Science Pacing Guide
Biology

Time Frame: September – October
Unit 1: Structure and Function

Science & Engineering Practices	Crosscutting Concepts	Literacy Standards	Mathematics Standards
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 world. • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-2) **Planning and Carrying Out Investigations** Planning and carrying out 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. (HS-LS1-3)	**Systems and System Models** Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. (HS-LS1-2) **Structure and Function** Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. (HS-LS1-1) **Stability and Change** Feedback (negative or positive) can stabilize or destabilize a system. (HS-LS1-3)	**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. (HS-LS1-1) **WHST.9-12.2** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS1-1) **WHST.9-12.7** 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. (HS-LS1-3) **WHST.11-12.8** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to	

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Science & Engineering Practices	Crosscutting Concepts	Literacy Standards	Mathematics Standards
Constructing Explanations and Designing Solutions 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. • Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-LS1-1) **Scientific Investigations Use a Variety of Methods** 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. (HS-LS1-3)		maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (HS-LS1-3) **WHST.9-12.9** Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS1-1) **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. (HS-LS1-2)	

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Next Generation Science Standards	Disciplinary Core Ideas	Essential Questions	Assessments	Vocabulary	Resources
Students who demonstrate understanding can: **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 functions of life through systems of specialized cells. [Assessment Boundary: Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis.] **HS-LS1-2** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate	**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) (Note: This Disciplinary Core Idea is also addressed by 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	How do the structures of organisms enable life's functions? (LS1-1) How could a mutation within a specialized cell affect the body's homeostasis? (LS1-2/3)	**<u>Before:</u>** Pretest (This is the same as the Posttest) Journal Writing to activate prior knowledge. **<u>During:</u>** Construct a DNA model using licorice toothpicks and marshmallows. Then allow students to use different color licorice to demonstrate DNA Replication, RNA transcription and translation. Students will research a genetic disorder caused by mutations within the DNA sequence. Teacher graded rubric based science, engineering and literacy standards. Students will plan and conduct an investigation on root development within different variations of water. Students will be graded on design, data collection and validity of conclusions. Create a diagram for a specialized cell and indicate the tissues,	Adenosine triphosphate Amino acid sequence Anticodon Base pairing Cells Codon DNA DNA polymerase DNA sequence Double helix Exon Homeostasis Intron Messenger RNA Negative feedback Nucleotide Organs Point mutation Positive feedback Promoter Replication Ribosomal RNA RNA RNA polymerase Systems Tissue Transcription Transfer RNA Translation	DNA Model Lab http://teach.genetics.utah.edu/content/begin/dna/eat_DNA.html Virtual Cell tour: http://www.ibiblio.org/virtualcell/ Interactive cell animations: http://cellsalive.com/ Explanation, with pictures, of hierarchy of living things. http://www.kidsbiology.com/biology_basics/cells_tissues_organs/structure_of_living_things1.php Sources for hierarchy of living things, includes links to other websites. (Possible webquest) http://facinatingamazinganimals.wordpress.com/2012/04/12/cell-biology-cells-tissues-organs-systems/ Homeostasis webquest: https://docs.google.com/document/d/1mLQsFwuT4iUGovKwd6xW9ocgN3YIuyT9Z45_E6-Rj0w/edit?pli=1 Animations of DNA: http://www.hhmi.org/biointeractive/browse?&field_bio_bio_series[0]=24143 Sources for labs, worksheets, and animations: http://www.nclark.net/DNA_RNA

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and deliver the proper amount of blood within the circulatory system.] [Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.] **HS-LS1-3** Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. [Clarification Statement: Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels.] [Assessment Boundary: Assessment does not include the cellular processes involved in the feedback mechanism.]	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)		organs, and systems it is associated with. **After:** Create comic strip, story, or movie portraying a germ/virus journey through the body as it attacks different cells. Students should indicate changes with DNA, homeostasis, tissues, organs, etc. Teacher graded rubric will include core discipline and literacy standards. Posttest		Genetic mutation worksheet: http://www.ptbeach.com/cms/lib02/NJ01000839/Centricity/Domain/113/Biology%20labs%20and%20handouts/Gene%20and%20Chromosome%20Mutation%20Worksheet.pdf

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Time Frame: November – December

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Time Frame: November – December
Unit 2: Matter and Energy in Organisms and Ecosystems

Science & Engineering Practices	Crosscutting Concepts	Literacy Standards	Mathematics Standards
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. • Use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-5),(HS-LS1-7) • Develop a model based on evidence to illustrate the relationships between systems or components of a system. (HS-LS2-5) **Using Mathematics and Computational Thinking** Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic	**Systems and System Models** Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. (HS-LS2-5) **Energy and Matter** • Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-LS1-5), (HS-LS1-6) • Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems.(HS-LS1-7),(HS-LS2-4) • Energy drives the cycling of matter within and between systems. (HS-LS2-3)	**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. (HS-LS1-6),(HS-LS2-3) **WHST.9-12.2** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS1-6),(HS-LS2-3) **WHST.9-12.5** 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. (HS-LS1-6),(HS-LS2-3) **WHST.9-12.9** Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS1-6) **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. (HS-LS1-5),(HS-LS1-7)	**MP.2** Reason abstractly and quantitatively. (HS-LS2-4) **MP.4** Model with mathematics. (HS-LS2-4) **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. (HS-LS2-4) **HSN-Q.A.2** Define appropriate quantities for the purpose of descriptive modeling. (HS-LS2-4) **HSN-Q.A.3** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-LS2-4)

Science & Engineering Practices	Crosscutting Concepts	Literacy Standards	Mathematics Standards
assumptions. • Use mathematical representations of phenomena or design solutions to support claims. (HS-LS2-4) **Constructing Explanations and Designing Solutions** 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. • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-LS1-6),(HS-LS2-3) **Connections to Nature of Science Scientific Knowledge is Open to Revision in Light of New Evidence** Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence. (HS-LS2-3)			

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Next Generation Science Standards	Disciplinary Core Ideas	Essential Questions	Assessments	Vocabulary	Resources
Students who demonstrate understanding can: **HS-LS1-5** Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. [Clarification Statement: Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Examples of models could include diagrams, chemical equations, and conceptual models.] [Assessment Boundary: Assessment does not include specific biochemical steps.] **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. [Clarification Statement: Emphasis is on using evidence from models and simulations to support explanations.] [Assessment Boundary: Assessment does not include the details of the specific chemical reactions or	**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) 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	How do organisms obtain and use energy they need to live and grow? How does matter and energy move through ecosystems? What evidence supports the combination of essential elements to form amino acids and/or other carbon-based molecules? What happens to energy when bonds are formed and/or broken? What would happen to life on Earth if all plants became extinct? How might cycles help us to understand the relationship between life and physical sciences?	<u>**Before:**</u> Pretest (This is the same as the Posttest) Concept map to activate prior knowledge. (photosynthesis would act as starting point) <u>**During:**</u> Interactive writing: Each student adds onto the photosynthesis/ cellular respiration process. Create a diagram for photosynthesis and cellular respiration. Diagram should include chemical equation, products and reactants. Students will demonstrate anaerobic and aerobic respiration using kinesthetic movement within the classroom and fermentation labs. • Effect of exercise on heart rate.	Aerobic Amino Acid Anaerobic ATP ATP synthase Calvin cycle Cellular respiration Chlorophyll Electron transport Fermentation Glucose Glycolysis Krebs cycle Light-dependent NAD+ NADPH Photosynthesis Stroma	Good resources for labs, worksheets, and activities: http://www.nclark.net/PhotoRespiration Interactive animation demonstrating photosynthesis: http://www.wonderville.ca/asset/photosynthesis Cellular respiration virtual lab: http://www.phschool.com/science/biology_place/labbench/lab5/intro.html Virtual Lab for Photosynthesis and cellular respiration: http://mhhe.com/biosci/genbio/virtual_labs/BL_25/BL_25.html Fermentation Demonstrations: http://www.asdk12.org/staff/hauser_scott/pages/curriculum/html/biology/labs/Demonstration_of_fermentation.htm http://employee.heartland.edu/hfei/Labs/CellularRespirationProtocol.pdf

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Next Generation Science Standards	Disciplinary Core Ideas	Essential Questions	Assessments	Vocabulary	Resources
identification of macromolecules.] **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. [Clarification Statement: Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration.] [Assessment Boundary: Assessment should not include identification of the steps or specific processes involved in cellular respiration.] **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. [Clarification Statement: Emphasis is on conceptual understanding of the role of aerobic and anaerobic respiration in different environments.] [Assessment Boundary: Assessment does not include the specific chemical processes of either aerobic or anaerobic	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.(HS-LS1-7) **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		• Making Root beer and bread in the classroom. • Chemical reaction with yeast and heat in flask causing balloon to expand. Teachers will evaluate lab reports, reflection journals and observation logs for understanding. Photosynthesis Inquiry Lab • Using spinach leaves and adjusting amount of light to measure rate of photosynthesis. Teacher created rubric will evaluate student understanding of science and engineering practices as well as literacy standards. **After:**		

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respiration.] **HS-LS2-4** Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. [Clarification Statement: Emphasis is on using a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and that matter and energy are conserved as matter cycles and energy flows through ecosystems. Emphasis is on atoms and molecules such as carbon, oxygen, hydrogen and nitrogen being conserved as they move through an ecosystem.] [Assessment Boundary: Assessment is limited to proportional reasoning to describe the cycling of matter and flow 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. [Clarification Statement: Examples of models could include simulations and mathematical	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, oceans, and geosphere through chemical, physical, geological, and biological processes. (HS-LS2-5) **PS3.D: Energy in**		Students will use the photosynthesis/respiration diagram created throughout the unit to calculate inputs and outputs required to obtain energy. Students will calculate energy input given a variety of carbon based molecules. Graphical analysis will also be incorporated. Posttest		

Next Generation Science Standards	Disciplinary Core Ideas	Essential Questions	Assessments	Vocabulary	Resources
models.] [Assessment Boundary: Assessment does not include the specific chemical steps of photosynthesis and respiration.]	**Chemical Processes** 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)				

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Science Pacing Guide
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Time Frame: January – February
Unit 3: Interdependent Relationships in Ecosystems

Science & Engineering Practices	Crosscutting Concepts	Literacy Standards	Mathematics Standards
Using Mathematics and Computational Thinking Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. • Use mathematical and/or computational representations of phenomena or design solutions to support explanations. (HS-LS2-1) • Use mathematical representations of phenomena or design solutions to support and revise explanations. (HS-LS2-2) • Create or revise a simulation of a phenomenon, designed device, process, or system. (HS-LS4-6) **Constructing Explanations and Designing Solutions** 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	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS2-8),(HS-LS4-6) **Scale, Proportion, and Quantity** • The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. (HS-LS2-1) • Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale. (HS-LS2-2) **Stability and Change** Much of science deals with constructing explanations of how things change and how they remain stable. (HS-LS2-6),(HS-LS2-7)	**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. (HS-LS2-6),*(HS-LS2-7)*,*(HS-LS2-8)* **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. *(HS-LS2-1)*,*(HS-LS2-2)*,(HS-LS2-6),(HS-LS2-8) **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. *(HS-LS2-6)*,*(HS-LS2-7)*,*(HS-LS2-8)* **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. (HS-LS2-6),(HS-LS2-7),(HS-LS2-8) **WHST.9-12.2** Write informative/explanatory texts,	**MP.2** Reason abstractly and quantitatively. (HS-LS2-1),(HS-LS2-2),(HS-LS2-6),*(HS-LS2-7)* **MP.4** Model with mathematics. *(HS-LS2-1)*,*(HS-LS2-2)* **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. (HS-LS2-1),(HS-LS2-2),(HS-LS2-4),*(HS-LS2-7)* **HSN.Q.A.2** Define appropriate quantities for the purpose of descriptive modeling. *(HS-LS2-1)*,*(HS-LS2-2)*,*(HS-LS2-7)* **HSN.Q.A.3** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-LS2-1),(HS-LS2-2),*(HS-LS2-7)* **HSS-ID.A.1** Represent data with plots on the real number line. *(HS-LS2-6)* **HSS-IC.A.1** Understand statistics as a process for making inferences about population parameters based on a random sample from that population.

Science & Engineering Practices	Crosscutting Concepts	Literacy Standards	Mathematics Standards
independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. • Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-LS2-7) **Engaging in Argument from Evidence** Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. • Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS2-6) • Evaluate the evidence behind currently accepted explanations to determine the merits of arguments. (HS-LS2-8) **Connections to Nature of Science** **Scientific Knowledge is Open to Revision in Light of New Evidence** • Most scientific knowledge is quite		including the narration of historical events, scientific procedures/ experiments, or technical processes. *(HS-LS2-1),(HS-LS2-2)* **WHST.9-12.5** 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. (HS-LS4-6) **WHST.9-12.7** 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. (HS-LS2-7),(HS-LS4-6)	*(HS-LS2-6)* **HSS-IC.B.6** Evaluate reports based on data. (HS-LS2-6)

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Science & Engineering Practices	Crosscutting Concepts	Literacy Standards	Mathematics Standards
durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence. (HS-LS2-2) • Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in revision of an explanation. (HS-LS2-6),(HS-LS2-8)			

Next Generation Science Standards	Disciplinary Core Ideas	Essential Questions	Assessments	Vocabulary	Resources
Students who demonstrate understanding can: **HS-LS2-1** Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. [Clarification Statement: Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate, and competition. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from simulations or historical data	**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	How do organisms interact with the living and nonliving environment to obtain matter and energy? How does biodiversity affect humans? What type of effect could an invasive species have on an ecosystem? Describe the demographic transition and explain how it	**Before:** Pretest (This is the same test as the posttest) Students will create a food web using the food they ate throughout the day, then connecting the foods to original energy source to activate prior knowledge of energy transfer throughout the ecosystem. **During:** Create food web demonstrating energy transfer among living things.	Age-structure diagram Biodiversity Biome Biosphere Carrying capacity Community Demographic transition Density-dependent factors Density-independent factors Ecology Ecosystem Emigration Exponential growth Immigration Invasive species	Lab activity demonstrating transfer of energy through the food web: http://forces.si.edu/ltop/pdfs/2-5-WeavingTheWeb.pdf Links to activities, labs and worksheets: http://www.nclark.net/Ecology Virtual lab for comparing growth curves of populations: http://glencoe.mcgraw-hill.com/sites/dl/free/0078759864/383928/BL_04.html Ecosystem in a shoebox: http://schlosser.wikispaces.com/file/view/Shoebox_Ecosystem_full.pdf

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Next Generation Science Standards	Disciplinary Core Ideas	Essential Questions	Assessments	Vocabulary	Resources
sets.] [*Assessment Boundary: Assessment does not include deriving mathematical equations to make comparisons.*] **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. [Clarification Statement: Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data.] [*Assessment Boundary: Assessment is limited to provided data.*] **HS-LS2-6** Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. [Clarification Statement: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate	species in any given ecosystem. (HS-LS2-1), (HS-LS2-2) **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	might affect a population's growth rate? How are scientists able to predict future population trends? What factors could influence change in a balanced ecosystem? What type of individual behaviors could influence the change in a species' chances to survive and reproduce?	Create graphs and make predictions for population and population change, given data. Write a letter to local government official explaining one change to be made within the community in order to save an endangered species or increase biodiversity within the community. Teacher created rubric evaluating literacy, engineering and crosscutting concepts. Ecosystem in a shoebox model. **<u>After:</u>** Using diagrams and graphs created during unit, students will make predictions for population changes given scenarios of changes to ecosystems. Provide each student with a major natural disaster and have students predict	Limiting factor Logistic growth Population Population density Predator-prey relationship Species	

Next Generation Science Standards	Disciplinary Core Ideas	Essential Questions	Assessments	Vocabulary	Resources
hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise.] **HS-LS2-7** Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.* [Clarification Statement: Examples of human activities can include urbanization, building dams, and dissemination of invasive species.] **HS-LS2-8** Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. [Clarification Statement: Emphasis is on: (1) distinguishing between group and individual behavior, (2) identifying evidence supporting the outcomes of group behavior, and (3) developing logical and reasonable arguments based on evidence. Examples of group behaviors could include flocking, schooling, herding, and cooperative behaviors such as hunting, migrating, and swarming.] **HS-LS4-6** Create or revise a	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. (HS-LS2-8) **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. (HS-LS4-6) **LS4.D: Biodiversity and Humans** Biodiversity is increased by the formation of new		effects and changes within that ecosystem Posttest		

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Next Generation Science Standards	Disciplinary Core Ideas	Essential Questions	Assessments	Vocabulary	Resources
simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.* [Clarification Statement: Emphasis is on designing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of organisms for multiple species.]	species (speciation) and decreased by the loss of species (extinction). *(secondary to HS-LS2-7)* 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 humanity by preserving landscapes of recreational or inspirational value. *(secondary to HS-LS2-7), (HS-LS4-6.)* **ETS1.B: Developing Possible Solutions** When evaluating solutions it is important to take into account a range of constraints including cost,				

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Next Generation Science Standards	Disciplinary Core Ideas	Essential Questions	Assessments	Vocabulary	Resources
	safety, reliability and aesthetics and to consider social, cultural and environmental impacts. *(secondary to HS-LS2-7),(secondary to HS-LS4-6)* Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. *(secondary to HS-LS4-6)*				

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Science Pacing Guide
Biology

Time Frame: March – April
Unit 4: Inheritance and Variation of Traits

Science & Engineering Practices	Crosscutting Concepts	Literacy Standards	Mathematics Standards
Asking Questions and Defining Problems Asking questions and defining problems in 9-12 builds on K-8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. • Ask questions that arise from examining models or a theory to clarify relationships. (HS-LS3-1) **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. • Use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-4) **Analyzing and Interpreting Data** Analyzing data in 9-12 builds on K-8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. • Apply concepts of statistics and	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS3-1),(HS-LS3-2) **Scale, Proportion, and Quantity** Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). (HS-LS3-3) **Systems and System Models** Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. (HS-LS1-4) **Science is a Human Endeavor** • Technological advances have influenced the progress of science and science has influenced advances in technology. (HS-LS3-3) • Science and engineering are influenced by society and society is influenced by science and engineering. (HS-LS3-3)	**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. *(HS-LS3-1),(HS-LS3-2)* **RST.11-12.9** Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. *(HS-LS3-1)* **WHST.9-12.1** Write arguments focused on *discipline-specific content.* (HS-LS3-2) **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. *(HS-LS1-4)*	**MP.2** Reason abstractly and quantitatively. (HS-LS3-2),(HS-LS3-3) **MP.4** Model with mathematics. *(HS-LS1-4)* **HSF-IF.C.7** Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. *(HS-LS1-4)* **HSF-BF.A.1** Write a function that describes a relationship between two quantities. *(HS-LS1-4)*

Science & Engineering Practices	Crosscutting Concepts	Literacy Standards	Mathematics Standards
probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. (HS-LS3-3) **Engaging in Argument from Evidence** Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. • Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence. (HS-LS3-2)			

Next Generation Science Standards	Disciplinary Core Ideas	Essential Questions	Assessments	Vocabulary	Resources
Students who demonstrate understanding can: **HS-LS1-4** Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex	**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	How are the characteristics from one generation related to the previous generation? What problems	**<u>Before:</u>** Pretest (This is the same test as the posttest) KWL-Inheritance, traits inventory sheet.	Allele Anaphase Cancer Cell cycle Centromere Chromatid Codominance Crossing over	Visual aids of cell division. http://www.neok12.com/Cell-Division.htm Onion Root Lab: http://www.marietta.edu/~biol/introlab/Onion%20root%20mitosis.pdf

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Next Generation Science Standards	Disciplinary Core Ideas	Essential Questions	Assessments	Vocabulary	Resources
organisms. [*Assessment Boundary: Assessment does not include specific gene control mechanisms or rote memorization of the steps of mitosis.*] **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. [*Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.*] **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. [Clarification Statement: Emphasis is on using data to support arguments for the way variation occurs.] [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]	the formation of proteins. *(secondary to HS-LS3-1) (Note: This Disciplinary Core Idea is also addressed by HS-LS1-1.)* **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 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.A: Inheritance of Traits** Each chromosome	can growth cause in the cell? What are the positive effects of crossing over? What are the differences between mitosis and meiosis? How do offspring get their characteristics?	**<u>During:</u>** Flip books of mitosis/meiosis. Evaluation will include accuracy of diagrams. Mitosis Onion Cell Lab. Research and present a specific type of cancer. Include cells affected, treatments, and the response by cells to the treatment. Teacher graded rubric will include engineering practices and literacy standards. **<u>After:</u>** Lab practical-microscope slides. Students will identify stages of mitosis/meiosis based on slides. Write a journal entry from the perspective of a cancer cell. Teacher graded rubric will include literacy and crosscutting standards. Posttest	Cytokinesis Diploid Fertilization G1 G2 Gamete Genetics Genotype Haploid Heterozygous Homologous pair homozygous Hybrid Independent Assortment interphase Meiosis Metaphase Mitosis Multiple alleles Polygenic traits Phenotype Probability Prophase Punnett Square S phase Spindle Telophase Trait True breeding	Virtual lab using Punnett squares. http://www.mhhe.com/biosci/genbio/virtual_labs/BL_05/BL_05.html virtual lab for cell cycle and cancer. http://www.glencoe.com/sites/common_assets/advanced_placement/mader10e/virtual_labs_2K8/labs/BL_03/ Ideas for activities, labs, worksheets. http://www.nclark.net/MitosisMeiosis Cell cycle game. http://www.nobelprize.org/educational/medicine/2001/index.html

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Next Generation Science Standards	Disciplinary Core Ideas	Essential Questions	Assessments	Vocabulary	Resources
HS-LS3-3 Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. [Clarification Statement: Emphasis is on the use of mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits.] [*Assessment Boundary: Assessment does not include Hardy-Weinberg calculations.*]	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				

Next Generation Science Standards	Disciplinary Core Ideas	Essential Questions	Assessments	Vocabulary	Resources
	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)				

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Time Frame: May – June
Unit 5: Natural Selection and Evolution

Science & Engineering Practices	Crosscutting Concepts	Literacy Standards	Mathematics Standards
Analyzing and Interpreting Data Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. • Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. (HS-LS4-3) **Constructing Explanations and Designing Solutions** 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. • Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-LS4-2),(HS-LS4-4)	**Patterns** Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-LS4-1),(HS-LS4-3) **Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS4-2),(HS-LS4-4),(HS-LS4-5) **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. (HS-LS4-1),(HS-LS4-4)	**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. *(HS-LS4-1),(HS-LS4-2),(HS-LS4-3),(HS-LS4-4)* **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. *(HS-LS4-5)* **WHST.9-12.2** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. *(HS-LS4-1),(HS-LS4-2),(HS-LS4-3),(HS-LS4-4)* **WHST.9-12.9** Draw evidence from informational texts to support analysis, reflection, and research. *(HS-LS4-1),(HS-LS4-2),(HS-LS4-3),(HS-LS4-4),(HS-LS4-5)* **SL.11-12.4** Present claims and findings, emphasizing salient points in a focused, coherent manner with	**MP.2** Reason abstractly and quantitatively. *(HS-LS4-1)*,(HS-LS4-2),(HS-LS4-3),*(HS-LS4-4),(HS-LS4-5)* **MP.4** Model with mathematics. *(HS-LS4-2)*

Science & Engineering Practices	Crosscutting Concepts	Literacy Standards	Mathematics Standards
Engaging in Argument from Evidence Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current or historical episodes in science. • Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS4-5) **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. • Communicate scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-LS4-1) **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** • A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment		relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. *(HS-LS4-1),(HS-LS4-2)*	

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Science & Engineering Practices	Crosscutting Concepts	Literacy Standards	Mathematics Standards
and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. (HS-LS4-1			

Next Generation Science Standards	Disciplinary Core Ideas	Essential Questions	Assessments	Vocabulary	Resources
Students who demonstrate understanding can: **HS-LS4-1** Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. [Clarification Statement: Emphasis is on a conceptual understanding of the role each line of evidence has relating to common ancestry and biological evolution. Examples of evidence could include similarities in DNA sequences, anatomical structures, and order of appearance of structures in embryological development.] **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	**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. (HS-LS4-1) **LS4.B: Natural Selection** Natural selection occurs only if there is both (1) variation in the genetic information between	How can there be so many similarities among organisms yet so many different plants, animals, and micro-organisms? Explain what type of evidence will demonstrate relationships among organisms as you move throughout the phylogenic tree. Why do some organisms survive cataclysmic changes in the environment and others do not?	**Before:** Pretest (This is the same test as the posttest) Students identify similarities in various skeletons and discuss how living things can appear similar but be quite different. **During:** Students will use the Spork and Beans Lab to construct a possible explanation for natural selection. Teacher graded rubric will include literacy and NGSS standards. Debate: theory of evolution. Teacher graded rubric based	Adaptation Evolution Fitness Fossil Founder effect Gene pool Genetic drift Genetic Equilibrium Hardy-Weinberg principle Homologous structure Natural Selection Reproductive isolation Single-gene trait Speciation Polygenic trait Theory Vestigial organ	Spork and Beans Activity demonstrating natural selection: http://www.gvsu.edu/cms3/assets/5FD8F095-BBA0-CAB4-D3330E7F1AD91A19/spork%20and%20beans.pdf Peppered moth activity to demonstrate natural selection. http://www.biologycorner.com/worksheets/peppermoth_paper.html#.UtbTC_vOQZM Links to various animations for evolution of humans: http://www.becominghuman.org/ Samples of lessons for evolution: http://www.nytimes.com/learning/teachers/lessons/evolution.html Virtual lab for common ancestors: http://www.ucmp.berkeley.edu/education/explorations/tours/Trex/index.html

Next Generation Science Standards	Disciplinary Core Ideas	Essential Questions	Assessments	Vocabulary	Resources
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. [Clarification Statement: Emphasis is on using evidence to explain the influence each of the four factors has on number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Examples of evidence could include mathematical models such as simple distribution graphs and proportional reasoning.] [*Assessment Boundary: Assessment does not include other mechanisms of evolution, such as genetic drift, gene flow through migration, and co-evolution.*] **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. [Clarification Statement: Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations.] [*Assessment Boundary:*	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 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	Explain how evolution is the result of organisms interacting with their environments, but is not goal-oriented. Describe the role that variation in traits, caused by genetic mutation and sexual recombination, plays in natural selection. What evidence can be found to support the theory of evolution?	on textual evidence, literacy standards and crosscutting standards. Students will research an extinct animal to determine possible causes of extinction. Teacher graded rubric will include literacy skills. **After:** Students will identify the possible physical/genetic traits of humans that could decrease their population. They will explain possibilities to increase the population. Given a graphical analysis of a decreasing species population students will construct a possible explanation and a possible solution to prevent extinction. Posttest		

Next Generation Science Standards	Disciplinary Core Ideas	Essential Questions	Assessments	Vocabulary	Resources
Assessment is limited to basic statistical and graphical analysis. Assessment does not include allele frequency calculations.] **HS-LS4-4** Construct an explanation based on evidence for how natural selection leads to adaptation of populations. [Clarification Statement: Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other organisms) contribute to a change in gene frequency over time, leading 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. [Clarification Statement: Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect	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				

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Next Generation Science Standards	Disciplinary Core Ideas	Essential Questions	Assessments	Vocabulary	Resources
distribution or disappearance of traits in species.]	species. (HS-LS4-5) 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)				

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