using Models; Planning and Carrying Out Investigations; Using Mathematics and Computational Thinking; Constructing Explanations and Designing Solutions; Engaging in Argument from Evidence. **Crosscutting Concepts** Scale, Proportion, and Quantity; Systems and System Models; Energy and Matter; Structure and Function.
Chapter 6: Cell Structure and Function, pages 148–179	**Performance Expectations** HS-LS1-5; HS-LS1-7; HS-LS2-3; HS-LS2-5 **Disciplinary Core Ideas** LS1.A; LS1.C; LS2.B; LS2.C **Science and Engineering Practices** Asking Questions and Defining Problems; Developing and Using Models; Using Mathematics and Computational Thinking. **Connections to Nature of Science** Scientific Investigations Use A Variety Of Methods. **Crosscutting Concepts** Energy and Matter; Structure and Function; Stability and Change. **Connections to Nature of Science** Science is a Human Endeavor.
Online Assessments and Investigations for Chapter 6	**Performance Expectations** HS-LS1-5; HS-LS1-7; HS-ETS1-2 **Disciplinary Core Idea**s LS1.A; LS1.C **Science and Engineering Practices** Developing and Using Models; Constructing Explanations and Designing Solutions. **Crosscutting Concepts** Energy and Matter.
Chapter 7: Cell Growth, pages 180–201	**Performance Expectations** HS-LS1-1; HS-LS1-4 **Disciplinary Core Ideas** LS1.A; LS1.B; LS3.A **Science and Engineering Practices** Asking Questions and Defining Problems; Developing and Using Models; Analyzing and Interpreting Data; Constructing Explanations and Designing Solutions; Engaging in Argument from Evidence. **Crosscutting Concepts** Systems and System Models; Structure and Function. **Connections to Nature of Science** Science Addresses Questions About the Natural and Material World.
Online Assessments and Investigations for Chapter 7	**Performance Expectations** HS-LS1-4 **Disciplinary Core Ideas** LS1.A; LS1.B **Science and Engineering Practices** Developing and Using Models; Constructing Explanations and Designing Solutions. **Crosscutting Concepts** Systems and System Models; Structure and Function.
Unit 2 Performance Tasks	**Performance Expectations** HS-LS1-4; HS-LS1-5; HS-LS1-6; HS-LS1-7 **Disciplinary Core Ideas** LS1.B; LS1.C; LS1.C; LS1.C **Science and Engineering Practices** Developing and Using Models; Constructing Explanations and Designing Solutions; Engaging in Argument from Evidence. **Crosscutting Concepts** Energy and Matter.
Unit 3: Interactions in Living Systems	
Chapter 8: Diversity of Living systems, pages 208–247	**Performance Expectations** HS-LS1-2 **Disciplinary Core Ideas** LS1.A; LS1.B; LS1.C; LS2.B; LS4.A; LS4.D **Science and Engineering Practices** Asking Questions and Defining Problems; Developing and Using Models; Analyzing and Interpreting Data; Using Mathematics and Computational Thinking; Constructing Explanations and Designing Solutions; Engaging in Argument from Evidence. **Connections to Nature of Science** Scientific Investigations Use a Variety of Methods; Scientific Knowledge is Open to Revision in Light of New Evidence. **Crosscutting Concepts** Patterns; Scale, Proportion, and Quantity; Energy and Matter; Structure and Function.
Online Assessments and Investigations for Chapter 8	**Science and Engineering Practices** Planning and Carrying Out Investigations; Constructing Explanations and Designing Solutions; Engaging in Argument from Evidence. **Connections to Nature of Science** Scientific Investigations Use a Variety of Methods; Scientific Knowledge is Open to Revision in Light of New Evidence; Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena. **Crosscutting Concepts** Patterns; Structure and Function. **Connections to Nature of Science** Science is a Human Endeavor.
Chapter 9: Plant Systems, pages 248–279	**Performance Expectations** HS-LS1-2, HS-LS1-3 **Disciplinary Core Ideas** LS1.A; LS1.B; LS2.A; LS2.C **Science and Engineering Practices** Engaging in Argument from Evidence. **Connections to Nature of Science** Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena. **Crosscutting Concepts** Systems and System Models; Stability and Change.

Unit 3: Interactions in Living Systems (continued)	
Online Assessments and Investigations for Chapter 9	**Performance Expectations** HS-LS1-2; HS-LS1-3 **Disciplinary Core Ideas** LS1.A **Science and Engineering Practices** Developing and Using Models; Planning and Carrying Out Investigations. **Crosscutting Concepts** Cause and Effect; Systems and System Models; Stability and Change.
Chapter 10: Animal Systems, pages 280–309	**Performance Expectations** HS-LS1-2; HS-LS1-3 **Disciplinary Core Ideas** LS1.A **Science and Engineering Practices** Developing and Using Models; Planning and Carrying Out Investigations. **Crosscutting Concepts** Cause and Effect; Systems and System Models; Stability and Change.
Online Assessments and Investigations for Chapter 10	**Performance Expectations** HS-LS1-2; HS-LS1-3; HS-LS2-8 **Disciplinary Core Ideas** LS1.A; LS2.D; LS3.B; ETS1.B **Science and Engineering Practices** Developing and Using Models; Planning and Carrying Out Investigations; Constructing Explanations and Designing Solutions; Engaging in Argument from Evidence. **Crosscutting Concepts** Systems and System Models; Stability and Change.
Unit 3 Performance Tasks	**Performance Expectations** HS-LS2-8 **Disciplinary Core Ideas** LS1.A; LS2.D **Science and Engineering Practices** Asking Questions and Defining Problems; Developing and Using Models; Planning and Carrying Out Investigations; Constructing Explanations and Designing Solutions; Engaging in Argument from Evidence. **Crosscutting Concepts** Systems and System Models; Stability and Change.
Unit 4: Genetics and Information	
Chapter 11: DNA, RNA and Proteins, pages 316–345	**Performance Expectations** HS-LS1-1; HS-LS3-1 **Disciplinary Core Ideas** LS1.A; LS1.C; LS2.C; LS3.A **Science and Engineering Practices** Asking Questions and Defining Problems; Developing and Using Models. **Connections to Nature of Science** Scientific Knowledge is Based on Empirical Evidence. **Crosscutting Concepts** Systems And System Models; Cause and Effect; Structure and Function.
Online Assessments and Investigations for Chapter 11	**Performance Expectations** HS-LS1-1, HS-LS3-1 **Disciplinary Core Ideas** LS1.A; LS3.A; LS3.B **Science and Engineering Practices** Asking Questions and Defining Problems. **Crosscutting Concepts** Cause and Effect.
Chapter 12: Genetic Variation and Heredity, pages 346–379	**Performance Expectations** HS-LS3-2; HS-LS3-3 **Disciplinary Core Ideas** LS3.A; LS3.B **Science and Engineering Practices** Asking Questions and Defining Problems; Developing and Using Models; Analyzing and Interpreting Data; Using Mathematics and Computational Thinking; Constructing Explanations and Designing Solutions; Engaging in Argument from Evidence. **Connections to Nature of Science** Scientific Investigations Use a Variety of Methods. **Crosscutting Concepts** Patterns; Cause and Effect; Scale, Proportion, and Quantity. **Connections to Nature of Science** Science is a Human Endeavor.
Online Assessments and Investigations for Chapter 12	**Performance Expectations** HS-LS3-2; HS-LS3-3 **Disciplinary Core Ideas** LS2.A; LS3.B **Science and Engineering Practices** Analyzing and Interpreting Data; Engaging in Argument from Evidence. **Crosscutting Concepts** Patterns; Cause and Effect.
Chapter 13: Genetic Technologies, pages 380–419	**Performance Expectations** HS-ETS1-3 **Disciplinary Core Ideas** LS1.A; LS2.C; ETS1.A; ETS1.B **Science and Engineering Practices** Asking Questions and Defining Problems; Developing and Using Models; Using Mathematics and Computational Thinking; Constructing Explanations and Designing Solutions; Engaging in Argument from Evidence. **Connections to Nature of Science** Scientific Investigations Use a Variety of Methods. **Crosscutting Concepts** Patterns; Cause and Effect; Scale, Proportion, and Quantity; Structure and Function. **Connections to Nature of Science** Science Addresses Questions About the Natural and Material World. **Connections to Engineering, Technology, and Applications of Science** Interdependence of Science, Engineering, and Technology; Influence of Engineering, Technology, and Science on Society and the Natural World.

Unit 4: Genetics and Information (continued)	
Online Assessments and Investigations for Chapter 13	**Performance Expectations** HS-LS3-3; HS-ETS1-1; HS-ETS1-2; HS-ETS1-3 **Disciplinary Core Idea**s ETS1.B **Science and Engineering Practices** Constructing Explanations and Designing Solutions. **Crosscutting Concepts** Patterns; Systems and System Models. **Connections to Engineering, Technology, and Applications of Science** Influence of Engineering, Technology, and Science on Society and the Natural World.
Unit 4 Performance Tasks	**Performance Expectations** HS-LS3-1; HS-LS3-2; HS-LS3-3; HS-ETS1-1; HS-ETS1-2 **Disciplinary Core Ideas** LS3.B; ETS1.A; ETS1.C **Science and Engineering Practices** Asking Questions And Defining Problems; Analyzing and Interpreting Data; Using Mathematics and Computational Thinking; Constructing Explanations and Designing; Engaging in Argument from Evidence. **Crosscutting Concepts** Cause and Effect; Scale, Proportion, and Quantity. **Connections to Nature of Science** Science is a Human Endeavor; Science Addresses Questions About the Natural and Material World. **Connections to Engineering, Technology, and Applications of Science** Influence of Engineering, Technology, and Science on Society and the Natural World.
Unit 5: Evolution and Changing Environments	
Chapter 14: Evidence for Evolution, pages 426–455	**Performance Expectations** HS-LS4-1 **Disciplinary Core Ideas** LS4.A; PS1.C; ESS2.A; ESS2.D **Science and Engineering Practices** Asking Questions and Defining Problems; Using Mathematics and Computational Thinking; Engaging in Argument from Evidence. **Connections to Nature of Science** Scientific Knowledge is Based on Empirical Evidence; Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena **Crosscutting Concepts** Patterns; Systems and System Models. **Connections to Nature of Science** Scientific Knowledge Assumes an Order and Consistency in Natural Systems.
Online Assessments and Investigations for Chapter 14	**Performance Expectations** HS-LS4-1 **Disciplinary Core Ideas** LS4.A, ETS1.B Science and Engineering Practices Engaging in Argument from Evidence. **Connections to Nature of Science** Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena. **Crosscutting Concept**s Patterns. **Connections to Nature of Science** Scientific Knowledge Assumes an Order and Consistency in Natural Systems. **Connections to Engineering, Technology, and Applications of Science** Influence of Engineering, Technology, and Science on Society and the Natural World.
Chapter 15: The Theory of Evolution, pages 456–483	**Disciplinary Core Ideas** HS-LS3-3; HS-LS4-2; HS-LS4-3; HS-LS4-4 **Science and Engineering Practices** Asking Questions and Defining Problems; Developing and Using Models; Analyzing and Interpreting Data; Constructing Explanations and Designing Solutions; Engaging in Argument from Evidence. **Connections to Nature of Science** Scientific Investigations Use a Variety of Methods; Scientific Knowledge is Based on Empirical Evidence; Scientific Knowledge is Open to Revision in Light of New Evidence. **Crosscutting Concepts** Patterns; Cause and Effect; Systems and System Models; Stability and Change. **Connections to Nature of Science** Scientific Knowledge Assumes an Order and Consistency in Natural Systems.
Online Assessments and Investigations for Chapter 15	**Performance Expectations** HS-LS4-2; HS-LS-4-3; HS-LS4-4 **Disciplinary Core Ideas** LS4.B, LS4.C **Science and Engineering Practices** Analyzing and Interpreting Data Constructing Explanations and Designing Solutions Engaging in Argument from Evidence. **Crosscutting Concepts** Patterns; Cause and Effect; Stability and Change. **Connections to Nature of Science** Scientific Knowledge Assumes an Order and Consistency in Natural Systems.
Chapter 16: Survival in Changing Environments, pages 484–519	**Performance Expectations** HS-LS2-7; HS-LS4-5; HS-LS4-6; HS-ETS1-4 **Disciplinary Core Ideas** LS2.A; LS2.C; LS4.A; LS4.B; LS4.C; LS4.D; ETS1.A; ETS1.C; ESS2.D ESS3.A; ESS3.C; ESS3.D **Science and Engineering Practices** Asking Questions and Defining Problems; Developing and Using Models; Analyzing and Interpreting Data; Using Mathematics and Computational Thinking; Constructing Explanations and Designing Solutions; Engaging in Argument from Evidence. **Connections to Nature of Science** Scientific Knowledge is Open to Revision in Light of New Evidence. **Crosscutting Concepts** Cause and Effect; Scale, Proportion, and Quantity; Systems and System Models; Stability and Change. **Connections to Nature of Science** Science Addresses Questions About the Natural and Material World. **Connections to Engineering, Technology, and Applications of Science** Influence of Engineering, Technology, and Science on Society and the Natural World.
Online Assessments and Investigations for Chapter 16	**Performance Expectations** HS-LS2-7; HS-LS4-5; HS-LS4-6; HS-ETS1-2; HS-ETS1-4 **Disciplinary Core Ideas** LS2.C ; LS4.A; LS4.C; LS4.D; ETS1.B; ESS3.A **Science and Engineering Practices** Developing and Using; Using Mathematics and Computational Thinking; Constructing Explanations and Designing Solutions; Engaging in Argument from Evidence. **Connections to Nature of Science** Scientific Knowledge is Open to Revision in Light of New Evidence. **Crosscutting Concepts** Cause and Effect; Systems and System Models; Stability and Change.
Unit 5 Performance Tasks	**Performance Expectations** HS-LS4-1; HS-LS4-2; HS-LS4-3; HS-LS4-4; HS-LS4-5; HS-LS4-6; HS-ETS1-2; HS-ETS1-4 **Disciplinary Core Ideas** LS2.C **Science and Engineering Practices** Asking Questions and Defining Problems; Developing and Using Models; Analyzing and Interpreting Data; Using Mathematics and Computational Thinking; Constructing Explanations and Designing Solutions. **Crosscutting Concepts** Patterns; Systems and System Models.