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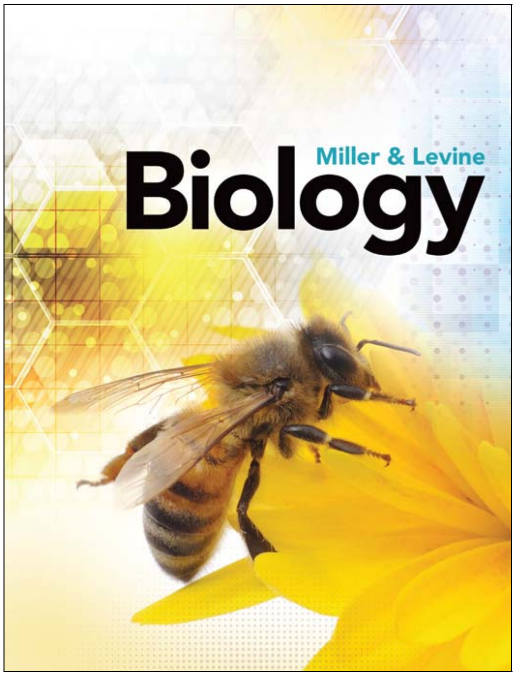

To the

Louisiana Student Standards for Science High School, Biology

Pearson

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INTRODUCTION

This document demonstrates how ***Miller & Levine Biology ©2019*** meets the Louisiana Student Standards for Science, grades 9-12. Correlation page references are to the Student and Teacher's Editions and cited at the page level.

Renowned Author Team Ken Miller and Joe Levine have created a comprehensive on-level program to inspire students to interact with trusted and up-to-date biology content. The authors' unique storytelling style engages students in biology, with a greater focus on written and visual analogies. This innovative and fresh new program was developed for modern biology classrooms with a focus on STEM integration and 21st century education.

Problem-Based Learning The Problem-Based Learning Strand introduced in each unit opener immerses students in an active learning environment with lab investigations, STEM projects, virtual activities, and authentic readings. When students each the end of the unit, they use their newly acquired scientific knowledge and data to design, test, and evaluate a solution to the presented problem.

Performance-Based Assessment Authentic assessments of STEM learning allow students to demonstrate mastery of the chapter concepts and new standards. All Performance-Based Assessments feature real-world problems and focus on science inquiry, engineering, and STEM practices.

Case Studies Students directly interact with science phenomena in every chapter as they learn about a real-world science problem. Throughout the lessons, students find case study connections in data analysis activities, labs, diagrams, illustrations, and interactivities.

Interactive Learning Students interact with digital art, videos, and animations through interactive prompts or questions, making ***Miller & Levine Biology*** relevant to their lives.

Reading and Study Support *Biology Foundations: Reading and Study Guide Workbook* includes lesson summaries, vocabulary help, and reading tools. Practice focuses on key concepts and science literacy to improve students' understanding of scientific text.

PearsonRealize.com PearsonRealize.com is your online destination for the complete Miller & Levine Biology digital curriculum. A single sign-on provides access to biology content, assessments, resources, management tools, and real-time student data. Realize directly syncs with providers such as Google® and OpenEd to provide a seamless digital experience.

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Louisiana Student Standards for Science		Miller-Levine Biology ©2019
Performance Expectation		
HS-LS1-1	**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.	**SE/TE:** 249-251, 267-268, 416-417, 418-423, 445-450, 466-467, 469 Quick Lab: Inserting Genetic Markers: 512
Disciplinary Core Idea		
LS1.A	**Structure and Function**	
	Systems of specialized cells within organisms help them perform the essential functions of life.	**SE/TE:** 267-268, 416-417
	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.	**SE/TE:** 249-251, 418-423
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.	**SE/TE:** 469
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.	**SE/TE:** 466-467

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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.	**SE/TE:** 267-268, 762-775, 857, 870-875, 876-879, 888-889, 896-897, 904-906, 910-922, 923-932, 952
Disciplinary Core Idea		
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.	**SE/TE:** 267-268, 888-889, 904-905
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.	**SE/TE:** 857, 896-897
Crosscutting Concepts		
	Systems and System Models	
	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.	**SE/TE:** 896-897, 952

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Performance Expectation		
HS-LS1-3	Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis in living organisms.	**SE/TE:** 260-265, 266-269, 776-783, 801, 888-891, 907-909, 930-932, 952 Exploration Lab: Exercise and Heart Rate
Disciplinary Core Idea		
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.	**SE/TE:** 260-265, 266-269, 776-783, 801, 888-891, 907-909, 930-932
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.	Exploration Lab: Exercise and Heart Rate
	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.	Exploration Lab: Exercise and Heart Rate

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Crosscutting Concepts		
	Stability and Change	
	Feedback (negative or positive) can stabilize or destabilize a system.	**SE/TE:** 260-265, 266-269, 776-783, 801, 888-891, 907-909, 930-932, 952
Performance Expectation		
HS-LS1-4	Use a model to illustrate the role of the cell cycle and differentiation in producing and maintaining complex organisms.	**SE/TE:** 238-242, 243-248, 338-342, 343-349, 355-358, 370 (Q30) Exploration Lab: Regeneration in Planaria
Disciplinary Core Idea		
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.	**SE/TE:** 238-242, 243-248, 338-342, 343-349, 355-358
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.	Exploration Lab: Regeneration in Planaria
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.	**SE/TE:** 370 (Q30)

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Performance Expectation		
HS-LS1-5	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.	**SE/TE:** 286-290, 291-295, 298-299, **305,** 306
Disciplinary Core Idea		
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.	**SE/TE:** 286-290, 291-295
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.	**SE/TE:** 298-299, 305
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.	**SE/TE:** 306
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.	**SE/TE:** 52-57, 58-61, 58-61, 291-295 Digital Course: Interactivity Carbon Compounds
Disciplinary Core Idea		
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.	**SE/TE:** 52-57

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	As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.	**SE/TE:** 58-61, 291-295
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.	Exploration Lab: Temperatures and Enzymes
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.	**SE/TE:** 58-61
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.	SE/TE: 310-313, 314-320, 321-323, 334 Modeling Lab: Making a Model of Cellular Respiration
Disciplinary Core Idea		
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.	**SE/TE:** 310-313, 321-323

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	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.	**SE/TE:** 310-313, 314-320
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.	**SE/TE:** Modeling Lab: Making a Model of Cellular Respiration
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.	**SE/TE:** 334
Performance Expectation		
HS-LS1-8	Obtain, evaluate, and communicate information about (1) viral and bacterial reproduction and adaptation, (2) the body's primary defenses against infection, and (3) how these features impact the design of effective treatment.	**SE/TE:** 681, 687, 688, 694, 710-711, 714-715, 939
Performance Expectation		
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, biodiversity and populations of	**SE/TE:** 144-151, 152-157, 158-161 Argument-Based Inquiry: Estimating Population Size

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	ecosystems at different scales.	
Disciplinary Core Idea		
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.	**SE/TE:** 144-151, 152-157, 158-161 Argument-Based Inquiry: Estimating Population Size
Science and Engineering Practices		
	Using Mathematics and Computational Thinking	
	Use mathematical and/ or computational representations of phenomena or design solutions to support explanations.	**SE/TE:** 144-151, 152-157, 158-161, 169 (Q 26) Argument-Based Inquiry: Estimating Population Size
Crosscutting Concepts		
	Scale, Proportion, and Quantity	
	The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.	**SE/TE:** 102-103, 144-151, 152-157, 158-161, 198
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.	**SE/TE:** 85-91, 92-101, 102-103, 152-157, 158-161, 162-163, 166-167, 174-181, 182-185, **194-195,** 206-217, 218-222

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Disciplinary Core Idea		
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.	**SE/TE:** 92-101, 152-157, 158-161, 174-181, 194-195, 206-217, 218-222
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.	**SE/TE:** 85-91, 102-103, 152-157, 174-181, 182-185, 194-195, 206-217, 218-222
Science and Engineering Practices		
	Using Mathematics and Computational Thinking	
	Use mathematical representations of phenomena or design solutions to support and revise explanations.	**SE/TE:** 85-91, 92-101, 102-103, 152-157, 158-161, 162-163, 166-167, 174-181, 182-185, 194-195, 206-217, 218-222

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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.	**SE/TE:** 85-91, 92-101, 102-103, 152-157, 158-161, 162-163, 166-167, 174-181, 182-185, 194-195, 198 (Q 32), 206-217, 218-222
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.	**SE/TE:** 114-117, 123-131 Digital Course: **Comparing Cellular Respiration and Fermentation**
Disciplinary Core Idea		
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.	**SE/TE:** 114-117, 123-131 Digital Course: Comparing Cellular Respiration and Fermentation
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, and 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.	**SE/TE:** 114-117, 117 (Q4), 123-131, 131 (Q6), 139 (Qs 26, 29, 31) Digital Course: Comparing Cellular Respiration and Fermentation
Crosscutting Concepts		
	Energy and Matter	
	Energy drives the cycling of matter within and between systems.	**SE/TE:** 114-117, 123-131, 140 (Q 32) Digital Course: Comparing Cellular Respiration and Fermentation
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.	**SE/TE:** 118-122, 121, 123-131, 302-303

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Disciplinary Core Idea		
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.	**SE/TE:** 118-122, 123-131, 302-303
Science and Engineering Practices		
	Using Mathematical and Computational Thinking	
	Use mathematical representations of phenomena or design solutions to support claims.	**SE/TE:** 118-122, 122, 123-131, 302-303, 303
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.	**SE/TE:** 118-122, 123-131, 140, 302-303
Performance Expectation		

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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	**SE/TE:** 123-131, 136-137, 286-290, 291-297, 302-303, 310-313
Disciplinary Core Idea		
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.	**SE/TE:** 123-131, 136-137, 286-290, 291-297, 302-303, 310-313
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)	**SE/TE:** 282-285
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.	**SE/TE:** 123-131, 131, 136-137, 139, 285, 286-290, 291-297, 302-303, 305, 310-313, 333
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.	**SE/TE:** 110, 123-131, 136-137, 140 , 286-290, 291-297, 302-303, 306, 310-313, 334
Performance Expectation		
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.	**SE/TE:** 182-185, 186-189 Case Study: 77, 102-103, 173, 190-191 Performance-Based Assessment: 194-195, 572';In Your Neighborhood Lab: Biodiversity on the Forest Floor , 573

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Disciplinary Core Idea		
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.	**SE/TE:** 182-185, 186-189 In Your Neighborhood Lab: Biodiversity on the Forest Floor
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	**SE/TE:** 182-185, 186-189 In Your Neighborhood Lab: Biodiversity on the Forest Floor
Crosscutting Concepts		
	Stability and Change	
	Much of science deals with constructing explanations of how things change and how they remain stable.	**SE/TE:** 182-185, 186-189, 198 In Your Neighborhood Lab: Biodiversity on the Forest Floor
Performance Expectation		
HS-LS2-7	Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.	**SE/TE:** 166-167, 182-185, 186-189, 194-195, 202-205, 206-217, 218-222, 223-225, 226-227, 230-231, 862-863, 858-859, 862-863 Develop a Solution Lab: Calculating Ecological Footprints

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Disciplinary Core Idea		
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.	**SE/TE:** 182-185, 186-189, 206-217, 218-222, 226-227, 230-231
LS4.D	**Biodiversity and Humans**	
	Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction).	**SE/TE:** 166-167, 202-205, 206-217, 218-222, 223-225, 230-231, 858-859, 862-863
	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 HSLS4-6.*)	**SE/TE:** 166-167, 202-205, 206-217, 218-222, 223-225, 230-231, 858-859, 862-863
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*)	**SE/TE:** 194-195, 218-222, 226-227, 230-231, 792-793, 858-859, 862-863
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	**SE/TE:** 166-167, 182-185, 186-189, 194-195, 202-205, 206-217, 218-222, 223-225, 226-227, 230-231, 233 (Q 28), 792-793,

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	sources of evidence, prioritized criteria, and tradeoff considerations.	862-863, 858-859, 862-863, 863 Develop a Solution Lab: Calculating Ecological Footprints
Crosscutting Concepts		
	Stability and Change	
	Much of science deals with constructing explanations of how things change and how they remain stable.	**SE/TE:** 166-167, 182-185, 186-189, 194-195, 202-205, 206-217, 218-222, 223-225, 226-227, 230-231, 234, 862-863, 858-859, 862-863 Develop a Solution Lab: Calculating Ecological Footprints
Performance Expectation		
HS-LS2-8	Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.	**SE/TE:** 822-827 Lab: The Role of Group Behavior
Disciplinary Core Idea		
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.	**SE/TE:** 822-827 Modeling Lab: The Role of Group Behavior
Science and Engineering Practices		
	Engaging in Argument from Evidence	
	Evaluate the evidence behind currently accepted explanations to determine the merits of arguments.	**SE/TE:** 822-827 Modeling Lab: The Role of Group Behavior
Crosscutting Concepts		
	Cause and Effect	
	Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	**SE/TE:** 822-827, 838 Modeling Lab: The Role of Group Behavior

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Performance Expectation		
HS-LS3	**Heredity: Inheritance and Variation of Traits**	
HS-LS3-1	Formulate, refine, and evaluate questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.	SE/TE: 343-344, 393-399, 412-417, 418-423, 428-429, 432-433, 440-444, 445-450, 451-456, 457-461, 466-467, 474-479, 480-484, 485-493, 494-495, 498-499, 516-523 Labs: Using DNA to Solve Crimes, Gel Electrophoresis
Disciplinary Core Idea		
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.*)	**SE/TE:** 412-417, 470 (Q 34), 440-444, 445-450
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.	**SE/TE:** 393-399, 418-423, 445-450, 451-456, 457-461, 474-479, 480-484, 485-493
Science and Engineering Practices		
	Asking Questions and Defining Problems	
	Ask questions that arise from examining models or a theory to clarify relationships.	**SE/TE:** 435, 466-467, 494, 501
Crosscutting Concepts		
	Cause and Effect	
	Empirical evidence is required to differentiate between cause and correlation and make claims about specific	**SE/TE:** 43, 502

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45	causes and effects.	
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.	**SE/TE:** 393-399, 424-427, 426, 456, 457-459, 460-461, 582-583, 597, 710-711 Quick Lab: 426 Case Study: 439 Labs: A Model of Meiosis, The Effect of Mutations
Disciplinary Core Idea		
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.	**SE/TE:** 393-399, 424-427, 457-461 Labs: A Model of Meiosis,
	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.	**SE/TE:** 456, 457-461, 710-711
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 studentgenerated evidence.	**SE/TE:** 393-399, 424-427, 457-461, 710-711 Quick Lab: **426** Labs: A Model of Meiosis, **The Effect of**

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		Mutations
Crosscutting Concepts		
	Cause and Effect	
	Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	**SE/TE:** 393-399, 424-427, 426, 457-461, 710-711 Labs: A Model of Meiosis, The Effect of Mutations
Performance Expectation		
HS-LS3-3	Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.	**SE/TE:** 378-382, 383-387, 388, 389-392, 400-401, 404-405, 581, 583, 584, 585-591, 599, 604-605 **Analyzing Data: 599** Case Study: 377, 381, 400-401 Quick Lab: 382 Performance-Based Assessment: 404-405
Disciplinary Core Idea		
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.	**SE/TE:** 378-382, 383-388, 389-392, 400-401, 404-405, 585-591, 604-605 Analyzing Data: 599
Science and Engineering Practices		
	Analyzing and Interpreting Data	
	Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation	**SE/TE:** 378-382, 383-388, 389-392, 400-401, 404-405, 585-591, 604-605

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	coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.	Analyzing Data: 599
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).	**SE/TE:** 378-382, 383-388, 389-392, 400-401, 404-405, 408 (Q32), 585-591, 604-605 Analyzing Data: 599
Performance Expectation		
HS-LS4	Biological Evolution: Unity and Diversity	
HS-LS4-1	Analyze and interpret scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.	**SE/TE:** 544-548, 549-554, 560-567, 619-629, 630-631, 634-635, 666-667 Exploration Lab: Evidence of Evolution: Argument-Based Inquiry: Construct a Cladogram
Disciplinary Core Idea		
LS4.A	**Interdependent Relationships in Ecosystems**	
	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.	**SE/TE:** 544-548, 549-554, 619-629, 630-631, 634-635, 666-667
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	Exploration Lab: Evidence of Evolution Argument-Based Inquiry: Construct a Cladogram

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	performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically)	
	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.	**SE/TE:** 565-567, 619-629 Exploration Lab: Evidence of Evolution
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.	**SE/TE:** 546-547, 548, 576. 619-629

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	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.	**SE/TE:** 549-550, 619-629
Performance Expectation		
HS-LS4-2	Construct an explanation based on evidence that biological diversity is influenced by (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.	**SE/TE:** 544-548, 549-554, 555-557, 560-567, 573, 580-581, 585-587, 595**,** Case Study: 543, 568-569
Disciplinary Core Idea		
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.	**SE/TE:** 549-554, 555-559, 562-565 Quick Lab: 553
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.	**SE/TE:** 544-548, 549-554, 555-559

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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.	**SE/TE:** 573
Crosscutting Concepts		
	Cause and Effect	
	Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	**SE/TE:** 568-569, 572-573, 576 (34)
Performance Expectation		
HS-LS4-3	Apply concepts of statistics and probability to support explanations that populations of organisms adapt when an advantageous heritable trait increases in proportion to organisms lacking this trait.	**SE/TE:** 555-559, 585-591, 604-605
Disciplinary Core Idea		
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.	**SE/TE:** 555-559, 585-591
	The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population.	**SE/TE:** 555-559, 585
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	**SE/TE:** 555-559, 585-591

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	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.	
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.	**SE/TE:** 604-605
Crosscutting Concepts		
	Patterns	
	Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	**SE/TE:** 586-587
Performance Expectation		
HS-LS4-4	Construct an explanation based on evidence for how natural selection and other mechanisms lead to genetic changes in populations.	**SE/TE:** 544-548, 555-559, 592-595, 596-599, 600-601 Modeling Lab: Competing for Resources
Disciplinary Core Idea		
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	**SE/TE:** 544-548, 555-559, 592-595, 596-599

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	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.	
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.	**SE/TE:** 600-601
Crosscutting Concepts		
	Cause and Effect	
	Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	**SE/TE:** 544-548, 555-559, 592-595, 596-599
	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.	**SE/TE:** 544-548, 555-559, 592-595, 596-599
Performance Expectation		
HS-LS4-5	Evaluate evidence supporting claims that changes in environmental conditions can affect the distribution of traits in a population causing: (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.	**SE/TE:** 596-599, 652-658, 670-671 Modeling Lab: 595
Disciplinary Core Idea		
LS4.C	**Adaptation**	
	Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the	**SE/TE:** 596-599, 652-658 Analyzing Data: 654

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	emergence of new distinct species as populations diverge under different conditions, and the decline—and sometimes the extinction—of some species.	
	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.	**SE/TE:** 596-599, 652-658
Science and Engineering Practices		
	Engaging in Argument From Evidence	
	Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments.	**SE/TE:** 670-671
Crosscutting Concepts		
	Cause and Effect	
	Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	**SE/TE:** 670-671, 674
Performance Expectation		
HS-LS4-6	Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.	Digital Course: Controlling Invasives **SE/TE:** 186-189, 206-217
	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.	SE: 186-189, 206-217 SE: 186-189, 206-217

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	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.	
	Science and Engineering Practices **Using Mathematics and Computational Thinking** Create or revise a simulation of a phenomenon, designed device, process, or system.	Digital Course: Controlling Invasives
	Crosscutting Concept **Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	SE: 186-189, 206-217