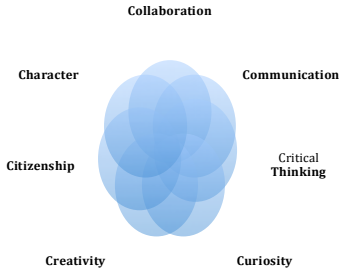
Content Area	Course: Biology	Grade Level: 9-10
Biology - Full Year 	**R14 The Seven Cs of Learning** 	

Unit Titles	Length of Unit
• Molecules to Organisms	• 9 weeks
• Heredity: Inheritance and Variation of Traits	• 10 weeks
• Biological Evolution: Unity and Diversity	• 8 weeks
• Ecosystems Interactions, Energy and Dynamics	• 8 weeks

Strands	Course Level Expectations
Structure and Processes	• 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. • Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. • Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. • Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. • 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. • 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.
Inheritance & Variation of Traits	• Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. • Clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. • 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. • Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
Ecosystems: Interactions, Energy, and Dynamics	• Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions. • Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. • Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. • Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. • Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity • Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
Interdependent Relationships in Ecosystems	• Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. • Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. • 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. • Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. • Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.

Biological Evolution: Unity and Diversity	• Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. • Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment. • 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. • Construct an explanation based on evidence for how natural selection leads to adaptation of populations. • 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. • Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity • Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.

Unit Title	Molecules to Organisms	**Length of Unit**	9 weeks

Inquiry Questions (Engaging & Debatable)	● How do the structures of organisms enable life's functions? ● How do organisms use matter and energy found in their environment to sustain life processes?
Standards*	HS-LS1-1, HS-LS1-2, HS-LS1-3. HS-LS1-5, HS-LS1-6, HS-LS1-7
Unit Strands & Concepts	**DISCIPLINARY CORE IDEAS (DCI):** ● Structure & Function ● Organization for Matter & Energy Flow in Organisms. **Cross Cutting Concepts (CCC)** ● Systems & System Models ● Structure & Function ● Stability & Change ● Energy & Matter
Key Vocabulary	Homeostasis, Photosynthesis, Light Energy, Chemical Energy, Cellular Respiration, Genes, Multi-Cellular Organisms

*Standards based on Next Generation Science Standards (NGSS) For more information visit: https://www.nextgenscience.org/

Unit Title	Molecules to Organisms	Length of Unit	weeks

Critical Content: **My students will Know…**	**Key Skills:** **My students will be able to (Do)…**
● 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. ● 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. ● 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) o discourage (negative feedback) what is going on inside the living system. ● The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen.	● 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. ● Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. ● Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. ● Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. ● Construct and revise an explanation based on evidence from models and simulations of how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. ● Construct a model to illustrate that cellular respiration is a chemical process whereby the bonds

● 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. ● 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.	of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.

Assessments:	Performance Task(s) focused on demonstrating an understanding of the structure and function of the various systems of specialized cells within multi-celled organisms necessary for life as well as how energy is used and transferred in sustaining these crucial life processes.
Teacher Resources:	NGSS Frameworks, Region 14 Science Implementation Guide, Model Based Inquiry Investigations, NGSS Phenomenon Resources, Stem Teaching Tools

Unit Title	Heredity: Inheritance and Variation of Traits	**Length of Unit**	9-10 weeks

Inquiry Questions **(Engaging & Debatable)**	● How are Characteristics of one generation passed to the next? ● How can individuals of the same species and even siblings have different characteristics?"
Standards	HS-LS1-4, HS-LS3-1, HS-LS3-2, HS-LS3-3
Unit Strands & Concepts	**DISCIPLINARY CORE IDEAS (DCI):** ● Structure & Function ● Inheritance of Traits ● Variance of Traits **Cross Cutting Concepts (CCC)** ● Cause and Effect ● Scale, Proportion, and Quantity
Key Vocabulary	Genes, Chromosomes, Meiosis, Mutations, Genetic Variation

Unit Title	Heredity: Inheritance and Variation of Traits	**Length of Unit**	9-10 weeks

Critical Content: **My students will Know…**	**Key Skills:** **My students will be able to (Do)…**
● 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. ● 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. ● 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	● Construct an explanation to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. ● 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. ● Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. ● Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. ● 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. ● 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.	

Assessments:	Performance Task(s) focused on demonstrating an understanding of why individuals of the same species vary in how they look, function, and behave. Additionally, students demonstrate an understanding of the mechanisms of genetic inheritance as well as the environmental and genetic causes of gene mutation and the alteration o gen expression.
Teacher Resources:	NGSS Frameworks, Region 14 Science Implementation Guide, Model Based Inquiry Investigations, NGSS Phenomenon Resources, Stem Teaching Tools

Unit Title	Biological Evolution: Unity and Diversity	**Length of Unit**	8 Weeks

Inquiry Questions **(Engaging & Debatable)**	● What evidence shows that different species are related? ● How does natural selection lead to a change in species over time?
Standards	HS-LS4-1, HS-LS4-2, HS-LS4-3, HS-LS4-4, HS-LS4-5, HS-LS4-6, HS-ESS2-7, HS-ETS1-2, HS-ETS1-3, HS-ETS1-4
Unit Strands & Concepts	**DISCIPLINARY CORE IDEAS (DCI):** ● Evidence of Common Ancestry and Diversity ● Natural Selection ● Adaptation ● Biodiversity and Humans **Cross Cutting Concepts (CCC)** ● Cause and Effect ● Patterns
Key Vocabulary	Natural Selection, Adaptation, DNA Sequences, Biodiversity, Speciation

Unit Title	Biological Evolution: Unity and Diversity	**Length of Unit**	weeks

Critical Content: **My students will Know…**	**Key Skills:** **My students will be able to (Do)…**
● 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 anatomical and embryological evidence. ● 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. ● 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	● Communicate scientific information that multiple lines of empirical evidence support common ancestry and biological evolution. ● Construct an explanation based on scientific evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment. ● 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. ● Construct an explanation based on evidence for how natural selection leads to adaptation of populations. ● Evaluate the evidence supporting claims that changes in

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. ● 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. ● Adaptation also means that the distribution of traits in a population can change when conditions change. ● 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. ● Biodiversity is increased by the formation of new species	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. ● Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

(speciation) and decreased by the loss of species (extinction). ● 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. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth.	

Assessments:	Performance task focusing on demonstrating an understanding of the processes of evolution and the role of natural selection. Additionally, students will show they can apply concepts of probability to explain population trends in specific environments.
Teacher Resources:	NGSS Frameworks, Region 14 Science Implementation Guide, Model Based Inquiry Investigations, NGSS Phenomenon Resources, Stem Teaching Tools

Unit Title	Ecosystems Interactions, Energy and Dynamics	**Length of Unit**	8 weeks

Inquiry Questions (Engaging & Debatable)	● How do organisms obtain and use energy they need to live and grow? ● How do matter and energy move through ecosystems?" ● How do organisms interact with the living and non-living environment to obtain matter and energy?
Standards	HS-LS2-1, HS-LS2-2, HS-LS2-3, HS-LS2-4, HS-LS2-5, HS-LS2-6, HS-LS2-7, HS-LS2-8, HS-ESS3-1, HS-ESS3-3, HS-ESS3-4, HS-ETS1-1, HS-ETS1-2, HS-ETS1-3, HS-ETS1-4
Unit Strands & Concepts	**DISCIPLINARY CORE IDEAS (DCI):** ● Cycles of Matter and Energy Transfer in Ecosystems ● Energy in Chemical Processes ● Social Interactions and Group Behavior ● Interdependent Relationships in Ecosystems ● Ecosystem Dynamics, Functioning, and Resilience ● Biodiversity and Humans **Cross Cutting Concepts (CCC)** ● Systems and System Models ● Energy and Matter ● Cause and Effect ● Scale, Proportion, and Quantity ● Stability and Change
Key Vocabulary	Aerobic and Anaerobic Conditions, Biosphere, Atmosphere, Hydrosphere, Geosphere, Ecosystem, Photosynthesis, Cellular Respiration

Unit Title	Ecosystems Interactions, Energy and Dynamics	**Length of Unit**	8 weeks

Critical Content: **My students will Know…**	**Key Skills:** **My students will be able to (Do)…**
● Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. ● 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. ● 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,	● Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions. ● Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. ● Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere carrying capacity of ecosystems at different scales. ● Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. ● Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of

physical, geological, and biological processes. ● The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis ● 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. ● complex set of interactions within an ecosystem 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 ● 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. ● Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives	organisms in stable conditions, but changing conditions may result in a new ecosystem. ● Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. ● Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. ● Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. ● Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. ● Evaluate or refine a technological solution that reduces impacts of human activities on natural systems

● Resource availability has guided the development of human society. ● Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations. ● The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. ● Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation.	

Assessments:	Performance task focusing on demonstrating an understanding of the role of energy in the cycling of matter in organisms and ecosystems, the interactions of photosynthesis and cellular respiration, and interactions among organisms and how those interactions influence the dynamics of ecosystems.
Teacher Resources:	NGSS Frameworks, Region 14 Science Implementation Guide, Model Based Inquiry Investigations, NGSS Phenomenon Resources, Stem Teaching Tools