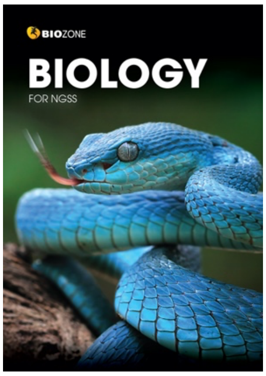

Alignment of BIOZONE's Biology for NGSS (3rd edition) to Louisiana Science Standards for Life Sciences

ISBN: 978-1-98-856692-4

SKU: NBI3

Note 1: Correlation locations are activity numbers (not page numbers).

Note 2: Correlations do not usually include reference to the Science practices chapter

Note 3: Correlations include background material to address the specific standard

Louisiana: Student Standards for Life Sciences

Standards source:
https://www.louisianabelieves.com/resources/library/academic-standards

TITLE: Biology for NGSS (3ed):

Correlation locations are activity numbers (not page numbers)**.**

Standard	Components	Correlation location
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.		47-52
Science and Engineering Practices	**6. Constructing explanations and designing solutions:** Constructing explanations (science) and designing solutions (engineering) in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.	47, 50, 52
	6. 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.	47, 50, 52
Disciplinary Core Ideas	**STRUCTURE AND FUNCTION** Systems of specialized cells within organisms help them perform the essential functions of life. (HS.LS1A.a)	30, 45-46
	All cells contain genetic information in the form of DNA molecules. (HS.LS1A.c)	47, 85, 86
	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 the cells. (HS.LS1A.c)	47, 51, 54-55
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.	50-54, 86-88

From Molecules to Organisms: Structures and Processes (LS1) **HS.LS1.2** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.		30, 55, 57, 60-64, 96
Science and Engineering Practices	**2. Developing and using models**: Modeling in 9-12 builds on K-8 experiences and progresses to using synthesizing and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).	50-53
	2. Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.	50-53
Disciplinary Core Ideas	**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. (HS.LS1A.b)	30, 55, 57, 60-64, 96
Crosscutting Concepts	**SYSTEMS AND SYSTEM MODELS**: Models (e.g., physical, mathematical, computer) can be used to simulate systems and interactions, including energy, matter, and information flow within and between systems at different scales.	50-53, 86-88

From Molecules to Organisms: Structures and Processes (LS1) **HS.LS1.3** Plan and conduct an investigation to provide evidence of the importance of maintaining homeostasis in living organisms.		75, 78-79
Science and Engineering Practices	**3. Planning and carrying out investigations:** Planning and carrying out investigations to answer questions or test solutions to problems in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.	75, 79
	3. 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	75, 79
Disciplinary Core Ideas	**STRUCTURE AND FUNCTION** Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing the organism to remain alive and functional even as external conditions change within some range. Feedback mechanisms can promote (through positive feedback) or inhibit (through negative feedback) activities within an organism to maintain homeostasis. (HS.LS1A.d)	68-71, 73-74, 76, 78
Crosscutting Concepts	**STABILITY AND CHANGE**: Feedback (negative or positive) can stabilize or destabilize a system.	70-71, 73-74, 76-79

From Molecules to Organisms: Structures and Processes (LS1) **HS.LS1.4** Use a model to illustrate the role of the cell cycle and differentiation in producing and maintaining complex organisms.		89-95, 200-202
Science and Engineering Practices	**2. Developing and using models**: Modeling in 9-12 builds on K-8 experiences and progresses to using synthesizing and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).	90, 93, 202
	2. Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.	90, 93, 202
Disciplinary Core Ideas	**GROWTH AND DEVELOPMENT OF ORGANISMS** In multicellular organisms the cell cycle is necessary for growth, maintenance and repair of multicellular organisms. Disruptions in the cell cycles of mitosis and meiosis can lead to diseases such as cancer. (HS.LS1B.a)	89, 90
	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. (HS.LS1B.b)	200-202
	Cellular division and differentiation (stem cells) produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. (HS.LS1B.c)	94-96
Crosscutting Concepts	**SYSTEMS AND SYSTEM MODELS**: Models (e.g., physical, mathematical, computer) can be used to simulate systems and interactions, including energy, matter, and information flow within and between systems at different scales.	93, 202

From Molecules to Organisms: Structures and Processes (LS1) **HS.LS1.5** Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.		101-105
Science and Engineering Practices	**Developing and using models**: 2. Modeling in 9-12 builds on K-8 experiences and progresses to using synthesizing and developing models to predict and show relationships among variables between systems and their components in the natural and designed world	102, 104
	2. Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.	102, 104, 105
Disciplinary Core Ideas	**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. (HS.LS1C.a)	101-105
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.	107-108

From Molecules to Organisms: Structures and Processes (LS1) **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.		47-50, 53, 106
Science and Engineering Practices	**6. Constructing explanations and designing solutions**: Constructing explanations (science) and designing solutions (engineering) in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.	47-50, 53, 106
	6. 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, 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.	47-50, 53, 106
Disciplinary Core Ideas	**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. (HS.LS1C.a)	101-105
	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 large molecules (such as proteins or DNA), used, for example, to form new cells. (HS.LS1C.b)	47-50, 53, 106
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.	107-108

From Molecules to Organisms: Structures and Processes (LS1) **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.		106-110
Science and Engineering Practices	**2. Developing and using models**: Modeling in 9-12 builds on K-8 experiences and progresses to using synthesizing and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).	106-110
	2. Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.	106-110
Disciplinary Core Ideas	**ORGANIZATION FOR MATTER AND ENERGY FLOW IN ORGANISMS** As matter and energy flow through different organization levels of living systems, chemical elements are recombined in different ways to form different products. (HS.LS1C.c)	106-110
	As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. (HS.LS1C.d)	106-110
	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. (HS.LS1C.d)	108
	Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. (HS.LS1C.d)	73-74
Crosscutting Concepts	**ENERGY AND MATTER**: Energy cannot be created or destroyed. It only moves between one place to another, between objects and/or fields, or between systems.	144, 145

From Molecules to Organisms: Structures and Processes (LS1) **HS.LS1.8** Obtain, evaluate, and communicate information about (1) viral and bacterial reproduction and adaptation, (2) the body's primary defences against infection, and (3) how these features impact the design of effective treatment.		130-131, 205
Science and Engineering Practices	**8. Obtaining, evaluating, and communicating information:** Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.	130 -131, 205
	8. Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence concepts, processes, or information by presenting them in simpler but still accurate terms.	205
Disciplinary Core Ideas	**Public Health** Viruses are obligate intracellular parasites that replicate using a cell's protein expression mechanisms. (HS.LS1E.a)	N/A
	Vaccines provide immunity to infections by exposing the immune system to antigens before infection which decreases the immune system's response time. Some vaccines may require more than one dose. (HS.LS1E.b)	N/A
	Antibiotics are effective treatments against most bacterial infections. Some bacteria may develop resistance to these treatments. (HS.LS1E.c)	205
	Microorganisms can cause diseases and can provide beneficial services. Microorganisms live in a variety of environments as both parasites and free-living organisms. (HS.LS1E.d)	138
	Microorganisms can reproduce quickly. (HS.LS1E.e)	130-132
Crosscutting Concepts	**SCALE, PROPORTION, AND QUANTITY** The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.	130-132

Ecosystems: Interactions, Energy, and Dynamics (LS2) **HS.LS2.1** Use mathematical and/or computational representations to support explanations of factors that affect carrying capacities of ecosystems at different scales.		125-133
Science and Engineering Practices	**5. Using mathematics & computational thinking**: Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to sing algebraic thinking and analysis, a range of linear and nonlinear functions (e.g. trigonometric, exponential and logarithmic) and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.	126-127, 130-133
	5. Use mathematical, computational, and/or algorithmic representations of phenomena to describe and/or support claims and/or explanations.	126-127, 130-133
Disciplinary Core Ideas	**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 as predation, competition, and disease that affect biodiversity, including genetic diversity within a population and species diversity within an ecosystem. (HS.LS2A.a)	125-127
	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). (HS.LS2A.a)	125-127, 131-133
	Human activity directly and indirectly affect biodiversity and ecosystem health (e.g., habitat fragmentation, introduction of nonnative or invasive species, overharvesting, pollution and climate change). (HS.LS2A.b)	162-167, 169
Crosscutting Concepts	**SCALE, PROPORTION AND QUANTITY**: The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.	125-127, 131-133

Ecosystems: Interactions, Energy, and Dynamics (LS2) **HS.LS2.4** Use a mathematical representation to support claims for the cycling of matter and the flow of energy among organisms in an ecosystem.		137-154
Science and Engineering Practices	**5. Using mathematics & computational thinking**: Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions (e.g. trigonometric, exponential and logarithmic) and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.	141-147, 149-150, 152, 154
	5. Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.	141-147, 149-150, 152, 154
Disciplinary Core Ideas	**CYCLES OF MATTER AND ENERGY TRANSFER IN ECOSYSTEMS** Energy is inefficiently transferred from one trophic level to another that affect the relative number of organisms that can be supported at each trophic level and necessitates a constant input of energy from sunlight or inorganic compounds from the environment. (HS.LS2B.b)	144-147
	Photosynthesis, cellular respiration, decomposition and combustion are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, hydrosphere, and geosphere through chemical, physical, geological, and biological processes. (HS.LS2B.b)	148, 150-151
	Photosynthesis, chemosynthesis, aerobic and anaerobic respiration and cellular respiration (including anaerobic processes) provide most of the energy for life processes. (HS.LS2B.a)	137-140, 144-145
	Environmental conditions restrict which and when reactions can occur. (HS.LS2B.a)	56-59, 138
Crosscutting Concepts	**ENERGY AND MATTER: FLOWS, CYCLES, AND CONSERVATION** Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems.	144-145

Ecosystems: Interactions, Energy, and Dynamics (LS2) **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.		114-124, 158-162
Science and Engineering Practices	**7. Engaging in argument from evidence:** Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.	114-124, 158-162
	7. Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.	114-124, 158-162
Disciplinary Core Ideas	**ECOSYSTEM DYNAMICS, FUNCTIONING, AND RESILIENCE** The dynamic 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 and may result in new ecosystems. (HS.LS2C.a)	114-124, 158-162
Cross Cutting Concepts	**STABILITY AND CHANGE** Much of science deals with constructing explanations of how things change and how they remain stable.	114-124, 158-162

Ecosystems: Interactions, Energy, and Dynamics (LS2) **HS.LS2.7** Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.		168, 170, 256-259 Background: 163-167, 169, 252-255
Science and Engineering Practices	**6. Constructing explanations and designing solutions:** Constructing explanations (science) and designing solutions (engineering) in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.	168, 170
	6. Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.	168, 170
Disciplinary Core Ideas	**ECOSYSTEM DYNAMICS, FUNCTIONING, AND RESILIENCE** Ecosystems with a greater biodiversity tend to have a greater resistance and resilience to change. 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. (HS.LS2C.b)	158-160, 252-253 162-167, 255
	BIODIVERSITY AND HUMANS Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). Humans depend on the living world for the resources and other benefits provided by biodiversity. 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. (HS.LS4D.a)	252-259
	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. (HS.ETS1B.a)	168, 170, 256-257
Cross Cutting Concepts	**STABILITY AND CHANGE** Much of science deals with constructing explanations of how things change and how they remain stable.	158-160, 162, 163, 165-168, 252

Heredity: Inheritance and Variation of Traits (LS3) **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.		47, 51, 186-191
Science and Engineering Practices	**1.Asking questions and defining problems:** Asking questions (science) and defining problems (engineering) in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.	186-191
	1. Ask questions that arise from examining models or a theory, to clarify and/or seek additional information and relationships.	186-191
Disciplinary Core Ideas	**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 which carry out the essential functions of life. (HS.LS1A.c)	47, 41, 55, 186-189
	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. (HS.LS3A.a)	47, 51, 186-187 188-189, 191 190
	In Mendel's model of inheritance an organism's phenotype is determined by the combined expression of two inherited versions they have for each gene. However, most traits follow more complex patterns of inheritance such as traits that are codominant, incomplete dominant, and polygenic. (HS.LS3A.b)	195-197, 211-216 199
Cross Cutting Concepts	**CAUSE AND EFFECT** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	186-191

Heredity: Inheritance and Variation of Traits (LS3) **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.		198-204
Science and Engineering Practice	**7. Engaging in argument from evidence:** Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.	198-204
	7. Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence.	198-204
Disciplinary Core Ideas	**VARIATION OF TRAITS** In sexual reproduction, chromosomes can sometimes swap sections or cross over 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. (HS.LS3B.a)	200-201 203-204 209-210
	Mutations may occur due to errors during DNA replication and/or environmental factors. In general, only mutations that occur in gametes (sperm and egg) can be passed to offspring. Genes have variations (alleles) that code for specific variants of a protein (or RNA), and therefore specific traits of an individual. (HS.LS3B.b)	203-204, 209-210 195-196
	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. (HS.LS3B.c)	209-210
Cross Cutting Concepts	**CAUSE AND EFFECT** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	198-204

Biological Evolution: Unity and Diversity (LS4) **HS.LS4.1** Analyze and interpret scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.		221-230
Science and Engineering Practice	**4. Analyzing and interpreting data:** Analyzing data in 9-12 builds on K-8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.	221-230
	4. Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations.	228-231
Disciplinary Core Ideas	**EVIDENCE OF COMMON ANCESTRY AND DIVERSITY** Genetic information 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 observable anatomical and embryological evidence. (HS.LS4A.a)	221, 227-230
Cross Cutting 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.	221-230

Biological Evolution: Unity and Diversity (LS4) **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.		234-235, 238-242, 246, 252 Background: 120-123
Science and Engineering Practices	**6. Constructing explanations and designing solutions:** Constructing explanations (science) and designing solutions (engineering) in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.	234-235, 238-242, 246, 252
	6. 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.	234-235, 238-242, 246, 252
Disciplinary Core Ideas	**NATURAL SELECTION** Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population e.g. mutations and sexual reproduction and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. Natural selection leads to populations that have more individuals with behavioral, anatomical, and physiological adaptations. (HS.LS4B.a)	234-242
	The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. (HS.LS4B.c)	234-242
Cross Cutting Concepts	**CAUSE AND EFFECT** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	234-242

Biological Evolution: Unity and Diversity (LS4) **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.		235, 238-242
Science and Engineering Practices	**4. Analyzing and interpreting data:** Analyzing data in 9-12 builds on K-8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.	238-242
	4. Apply concepts of statistics and probability (e.g., determining function fits to data and correlation coefficient for linear or nonlinear fits) to scientific and engineering questions and problems, using digital tools when feasible.	242
Disciplinary Core Ideas	**NATURAL SELECTION** Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population e.g. mutations and sexual reproduction and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. Natural selection leads to populations that have more individuals with behavioral, anatomical, and physiological adaptations. (HS.LS4B.a)	234-235, 238-242, 246, 252
	The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. (HS.LS4B.c)	234, 235, 138, 240-242
	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. (HS.LS4C.a)	236-237
	Adaptation also means that the distribution of traits in a population can change when conditions change. (HS.LS4C.b)	238-242
Cross Cutting 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.	245

Biological Evolution: Unity and Diversity (LS4) **HS.LS4.4** Construct an explanation based on evidence for how natural selection and other mechanisms lead to genetic changes in populations.		238-242, 245-248
Science and Engineering Practice	**6. Constructing explanations and designing solutions:** Constructing explanations (science) and designing solutions (engineering) in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.	238-242
	6. 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.	238-242
Disciplinary Core Ideas	**NATURAL SELECTION** Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population e.g. mutations and sexual reproduction and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. Natural selection leads to populations that have more individuals with behavioral, anatomical, and physiological adaptations. (HS.LS4B.a)	234-235, 238-242
	Genetic drift and gene flow can lead to genetic changes in populations, not adaptations. (HS.LS4B.b)	244
	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. (HS.LS4C.a)	236-237
	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. (HS.LS4C.c)	245-248
Cross Cutting Concepts	**CAUSE AND EFFECT** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	238-242, 245-248

Biological Evolution: Unity and Diversity (LS4) **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.		243-248
Science and Engineering Practice	**7. Engaging in argument from evidence:** Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.	243-248
	7. Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.	243-248
Disciplinary Core Ideas	**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. (HS.LS4C.c)	245-248
	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. (HS.LS4C.d)	247-248
Cross Cutting Concepts	**CAUSE AND EFFECT** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	243-248