Content Area:
Grade: Biology

Unit	Enduring Understandings	Essential Questions	Objectives	Skills
Unit 1 From Molecules to Organisms	**Students will understand that:** ● 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-LS1-2) ● 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	● What Is Science? ● What skills do scientists have? ● What is life? ● What is the chemistry of life? ● How did we go from element to living organisms? ● Why is water so important for life? ● How is structure related to function within cells? ● Why are cells small?	● Explain the connection between the sequence and the subcomponents of a biomolecule and its properties. ● Create representations that explain how genetic information flows from a sequence of nucleotides in a gene to a sequence of amino acids in a protein. ● Construct an explanation based on evidence for how the structure of DNA determines	● Constructing explanations 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. ● Develop and use a model based on evidence to illustrate the

	change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS1-3) ● Regions of DNA called genes determine the structure of proteins, which carry out the essential functions of life through systems of specialized cells. The sequence of genes contains instructions that code for proteins. (LS1.A) ● Systems of specialized cells		the structure of proteins which carry out the essential functions of life through systems of specialized cells. ● Construct models that explain the movement of molecules across membranes with membrane structure and function. ● Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. ● Provide examples and explain how organisms use feedback	relationship between systems or between components of a system. ● 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, coat, risk, time), and refine the design accordingly. ● Scientific inquiry is characterized by

	within organisms help them perform the essential functions of life. (HS-LS1-1) ● Groups of specialized cells (tissues) use proteins to carry out functions that are essential to the organism. (LS1.A) ● Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of		systems to maintain their internal environments. ● Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. ● Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.	a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings. ● Use a model to illustrate the relationship between systems or between components of a system.

	the subject under investigation. WHST.9-12.7 (HS-LS1-3) ● All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. (secondary to HS-LS3-1) ● 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.			
Unit 2 Photosynthesis and Respiration	**Students will understand that:** ● The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. ● Plants, green algae, and some bacteria convert light energy to chemical energy in the chemical reactions of photosynthesis. ● Plants need light energy, the green	● How can the process of photosynthesis and respiration in a cell impact ALL of Earth's systems? ● Why is ATP so useful? ● What happens during the process of photosynthesis? ● What role do pigments play in the process of photosynthesis? ● What are electron carrier molecules? ● What are the reactants and	● Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. ● Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions. ● Develop a model to illustrate the role of photosynthesis	● Constructing explanations 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

	pigment chlorophyll, carbon dioxide and water as reactants and produce oxygen and biomolecules as products of the photosynthetic reactions. ● The chemical energy that is converted during photosynthesis is stored in the bonds of the biomolecules that are produced. ● ATP is the molecule of energy for the entire living world. ● All living things perform cellular respiration reactions that break-down biomolecules to convert stored energy into the	products of photosynthesis? ● What happens during the light-dependent reactions? ● What happens during the light-independen t reactions? ● What factors affect photosynthesis? ● Where do organisms get their energy? ● What is cellular respiration? ● What is the relationship between photosynthesis and cellular respiration? ● What happened during glycolysis and the krebs cycle? ● How does the electron transport chain use high-energy electrons from	and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere and geosphere. ● 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.	continue to do so in the future. ● Develop and use a model based on evidence to illustrate the relationship between systems or between components of a system. ● 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, coat, risk, time),

	usable form of energy for all of life which is ATP. ● These reactions can occur with oxygen (aerobic) and in some organisms without oxygen (anaerobic). ● Aerobic reactions convert more energy than anaerobic reactions, and can lead to muscle fatigue when reactions run in low oxygen situations.	glycolysis and the kreb cycle? ● How much ATP does cellular respiration generate? ● How do organisms produce energy when oxygen is not available?		and refine the design accordingly. ● Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings. ● Use a model to illustrate the relationship between systems or between components of a system.
Heredity: Inheritance and Variation of Traits	**Students will understand that:** ● All cells contain genetic information in	● Where does an organism get its unique characteristics? ● How are different forms	● Students analyze data and develop models to make sense of the relationship between DNA	● Constructing explanations based on valid and reliable evidence obtained from a

	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	of a gene distributed to offspring? ● How can we use probability to predict traits? ● What did Mendel contribute to our understanding of genetics? ● What clues did bacterial transformation yield about the gene? ● What is the role of DNA in heredity? ● What are the chemical components of DNA? ● How does DNA replication differ in prokaryotes and eukaryotes? ● How does RNA differ from DNA? ● How does the cell make RNA?	and chromosomes in the process of cellular division, which passes traits from one generation to the next. ● Students determine why individuals of the same species vary in how they look, function, and behave. ● Students develop *conceptual models* of the role of DNA in the unity of life on Earth and *use statistical models* to explain the importance of variation within populations for the survival and evolution of species. Ethical issues related to genetic modification of	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. ● Develop and use a model based on evidence to illustrate the relationship between systems or between components of a system. ● Plan and conduct an investigation individually and collaboratively to produce data

	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 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	● How does the genetic code work? ● How are genes regulated? ● In what ways do mutations change genetic information? ● What are the effects of errors in meiosis? ● How do small changes in DNA affect human traits? ● How can scientists read DNA base sequences? ● How is recombinant DNA used? ● How are transgenic organisms produced? ● How can genetic engineering and biotechnology benefit society? ● What are some of the ethical	organisms and the nature of science are described. ● Students explain the mechanisms of genetic inheritance and describe the environmental and genetic causes of gene mutation and the alteration of gene expression	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, coat, risk, time), and refine the design accordingly. ● Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and

	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.	issues around new biotechnology?		ethical reporting of findings. ● Use a model to illustrate the relationship between systems or between components of a system.

Unit 4: Biological Evolution: Unity and Diversity	**Students will understand that:** ● Darwin's theory of evolution by natural selection is the best scientific explanation for patterns among organisms. ● Evolutionary theory demonstrates and explains relationships between structure of living things and their functions, mechanisms of change and their effects and patterns of change over time. ● Evolutionary fitness is measured by reproductive success. ● Humans impact variation in other species.	● How do the ideas of natural selection and descent with modification explain the majority of biological phenomena? ● What did Charles Darwin contribute to the modern understanding of evolution? ● How is inherited variation used in artificial selection? ● Under what conditions does natural selection occur? ● What does evolutionary theory suggest about the	● Students constructing explanations and designing solutions, analyzing and interpreting data, and engaging in arguments from evidence investigate to make sense of the relationship between the environment and natural selection. ● Students also develop an understanding of the factors causing natural selection of species over time. They also demonstrate and understand how multiple lines of evidence contribute to the strength of scientific theories of natural selection.	● Constructing explanations 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. ● Develop and use a model based on evidence to illustrate the relationship between systems or between components of a system.

	● Mathematical models and simulations can be used to illustrate and support evolutionary concepts. ● Evolution is an ongoing process	unity and diversity of life? ● How does geographic distribution of species today relate to their evolutionary history? ● How do fossils help document the descent of modern species? ● What do homologous structures and similarities in development suggest about the progress of evolutionary change? ● How can molecular biology be used to trace the process of evolution?	● The crosscutting concepts of patterns and cause and effect serve as organizing concepts for the disciplinary core ideas. ● Students also use the science and engineering practices to demonstrate understanding of the disciplinary core ideas.	● 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, coat, risk, time), and refine the design accordingly. ● Scientific inquiry is characterized by a common set of values that include: logical thinking, precision,

				open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings. ● Use a model to illustrate the relationship between systems or between components of a system
Unit 5: Biological Evolution and Biodiversity	**Students will understand that:** ● A diverse gene pool is important for the survival of a species in a changing environment. ● Phenotypic variations are not directed by the environment, but occur through random changes in the DNA and through new	● How is evolution defined in genetic terms? ● What are the sources of genetic variation? ● What determines the number of phenotypes for a given trait? ● How does natural selection affect single-gene traits?	● Students construct explanations for the processes of natural selection and evolution and then communicate how multiple lines of evidence support these explanations. ● Students evaluate evidence of the conditions that may result in	● Constructing explanations 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

	gene combinations. ● Reduction of genetic variation within a given population can increase the differences between populations of the same species. ● Phylogenetic trees and cladograms illustrate speciation that has occurred. ● Phylogenetic trees and cladograms are dynamic, based on the biological data used, new mathematical and computational ideas, and current and emerging knowledge. ● New species arise from	● What is genetic drift? ● What are the conditions required to maintain genetic equilibrium? ● What types of isolation lead to the formation of new species? ● Where do new genes come from? ● How may Hox genes be involved in evolutionary change? ● What is the goal of evolutionary classification? ● How are DNA sequences used in classification? ● What does the tree of life show?	new species and understand the role of genetic variation in natural selection. ● Students can apply concepts of probability to explain trends in population as those trends relate to advantageous heritable traits in a specific environment. ● Students demonstrate an understanding of these concepts by obtaining, evaluating, and communicating information and constructing explanations and designing solutions. ● Students will evaluate human impacts on biodiversity and their dependence	describe the natural world operate today as they did in the past and will continue to do so in the future. ● Develop and use a model based on evidence to illustrate the relationship between systems or between components of a system. ● 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

	reproductive isolation over time, which can involve scales of hundreds of thousands or even millions of years, or speciation can occur rapidly. ● Evolution is an ongoing process ● Speciation rates can vary, especially when adaptive radiation occurs when new habitats become available. ● Species extinction rates are rapid at times of ecological stress ● Humans depend on the living world, the resources and other benefits provided by biodiversity. But human activity		on resources while postulating strategies to preserve biodiversity.	limitations on the precision of the data (e.g., number of trials, coat, risk, time), and refine the design accordingly. ● Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings. ● Use a model to illustrate the relationship between systems or between components of a system.

	is having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species and climate change.			