Introduction

Science, Technology & Engineering, and Environmental Literacy & Sustainability (STEELS) Standards guide the study of the natural and human-made world through inquiry, problem-solving, critical thinking, and authentic exploration. This document displays a curriculum framework for High School Life Science. It is designed to focus curriculum and teaching, provide guidance for multiple approaches to curriculum development, encourage less reliance on textbooks as curriculum, and avoid activity-oriented teaching without focus/purpose.

Science Long Term Transfer Goals

In support of the Curriculum Framework, Long Term Transfer Goals (LTTG) provide the overarching practices that ground the foundation for a robust curriculum; thus, all curriculum should relate to one or more of the LTTGs detailed below – as they highlight the effective uses of understanding, knowledge, and skill that we seek in the long run; i.e., what we want students to be able to do when they confront new challenges – both in and outside of school.

Students will be able to engage as technological and engineering literate members of a global society, using their learning to:

1. Approach science as a reliable and tentative way of knowing and explaining the natural world and designed world.
2. Weigh evidence and use scientific approaches to ask questions, investigate, and make informed decisions.
3. Make and use observations to analyze relationships and patterns in order to explain phenomena, develop models, and make predictions.
4. Evaluate systems, in order to connect how form determines function and how any change to one component affects the entire system.
5. Explain how the natural and designed worlds are interrelated and the application of scientific knowledge and technology can have beneficial, detrimental, or unintended consequences.

Note: The 2014 Assessment Anchors and Eligible Content will be used for the Biology Keystone Exam during the 2024-2025 school year. For the 2025-2026 school year, the Biology Keystone Exam will not have Assessment Anchors/Eligible Content. The Biology Keystone Exam will be based upon the STEELS Life Science Standards and Assessment Boundaries.

Grade 9-12 Life Science

Structure and Function							
Big Idea	**Essential Question**	**Standard**	**Science and Engineering Practices**	**Disciplinary Core Idea**	**Crosscutting Concepts**	**Vocabulary**	**Assessment Anchors Eligible Content**
Organisms have characteristic structures which enable functions and behaviors that allow them to grow, reproduce, and die.	How do the structures of organisms enable life's functions?	**3.1.9-12.A 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.**	**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.	Systems of specialized cells within organisms help them perform the essential functions of life. 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.	**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.	DNA RNA Genes Protein Protein Synthesis DNA replication transcription translation	BIO.B.1.2.1 BIO.B.1.2.2 BIO.B.2.2.1 BIO.B.2.2.2
Organisms have characteristic structures which enable functions and behaviors that allow them to grow, reproduce, and die.	How do the structures of organisms enable life's functions?	**3.1.9-12.B Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within**	**Developing and Using Models** Develop and use a model based on evidence to illustrate the relationships between systems or	Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a	**Systems and System Models** Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—	unicellular multicellular prokaryotic eukaryotic tissue organ organ system organism	BIO.A.1.1.1 BIO.A.1.2.2

		multicellular organisms.	between components of a system.	component of the next level.	including energy, matter, and information flows—within and between systems at different scales.	stimuli circulatory system nutrient levels of biological organization model system	
Organisms have characteristic structures which enable functions and behaviors that allow them to grow, reproduce, and die.	How do the structures of organisms enable life's functions?	**3.1.9-12.C** **Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.**	**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.	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.	**Stability and Change** Feedback (negative or positive) can stabilize or destabilize a system.	homeostasis feedback loops stomate transpiration temperature regulation osmoregulation excretory system	BIO.A.4.2.1 BIO.A.4.1.1 BIO.A.4.1.2

Growth and Development of Organisms

Big Idea	Essential Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Cross-Cutting Concepts	Vocabulary	Assessment Anchors Eligible Content
The characteristic structures, functions and behaviors of organisms change in predictable ways as they progress through their life cycle.	How do organisms grow and develop?	**3.1.9-12.D** **Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.**	**Developing and Using Models** Use a model based on evidence to illustrate the relationships between systems or between components of a system.	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.	**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.	mitosis gene expression differentiation multicellular differentiation tissue organ organ system organism input output system model	BIO.B.1.1.1 BIO.B.1.1.2

Organization for Matter and Energy Flow in Organisms

Big Idea	Essential Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Cross-Cutting Concepts	Vocabulary	Assessment Anchors Eligible Content
The structures, functions, and behaviors of organisms allow them to obtain, use, transport, and remove the matter and energy needed to live.	How do organisms obtain and use the matter and energy they need to live and grow?	**3.1.9-12.E** **Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.**	**Developing and Using Models** Use a model based on evidence to illustrate the relationships between systems or between components of a system.	The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen.	**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.	photosynthesis glucose input output reactant product chemical energy light energy	BIO.A.3.1.1 BIO.A.3.2.1 BIO.A.3.2.2
The structures, functions, and behaviors of organisms allow them to obtain, use, transport, and remove the matter and energy needed to live.	How do organisms obtain and use the matter and energy they need to live and grow?	**3.1.9-12.F** **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.**	**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.	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. As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.	**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.	organic molecules monomer polymer macromolecules protein hydrocarbon amino acid cellular respiration matter element metabolism	BIO.A.2.2.1 BIO.A.2.2.2 BIO.A.2.2.3 BIO.A.2.3.2 BIO.A.2.3.1

The structures, functions, and behaviors of organisms allow them to obtain, use, transport, and remove the matter and energy needed to live.	How do organisms obtain and use the matter and energy they need to live and grow?	**3.1.9-12.G** **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.**	**Developing and Using Models** Use a model based on evidence to illustrate the relationships between systems or between components of a system.	As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. 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.	**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.	mitochondria cellular respiration reactants products chemical energy stored energy input output food molecule net transfer ADP/ATP	BIO.A.2.3.1 BIO.A.2.3.2 BIO.A.3.1.1 BIO.A.3.2.1 BIO.A.3.2.2

Interdependent Relationships in Ecosystems

Big Idea	Essential Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Cross-Cutting Concepts	Vocabulary	Assessment Anchors Eligible Content
Ecosystems are complex systems that include both	How do organisms interact with the living and nonliving	**3.1.9-12.H** **Use mathematical representations to**	**Using Mathematical and Computational Thinking**	Plants or algae form the lowest level of the food web. At each link upward	**Energy and Matter** Energy cannot be created or destroyed—it	food chains/webs trophic levels energy	BIO.B.4.1.1

living (biotic) and non-living (abiotic) components that interact with each other.	environments to obtain matter and energy?	**support claims for the cycling of matter and flow of energy among organisms in an ecosystem.**	Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical representations of phenomena or design solutions to support claims.	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.	only moves between one place and another place, between objects and/or fields, or between systems.	conservation of energy	BIO.B.4.1.2 BIO.B.4.2.1 BIO.B.4.2.2 BIO.B.4.2.3 BIO.B.4.2.4
Ecosystems are complex systems that include both living (biotic) and	How do organisms interact with the living and nonliving environments to	**3.1.9-12.I** **Use mathematical and/or computational representations to**	**Using Mathematics and Computational Thinking**	Ecosystems have carrying capacities, which are limits to the numbers of organisms and	**Scale Proportion and Quantity** The significance of a phenomenon is	carrying capacity limiting factors ecosystem predation	BIO.B.4.1.1 BIO.B.4.1.2 BIO.B.4.2.1

non-living (abiotic) components that interact with each other.	obtain matter and energy?	**support explanations of factors that affect carrying capacity of ecosystems at different scales.**	Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical and/or computational representations of phenomena or design solutions to support explanations.	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.	dependent on the scale, proportion, and quantity at which it occurs.	competition biotic abiotic scale proportion	BIO.B.4.2.2 BIO.B.4.2.5

Cycles of Matter and Energy Transfer in Ecosystems

Big Idea	Essential Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Cross-Cutting Concepts	Vocabulary	Assessment Anchors Eligible Content
The cycling of matter and the flow of energy within ecosystems occur through interactions among different organisms and between organisms and the	How do matter and energy move through an ecosystem?	**3.1.9-12.J** **Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.**	**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,	Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes.	**Energy and Matter** Energy drives the cycling of matter within and between systems.	anaerobic respiration aerobic respiration photosynthesis cellular respiration energy transfer	BIO.A.3.2.1 BIO.A.3.2.2

physical environment.			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.				
The cycling of matter and the flow of energy within ecosystems occur through interactions among different organisms and between organisms and the physical environment.	How do matter and energy move through an ecosystem?	**3.1.9-12.K** **Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.**	**Developing and Using Models** Develop a model based on evidence to illustrate the relationships between systems or components of a system.	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.	**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.	carbon cycle photosynthesis cellular respiration carbon cycle biosphere atmosphere hydrosphere geosphere	BIO.B.4.1.1 BIO.B.4.1.2 BIO.B.4.2.1 BIO.B.4.2.2 BIO.B.4.2.3
The cycling of matter and the flow of energy within ecosystems occur through interactions among different organisms and	How do matter and energy move through an ecosystem?	**3.1.9-12.L** **Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and**	**Using Mathematics and Computational Thinking** Simple computational simulations are created and used based on	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	**Scale Proportion and Quantity** Using the concept of orders of magnitude allows one to understand how a model at one scale	carrying capacity limiting factors biodiversity biotic abiotic population ecosystem predation	BIO.B.4.1.1 BIO.B.4.1.2 BIO.B.4.2.1 BIO.B.4.2.2 BIO.B.4.2.5

between organisms and the physical environment.		**populations in ecosystems of different scales.**	mathematical models of basic assumptions. Use mathematical representations of phenomena or design solutions to support and revise explanations.	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.	relates to a model at another scale.	competition	

Ecosystem Dynamics, Functioning, and Resilience

Big Idea	Essential Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Cross-Cutting Concepts	Vocabulary	Assessment Anchors Eligible Content
As the environment and populations of species change, there are resulting changes in ecosystems.	How do environmental changes impact ecosystems?	**3.1.9-12.M** **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.**	**Engaging in Argument from Evidence** Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.	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	**Stability and Change** Much of science deals with constructing explanations of how things change and how they remain stable.	ecological relationships niche succession organism	BIO.B.4.2.4 BIO.B.4.2.5

Big Idea	Essential Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Cross-Cutting Concepts	Vocabulary	Assessment Anchors Eligible Content
				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.			
As the environment and populations of species change, there are resulting changes in ecosystems	How do environmental changes impact ecosystems?	**3.1.9-12.N** **Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.**	**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 trade off considerations.	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.	**Stability and Change** Much of science deals with constructing explanations of how things change and how they remain stable.	human disturbances ecosystem biodiversity	BIO.B.4.2.4 BIO.B.4.2.5
Social Interactions and Group Behavior							
Big Idea	**Essential Question**	**Standard**	**Science and Engineering Practices**	**Disciplinary Core Idea**	**Cross-Cutting Concepts**	**Vocabulary**	**Assessment Anchors Eligible Content**
Many species live in groups, increasing the chances of survival for	How do organisms interact in groups so as to benefit individuals?	**3.1.9-12.O** **Evaluate the evidence for the role of group behavior on individual and species' chances to**	**Engaging in Argument from Evidence** Engaging in argument from evidence in 9–12 builds on K–8 experiences and	Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives.	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make	group behaviors genetic relatedness species group behaviors natural selection	N/A

individuals and their relatives.		**survive and reproduce.**	progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed worlds. Arguments may also come from current scientific or historical episodes in science. Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.		claims about specific causes and effects.	evolution cause and effect correlation	

Inheritance of Traits

Big Idea	Essential Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Cross-Cutting Concepts	Vocabulary	Assessment Anchors Eligible Content
Offspring resemble, but are not identical to, their parents due to traits being passed from one generation to the next via genes.	How are the characteristics of one generation related to the previous generation?	**3.1.9-12.P** **Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits**	**Asking Questions and Defining Problems** Ask questions that arise from examining models or a theory to clarify relationships.	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	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	DNA gene allele chromosome gene expression protein traits inheritance	BIO.B.1.2.2

		passed from parents to offspring.		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.			

Variation of Traits

Big Idea	Essential Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Cross-Cutting Concepts	Vocabulary	Assessment Anchors Eligible Content
Variation among individuals of the same species can be explained by both genetic and environmental factors.	Why do individuals of the same species vary in how they look, function, and behave?	**3.1.9-12.Q** **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.**	**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.	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	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	meiosis genetic mutation genetic variation	BIO.B.2.1.2 BIO.B.2.3.1 BIO.B.2.4.1

				genes, and viable mutations are inherited. 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.			
Variation among individuals of the same species can be explained by both genetic and environmental factors.	Why do individuals of the same species vary in how they look, function, and behave?	**3.1.9-12.R Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.**	**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.	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.	**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).	genotype phenotype inheritance traits gene expression population	BIO.B.2.1.1 BIO.B.3.3.1

Evidence of Common Ancestry and Diversity

Big Idea	Essential Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Cross-Cutting Concepts	Vocabulary	Assessment Anchors Eligible Content
Comparisons between species provides evidence	What evidence supports the	**3.1.9-12.S Communicate scientific information**	**Obtaining, Evaluating, and Communicating Information**	Genetic information, like the fossil record, provides evidence of evolution.	**Patterns** Different patterns may be observed at each of	evolution evolutionary evidence	BIO.B.3.2.1 BIO.B.3.3.1

that they evolved from common ancestors, explaining the similarities and differences between species.	relationship between species?	**that common ancestry and biological evolution are supported by multiple lines of empirical evidence.**	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).	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.	the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.		

Natural Selection

Big Idea	Essential Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Cross-Cutting Concepts	Vocabulary	Assessment Anchors Eligible Content
In any environment, individuals with particular traits may be more likely than others to survive and produce offspring.	How does genetic variation among organisms affect survival and reproduction?	**3.1.9-12.T 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**	**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	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.	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	natural selection evolution biological fitness genetic variation mutation competition	BIO.B.3.1.1 BIO.B.3.3.1

		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.	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.				
In any environment individuals with particular traits may be more likely than others to survive and produce offspring.	How does genetic variation among organisms affect survival and reproduction?	**3.1.9-12.U** **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.**	**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. Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and	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. The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population.	**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.	natural selection evolution allele frequency biological fitness	BIO.B.3.1.1 BIO.B.3.3.1

			engineering questions and problems, using digital tools when feasible.				

Adaptation

Big Idea	Essential Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Cross-Cutting Concepts	Vocabulary	Assessment Anchors Eligible Content
When the environment changes, some individuals in a population may have traits that provide a reproductive advantage which over many generations can change the make-up of a population.	How does the environment influence populations of organisms over multiple generations?	**3.1.9-12.V** **Create or revise a simulation to test a solution to mitigate the adverse impacts of human activity on biodiversity.**	**Using Mathematics and Computational Thinking** Simple computational simulations are created and used based on mathematical models of basic assumptions. Create or revise a simulation of a phenomenon, designed device, process, or system.	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.	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	biodiversity speciation biological extinction human disturbances	BIO.B.4.2.4 BIO.B.4.2.5
When the environment changes, some individuals in a population may have traits that provide a reproductive advantage which over many generations can change the make-	How does the environment influence populations of organisms over multiple generations?	**3.1.9-12.W** **Construct an explanation based on evidence for how natural selection leads to adaptation of populations.**	**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,	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	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	Adaptation Biological fitness natural selection evolution	BIO.B.3.2.1 BIO.B.3.3.1

up of a population.			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.	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.			
When the environment changes, some individuals in a population may have traits that provide a reproductive advantage which over many generations can change the make-up of a population.	How does the environment influence populations of organisms over multiple generations?	**3.1.9-12.X** **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.**	**Engaging in Argument from Evidence** Arguments may also come from current or historical episodes in science. Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments.	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. 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.	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	Biodiversity species speciation extinction divergent evolution convergent evolution	BIO.B.3.2.1 BIO.B.3.3.1