Diocese of Greensburg Curriculum
Biology I

Unit	Standards	Content	Skills
Molecules to Organisms: Structures and Processes	**CCSS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12** **CCSS: Grades 9-10** **Writing** **5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach.** **Research to Build and Present Knowledge** **7. Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.** **9. Draw evidence from literary or informational texts to support analysis, reflection, and research.** **NGSS: Science Performance Expectations (2013)** **NGSS: HS Life Sciences** **HS.Matter and Energy in Organisms and Ecosystems** **Performance Expectations** 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. HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. **NGSS: Science and Engineering Practices** **NGSS: 9-12** **Practice 1. Asking questions (for science) and defining problems (for engineering)** **Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to**	• All living organisms have common characteristics. • The scientific method is used for scientific investigations. • All living things are composed of matter. • Living organisms are comprised of organic compounds. • Cells are made up of organelles which carry out specific functions. • Cells carry out specific processes such as cellular transport, photosynthesis, and respiration. • Terminology related to the characteristics of life, themes of biology, basic chemistry, organic chemistry, cellular organelles, cellular transport, photosynthesis and cellular respiration.	Students will be able to... • Complete “Characteristics of Life Lab” to identify common characteristics of living organisms. • Conduct a simple experiment using the scientific method and then write up a formal lab report. • Describe terminology used in basic chemistry. • Conduct tests to differentiate organic compounds. • Utilize a microscope to observe characteristic plant and animal cells. • Conduct experiments to observe cellular processes including photosynthesis and osmosis.

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	formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory. **Practice 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 worlds.** **Practice 3. Planning and carrying out investigations** **Planning and carrying out investigations 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.** 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. Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated. **Practice 6. Constructing explanations (for science) and designing solutions (for engineering)** **Constructing explanations and designing solutions 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.** Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables.		

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	Practice 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.** Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source. Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (i.e., orally, graphically, textually, mathematically). **NGSS: Disciplinary Core Ideas** **NGSS: 9-12** **LS1: From Molecules to Organisms: Structures and Processes** **LS1.A: Structure and Function** Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1) 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. (HS-LS1-1)(secondary to HS-LS3-1) 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 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) **LS1.C: Organization for Matter and Energy Flow in Organisms** The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. (HS-LS1-5)		

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	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. (HS-LS1-6) As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (HS-LS1-6),(HS-LS1-7) As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another and release energy to the surrounding environment and to maintain body temperature. Cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. (HS-LS1-7) **PS1: Matter and Its Interactions** **PS1.A: Structure and Properties of Matter** Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1) **PS3: Energy** **PS3.B: Conservation of Energy and Energy Transfer** Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. (HS-PS3-1) Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1),(HSPS3-4) 		
Genetics	**CCSS: English Language Arts 6-12** **CCSS: Grades 11-12** **Speaking & Listening**	• Mitosis and meiosis are events that allow organisms to grow and reproduce and through these processes genetic	The students will be able to: • Create a model to illustrate the phases of the cell cycle and meiosis

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	5. Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations. SL.11-12.5. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. **CCSS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12** **CCSS: Grades 9-10** **Writing** **Research to Build and Present Knowledge** **7. Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.** WHST.9-10.7. 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 the subject under investigation. **9. Draw evidence from literary or informational texts to support analysis, reflection, and research.** WHST.9-10.9. Draw evidence from informational texts to support analysis, reflection, and research. **NGSS: Disciplinary Core Ideas** **NGSS: 9-12** **LS1: From Molecules to Organisms: Structures and Processes** **LS1.A: Structure and Function** All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1)(secondary to HS-LS3-1) **LS1.B: Growth and Development of Organisms** In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively	variation occurs among organisms • Chromosomes are made of DNA and DNA contains the genetic information that is inherited by an organism's offspring • DNA is replicated in order for reproduction of cells to occur. • DNA is directly related to the production of proteins through the process of protein synthesis. This guides the inheritance of traits. • Mendelian patterns of inheritance can be used to predict offspring • Modern patterns of inheritance are more complex and involve multiple alleles, many genes, sex-linked genes, codominance and incomplete dominance • Genetic mutations may alter the DNA sequence and may or may not have detrimental effects on phenotypes • Environmental factors can induce mutations and alter the expression of traits • Gene technology has impacted human health, medicine, forensics and agriculture and has moral and ethical implications • Terminology related to mitosis and meiosis, DNA structure, DNA replication, mutations, genes, protein synthesis, the inheritance of traits and gene technology.	• Using models, construct a molecule of DNA and identify the steps of DNA replication. Explain how errors can occur during this process. • Observe, through student demonstration and/or video, the processes of transcription and translation. Explain the importance of proteins in maintaining homeostasis and the expression of genes. • Predict offspring using Mendelian patterns of inheritance (monohybrid, dihybrid) • Show how more complex patterns of inheritance affect phenotypic and genotypic ratios using Punnett squares • Research genetic disorders caused by mutations and present findings to the class • Analyze the moral and ethical dilemmas associated with certain gene technology (genetic testing, cloning, genetic engineering) and debate the implications for society. • Design a technique to improve or eliminate the genetic disorder that was researched.

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	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. (HS-LS1-4) **LS3: Heredity: Inheritance and Variation of Traits** **LS3.A: Inheritance of Traits** Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used(expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. (HS-LS3-1) **LS3.B: Variation of Traits** In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. (HS-LS3-2) 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-LS3-2),(HS-LS3-3) **ETS1: Engineering Design** **ETS1.A: Defining and Delimiting an Engineering Problem** Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such away that one can tell if a given design meets them. (HS-ETS1-1)(secondary to HS-PS2-3) (secondary to HS-PS3-3)		

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Evolution	**CCSS: English Language Arts 6-12** **CCSS: Grades 11-12** **Speaking & Listening** **Presentation of Knowledge and Ideas** **4. Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.** SL.11-12.4. Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range or formal and informal tasks. **CCSS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12** **CCSS: Grades 9-10** **Writing** **2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.** WHST.9-10.2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. **5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach.** WHST.9-10.5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or	• Scientist have specific theories on the formation of the earth. • Certain conditions had to exist for life to emerge on the primitive earth. • The first forms of life on earth existed at the cellular level. • All living organisms share a common ancestor. • The fossil record, comparative anatomy, and embryology are evidence for evolution. • Natural selection is the driving force behind evolution. • Species must adapt to changing conditions over time in order to survive. • Biodiversity has increased over time due to speciation. • Certain conditions must exist in order for speciation to occur. • Terminology related to natural selection, fitness, variation, reproductive isolation, geographic isolation, allele frequency, speciation, biodiversity, macroevolution, microevolution, vestigial and homologous structures	The students will be able to: • Illustrate the history of the earth using a timeline or flow chart. • Simulate the conditions found on early earth by making microspheres. • Analyze the evidence that supports the existence of early life forms. • Analyze data and evidence to determine relative age of organisms and how closely related organisms are to one another. • Model the selection of favorable traits in new generations. • Use on-line tools to explore how speciation can occur.

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	trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. **Research to Build and Present Knowledge** **7. Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.** WHST.9-10.7. 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 the subject under investigation. **9. Draw evidence from literary or informational texts to support analysis, reflection, and research.** WHST.9-10.9. Draw evidence from informational texts to support analysis, reflection, and research. **CCSS: Grades 11-12** **Reading: Science & Technical Subjects** **Key Ideas and Details** **1. Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.** RST.11-12.1. Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. **8. Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.** RST.11-12.8. Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or		

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	challenging conclusions with other sources of information. **CCSS: Mathematics** **CCSS: HS: Num/Quantity** **Mathematical Practice** **MP.The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students.** MP.2. Reason abstractly and quantitatively. MP.4. Model with mathematics. **NGSS: Disciplinary Core Ideas** **NGSS: 9-12** **LS4: Biological Evolution: Unity and Diversity** **LS4.A: 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 anatomical and embryological evidence. (HS-LS4-1) **LS4.B: Natural Selection** Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. (HS-LS4-2),(HS-LS4-3) The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. (HS-LS4-3) **LS4.C: Adaptation** Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in		

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	number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3)competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. (HS-LS4-2) 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-LS4-3),(HS-LS4-4) Adaptation also means that the distribution of traits in a population can change when conditions change. (HS-LS4-3) 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-LS4-5),(HS-LS4-6) 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-LS4-5) **LS4.D: Biodiversity and Humans** Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are		

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	maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (secondary to HS-LS2-7)(HS-LS4-6) **ESS1: Earth's Place in the Universe** **ESS1.B: Earth and the Solar System** Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes. (secondary to HS-ESS2-4) **ESS2.E:Biogeology** The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it. (HS-ESS2-7) **ESS3: Earth and Human Activity** **ESS3.B: Natural Hazards** 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. (HS-ESS3-1) **PS1: Matter and Its Interactions** **PS1.C: Nuclear Processes** Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process. (HSPS1-8) Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials. (secondary to HS-ESS1-5),(secondary to HS-ESS1-6)		

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Ecology and Biodiversity	**CCSS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12** **CCSS: Grades 9-10** **Reading: Science & Technical Subjects** **8. Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.** RST.9-10.8. Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. **Writing** **2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.** WHST.9-10.2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. **5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach.** WHST.9-10.5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. **Research to Build and Present Knowledge** **7. Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.**	• The various species of organisms in an ecosystem form interdependent relationships including social interactions and group behaviors • All organisms in an ecosystem are affected by the availability of resources in the environment • Matter and energy are cycled within an ecosystem between species and the environment • Physical and biological disturbances can affect the dynamics of an ecosystem • Biodiversity and humans have an intricate interconnected relationship. • Terminology related to the biosphere, ecosystems, energy transfer in ecosystems, biogeochemical cycles, community interactions and patterns, levels of organization in ecosystems, biodiversity and environmental science	Students will be able to … • Identify key themes in ecology such as levels of organization and interdependence • Demonstrate understanding of the effect of abiotic/biotic factors on an organism's survival • Mathematically trace the energy flow within an ecosystem • Use models to explain the major biogeochemical cycles (water, carbon, nitrogen) • Observe and analyze the structure of various freshwater producers, mold, fungi and other decomposers • Describe how limiting factors control population size • Describe the interactions in different ecosystems and observe the structures and functions of representative organisms from various ecosystems (plants, protists, animals) • Identify ways that humans impact different ecosystems and describe ways that biodiversity in

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	WHST.9-10.7. 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 the subject under investigation. **CCSS: Grades 11-12** **Reading: Science & Technical Subjects** **Key Ideas and Details** **1. Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.** RST.11-12.1. Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. **Integration of Knowledge and Ideas** **7. Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.** RST.11-12.7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. **8. Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.** RST.11-12.8. Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. **CCSS: Mathematics** **CCSS: HS: Num/Quantity**		ecosystems is beneficial to the quality of human life • Design a solution that will help to conserve resources, repair damaged ecosystems, protect ecosystems for the future or minimize the human impact on the ecosystems

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	Quantities **HSN-Q.A. Reason quantitatively and use units to solve problems.** HSN-Q.A.1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2. Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. **CCSS: HS: Modeling** **Mathematical Practice** **MP.The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students.** MP.2. Reason abstractly and quantitatively. MP.4. Model with mathematics. **CCSS: HS: Stats/Prob** **Interpreting Categorical & Quantitative Data** **HSS-ID.A. Summarize, represent, and interpret data on a single count or measurement variable** HSS-ID.A.1. Represent data with plots on the real number line (dot plots, histograms, and box plots). **Making Inferences & Justifying Conclusions** **HSS-IC.A. Understand and evaluate random processes underlying statistical experiments** HSS-IC.A.1. Understand that statistics is a process for making inferences about population parameters based on a random sample from that population. **HSS-IC.B. Make inferences and justify conclusions from sample surveys, experiments and observational studies** HSS-IC.B.6. Evaluate reports based on data.		

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	NGSS: Disciplinary Core Ideas **NGSS: 9-12** **LS2: Ecosystems: Interactions, Energy, and Dynamics** **LS2.A: Interdependent Relationships in Ecosystems** Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and non-living 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. (HS-LS2-1),(HSLS2-2) **LS2.B: Cycles of Matter and Energy Transfer in Ecosystems** Photosynthesis and cellular respiration (including anaerobic processes)provide most of the energy for life processes. (HS-LS2-3) 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. (HS-LS2-4) Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere,		

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	oceans, and geosphere through chemical, physical, geological, and biological processes. (HS-LS2-5) **LS2.C: Ecosystem Dynamics, Functioning, and Resilience** A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e. the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. (HS-LS2-2),(HS-LS2-6) 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-LS2-7) **LS2.D: Social Interactions and Group Behavior** Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives. (HSLS2-8) **LS4: Biological Evolution: Unity and Diversity** **LS4.D: Biodiversity and Humans** Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). (secondary to HSLS2-7) Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids		

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	humanity by preserving landscapes of recreational or inspirational value. (secondary to HS-LS2-7)(HS-LS4-6) **ESS2: Earth's Systems** **ESS2.E:Biogeology** The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it. (HS-ESS2-7) **ESS3: Earth and Human Activity** **ESS3.A: Natural Resources** Resource availability has guided the development of human society.(HS-ESS3-1) All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulation scan change the balance of these factors. (HS-ESS3-2) **ESS3.C: Human Impacts on Earth Systems** The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. (HS-ESS3-3) **ESS3.D: Global Climate Change** Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. (HS-ESS3-5) Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (HS-ESS3-6) **PS3: Energy** **PS3.D: Energy in Chemical Processes and Everyday Life**		

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	The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis.(secondary to HS-LS2-5) **ETS1: Engineering Design** **ETS1.B: Developing Possible Solutions** When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts.(secondary to HS-LS2-7) (secondary to HS-LS4-6) (secondary to HSESS3-2),(secondaryHS-ESS3-4) (HS-ETS1-3) 		