BIOLOGY

COURSE OUTLINE		
Unit One	*Title of Unit: MOLECULES AND CELLS*	*Suggested Time Frame: Quarter 1*
Unit Two	*Title of Unit: GENETICS*	*Suggested Time Frame: Quarter 2*
Unit Three	*Title of Unit: EVOLUTION*	*Suggested Time Frame: Quarter 3*
Unit Four	*Title of Unit: ECOLOGY*	*Suggested Time Frame: Quarter 4*

School-wide Academic Expectations Taught In This Course

- Communication
- Collaboration
- Analysis
- Literacy

School-wide Social and Civic Expectations Taught in This Course

- Demonstrate Honesty
- Demonstrate Responsibility
- Demonstrate Respect
- Demonstrate Safety

Performance Expectations Taught in This Course		
UNIT	PERFORMANCE EXPECTATION	DESCRIPTOR
Unit 1	HS-LS1-1	Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential function of life through systems of specialized cells.
	HS-LS1-2	Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
	HS-LS1-3	Plan and conduct an investigation to provide evidence that feedback mechanism maintain homeostasis.
	HS-LS1-4	Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
	HS-LS1-5	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
	HS-LS1-6	Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
	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
Unit 2	HS-LS3-1	Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
	HS-LS3-2	Make and defend a claim based on evidence that inheritable genetic variations may result from (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.
	HS-LS3-3	Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
Unit 3	HS-LS4-1	Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence
	HS-LS4-2	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.
	HS-LS4-3	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.
	HS-LS4-4	Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
	HS-LS4-5	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.
	HS-LS4-6	Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.
Unit 4	HS-LS2-1	Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.

	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
	HS-LS2-3	Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
	HS-LS2-4	Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
	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.
	HS-LS2-6	Evaluate 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.
	HS-LS2-7	Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
	HS-LS2-8	Evaluate evidence for the role of group behavior on individual and species' chances to survive and reproduce.

UNIT 1: MOLECULES AND CELLS

Introduction: In this unit the students will explore molecular structure and function, cell structure and function, homeostasis and transport, photosynthesis, cellular respiration, and cell reproduction.

Next Generation Science Standard: HS-LS1 (From Molecules to Organisms: Structures and Processes).

Science and Engineering Practices: **Developing and Using Models**
Planning and Carrying Out Investigations
Constructing Explanations and Designing Solutions

Cross-cutting Concepts: **Systems and System Models**
Energy and Matter
Structure and Function
Stability and Change

Common Core Standards: *CCSS.ELA-LITERACY.RST.9-10.1*
CCSS.ELA-LITERACY.RST.9-10.4
CCSS.ELA-LITERACY.RST.9-10.8
CCSS.ELA-LITERACY.RST.9-10.2
CCSS.ELA-LITERACY.RST.9-10.5
CCSS.ELA-LITERACY.RST.9-10.7

Suggested Resources:
***Modern Biology*, Holt, Rinehart and Winston (1999); chapters 1-8.**
***Life Science*, Holt, Rinehart and Winston (2007); chapters 3, 4, 10.**

Essential Question(s):

- *In what ways are acids different from bases?*
- *Compare and contrast the four main classes of organic compounds.*
- *What is the relationship between a cell's structure and its function?*
- *How is active transport different from passive transport?*
- *What happens to a water molecule in photosynthesis?*
- *Compare and contrast lactic acid fermentation and alcoholic fermentation.*
- *How is cytokinesis in animal cells different from cytokinesis in plant cells?*

Key Terms/Concepts: *energy, acids and bases, monomer, polymer, organic compounds, prokaryote, eukaryote, organelles, passive transport, active transport, photosynthesis, cellular respiration, chromosomes, cell cycle, meiosis*

Suggested Technology: Microscopes, computers.

LEARNING PLAN

Performance Expectation	Disciplinary Core Ideas	Instructional Strategies	Assessment Evidence
HS-LS1-1	LS1.A: Structure and Function • *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) or discourage (negative feedback) what is going on inside the living system.*	Lab: Protein Synthesis	Formative Assessments: Critical Thinking Collaboration Summative Assessments: Quizzes Open-ended Assessments Lab
HS-LS1-2	LS1.A: Structure and Function • *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) or discourage (negative feedback) what is going on inside the living system.*	Lab: Cell Structure and Function	Formative Assessments: Critical Thinking Collaboration Summative Assessments: Quizzes Open-ended Assessments Lab
HS-LS1-3	LS1.A: Structure and Function	Lab: Acids and Bases Lab: Passive Transport	Formative Assessments: Critical Thinking Collaboration

	• *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) or discourage (negative feedback) what is going on inside the living system.*		Summative Assessments: Quizzes Open-ended Assessments Lab
HS-LS1-4	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 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.*	Lab: Cell Division (Identification and Analysis)	Formative Assessments: Critical Thinking Collaboration Summative Assessments: Quizzes Open-ended Assessments Lab
HS-LS1-5	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.* • *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*	Analysis: Photosynthesis and Respiration	Formative Assessments: Critical Thinking Collaboration Summative Assessments: Quizzes Open-ended Assessments Writing

	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.		
HS-LS1-6	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.* • *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.*	Lab: Organic Compounds in Nutrition Critical Thinking: Article on Adkins Diet	Formative Assessments: Critical Thinking Collaboration Summative Assessments: Quizzes Open-ended Assessments Lab Writing
HS-LS1-7	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.* • *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.*	Analysis: Photosynthesis and Respiration	Formative Assessments: Critical Thinking Collaboration Summative Assessments: Quizzes Open-ended Assessments Writing

	• *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.*		

UNIT 2: GENETICS

Introduction: In this unit the students will investigate Mendelian genetics, protein synthesis, gene expression, human genetics, and DNA technology.

Next Generation Science Standard: HS-LS3 (Inheritance and Variation of Traits).

Science and Engineering Practices: **Asking Questions and Defining Problems**
Analyzing and Interpreting Data
Engaging in Argument from Evidence

Cross-cutting Concepts: Cause and Effect
Scale, Proportion, and Quantity

Common Core Standards: *CCSS.ELA-LITERACY.RST.9-10.8*
CCSS.MATH.CONTENT.HSS.MD.B.5
CCSS.MATH.CONTENT.HSS.MD.B.6

Suggested Resources:
***Modern Biology*, Holt, Rinehart and Winston (1999); chapters 9-13.**
***Life Science*, Holt, Rinehart and Winston (2007); chapters 5, 6.**

Essential Question(s):

- *How can a testcross be used to determine the genotype of an individual with a dominant phenotype?*
- *What is the role of complementary base pairing in the replication of DNA?*
- *What are the key characteristics of cancer cells?*
- *Explain the inheritance of ABO blood groups.*
- *How can DNA technology by used to produce medical products?*

Key Terms/Concepts: *allele, genotype, phenotype, homozygous, heterozygous, dominant, recessive, Punnett square, probability, base-pairing rule, DNA, RNA, transcription, translation, lac operon, regulation, structural gene, cancer, metastasis, mutagen, mutation, sex-linkage, pedigree, sex-influenced trait, DNA technology, recombinant DNA, gel electrophoresis, polymerase chain reaction, vaccine.*

Suggested Technology: Computers.

LEARNING PLAN

Performance Expectation	Disciplinary Core Ideas	Instructional Strategies	Assessment Evidence
HS-LS3-1	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.*	Critical Thinking: Article on Heredity Lab: Pedigree	Formative Assessments: Critical Thinking Collaboration Summative Assessments: Quizzes Open-ended Assessments Lab Writing
HS-LS3-2	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.* • *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.*	Group Work: Effect of Mutations Telecast: Genetic Modification	Formative Assessments: Critical Thinking Collaboration Summative Assessments: Quizzes Open-ended Assessments
HS-LS3-3	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.* • *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.*	Lab: Heredity Critical Thinking: Article on Genetic Testing	Formative Assessments: Critical Thinking Collaboration Summative Assessments: Quizzes Open-ended Assessments Lab Writing

UNIT 3: EVOLUTION

Introduction: This unit includes an exploration of the origin of life, absolute dating, the theory of evolution, population genetics, human evolution, and classification.

Next Generation Science Standard: HS-LS4 (Biological Evolution: Unity and Diversity).

Science and Engineering Practices: **Analyzing and Interpreting Data**
Using Mathematics and Computational Thinking
Constructing Explanations and Designing Solutions
Engaging in Argument from Evidence
Obtaining, Evaluating, Communicating Information

Cross-cutting Concepts: Patterns
Cause and Effect

Common Core Standards: *CCSS.ELA-LITERACY.RST.9-10.2*
CCSS.ELA-LITERACY.RST.9-10.4
CCSS.ELA-LITERACY.RST.9-10.7

Suggested Resources:
***Modern Biology*, Holt, Rinehart and Winston (1999); chapters 14-18.**
***Life Science*, Holt, Rinehart and Winston (2007); chapters 7-9.**

Essential Question(s):

- *How did Pasteur's experiment disprove the hypothesis of spontaneous generation?*
- *How was Darwin's theory of evolution different from Lamarck's?*
- *Contrast the effects of stabilizing, directional, and disruptive selection on variations in a trait over time.*
- *How are hominids different from other primates?*
- *Why was Aristotle's classification system not as functional as Linnaeus's?*

Key Terms/Concepts: *spontaneous generation, biogenesis, radioactive decay, half-life, ribozyme, endosymbiosis, fossil, acquired trait, fitness, natural selection, convergent evolution, divergent evolution, frequency, gene flow, isolation, speciation, primate, hominid, bipedalism, australopithecine, recent-African-origin hypothesis, binomial nomenclature, taxonomy, cladogram, phylogenetic tree, domain.*

Suggested Technology: Computers.

LEARNING PLAN

Performance Expectation	Disciplinary Core Ideas	Instructional Strategies	Assessment Evidence
HS-LS4-1	LS4.A: Evidence of Common Ancestry and Diversity • *Genetic information, like the fossil record, 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.*	Lab: Absolute Dating Lab: Cladogram	Formative Assessments: Critical Thinking Collaboration Summative Assessments: Quizzes Open-ended Assessments Lab
HS-LS4-2	LS4.B: Natural Seclection • *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.* LS4.C: Adaptation • *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 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.*	Group Work: Lamarck vs Darwin	Formative Assessments: Critical Thinking Collaboration Summative Assessments: Quizzes Open-ended Assessments
HS-LS4-3	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.* • *The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population.* LS4.C: Adaptation • *Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals*	Lab: Genetic Equilibrium Lab: Genetic Drift (Math)	Formative Assessments: Critical Thinking Collaboration Summative Assessments: Quizzes Open-ended Assessments Lab

	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.*		
HS-LS4-4	LS4.C: Adaptation • *Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not.*	Critical Thinking: Article (Human Evolution)	Formative Assessments: Critical Thinking Collaboration Summative Assessments: Quizzes Open-ended Assessments Writing
HS-LS4-5	LS4.C: Adaptation • *Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species.* • *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.*	Lab: Population Genetics Group Work: Geologic History of Earth	Formative Assessments: Critical Thinking Collaboration Summative Assessments: Quizzes Open-ended Assessments Lab
HS-LS4-6	LS4.C: Adaptation • *Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species.* 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 maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value.*	Group Work: Global Climate Change Destruction of Ozone Layer Human Overpopulation	Formative Assessments: Critical Thinking Collaboration Summative Assessments: Quizzes Open-ended Assessments

UNIT 4: ECOLOGY

Introduction: In this unit the students will examine environmental issues affected by human population growth, as well as ecological models, habitats, and niches.

Next Generation Science Standard: HS-LS2 (Ecosystems: Interactions, Energy, and Dynamics).

Science and Engineering Practices: **Developing and Using Models**
Using Mathematics and Computational Thinking
Constructing Explanations and Designing Solutions
Engaging in Argument from Evidence

Cross-cutting Concepts: **Cause and Effect**
Scale, Proportion, and Quantity
Systems and System Models
Energy and Matter
Stability and Change

Common Core Standards: *CCSS.ELA-LITERACY.RST.9-10.2*
CCSS.ELA-LITERACY.RST.9-10.5

Suggested Resources:
***Modern Biology*, Holt, Rinehart and Winston (1999); chapter 19-23.**
***Life Science*, Holt, Rinehart and Winston (2007); chapter 18.**

Essential Question(s):

- *What is the role of interconnectedness in ecology?*
- *How is the logistic model of population growth different from the exponential model? How are they similar?*
- *Compare and contrast parasitism, mutualism, and commensalism.*
- *Contrast producers with consumers and discuss the role of each in energy transfer.*
- *Discuss two strategies for conserving biodiversity.*

Key Terms/Concepts: *ecology, global climate change, niche, resource, biotic and abiotic factors, properties of populations, population dynamics, population growth, human population growth, species interactions, species richness and diversity, succession, energy transfer, ecosystem recycling, biomes, aquatic ecosystems, freshwater zones, biodiversity, conservation biology, restoration biology.*

Suggested Technology: Computers.

LEARNING PLAN

Standard	Disciplinary Core Ideas	Instructional Strategies	Assessment Evidence
HS-LS2-1	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 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.*	Group Work: Energy Pyramid (Math) Logistical vs Exponential Models	Formative Assessments: Critical Thinking Collaboration Summative Assessments: Quizzes Open-ended Assessments
HS-LS2-2	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 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.* 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.*	Group Work: Species Richness vs Species Diversity	Formative Assessments: Critical Thinking Collaboration Summative Assessments: Quizzes Open-ended Assessments
HS-LS2-3	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.*	Group Work: Water Cycle, Nitrogen Cycle	Formative Assessments: Critical Thinking Collaboration Summative Assessments: Quizzes Open-ended Assessments

HS-LS2-4	LS2.B: Cycles of Matter and Energy Transfer in Ecosystems • *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.*	Group Work: Energy Pyramid (Math) Food Chains and Food Webs	Formative Assessments: Critical Thinking Collaboration Summative Assessments: Quizzes Open-ended Assessments
HS-LS2-5	LS2.B: Cycles of Matter and Energy Transfer in Ecosystems • *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.*	Group Work: Roles of Producers and Consumers	Formative Assessments: Critical Thinking Collaboration Summative Assessments: Quizzes Open-ended Assessments
HS-LS2-6	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.*	Group Work: Symbiotic Interactions Engineering Practice: The Environment of Yeast	Formative Assessments: Critical Thinking Collaboration Summative Assessments: Quizzes Open-ended Assessments Lab
HS-LS2-7	LS2.C: Ecosystem Dynamics, Functioning, and Resilience • *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.*	Critical Thinking: Article (Ethanol) Lab: Cladogram Podcasts: Global Climate Change Group Work: Human Population Growth Writing: The Environment and War	Formative Assessments: Critical Thinking Collaboration Summative Assessments: Quizzes Open-ended Assessments Lab Writing
HS-LS2-8	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.*	Group Work: Dispersion Patterns	Formative Assessments: Critical Thinking Collaboration Summative Assessments: Quizzes Open-ended Assessments

APPENDIXES

Link to NGSS:
https://www.google.com/search?q=next+generation+science+standards&sourceid=ie7&rls=com.microsoft:en-us:ie-searchbox&ie=&oe=&safe=active&ibss=1&gws_rd=ssl

Crosscutting Concepts:

1. **Patterns**.
Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

2. **Cause and Effect: Mechanism and Explanation**.
Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

3. **Scale, Proportion, and Quantity.**
In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.

4. **Systems and System Models**.
Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.

5. **Energy and Matter: Flows, Cycles, and Conservation**.
Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.

6. **Structure and Function**.
The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.

7. **Stability and Change**.
For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

Science and Engineering Practices

Asking Questions and Defining Problems

A practice of science is to ask and refine questions that lead to descriptions and explanations of how the natural and designed world works and which can be empirically tested.

Developing and Using Models

A practice of both science and engineering is to use and construct models as helpful tools for representing ideas and explanations. These tools include diagrams, drawings, physical replicas, mathematical representations, analogies, and computer simulations.

Planning and Carrying Out Investigations

Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually. Their investigations are systematic and require clarifying what counts as data and identifying variables or parameters.

Analyzing and Interpreting Data

Scientific investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists use a range of tools—including tabulation, graphical interpretation, visualization, and statistical analysis—to identify the significant features and patterns in the data. Scientists identify sources of error in the investigations and calculate the degree of certainty in the results. Modern technology makes the collection of large data sets much easier, providing secondary sources for analysis.

Using Mathematics and Computational Thinking

In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; statistically analyzing data; and recognizing, expressing, and applying quantitative relationships.

Constructing Explanations and Designing Solutions

The products of science are explanations and the products of engineering are solutions.

Engaging in Argument from Evidence

Argumentation is the process by which explanations and solutions are reached.

Obtaining, Evaluating, and Communicating Information

Scientists and engineers must be able to communicate clearly and persuasively the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity.