Bloomfield Public Schools
Bloomfield, New Jersey 07003

Curriculum Guide

Biology CP
Grade 10

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Conforms to the Next Generation Science Standards and NJSLS Standards – Standards Revision

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COURSE: BIOLOGY CP

GRADE LEVEL: 10

Introduction:

Biology investigates patterns, processes and relationships among organisms. The core concepts are powerful conceptual tools for making sense of the complexity, diversity, and interconnectedness of life on Earth. Order in natural systems arises in accordance with rules that govern the physical world, and the order of natural systems can be modeled and predicted through the use of mathematics.

Bloomfield High School's lab-based/inquiry biology course is structured so that students actively engage in scientific and engineering practices and apply crosscutting concepts to deepen their understanding of the core ideas. The learning experiences provided for students will engage them with fundamental questions about the world and with how scientists have investigated and found answers to those questions. Students will have the opportunity to carry out scientific investigations and engineering design projects related to the disciplinary core ideas in life sciences.

This curriculum is aligned with the *Next Generation Science Standards*, the *New Jersey Student Learning Standards for Math, ELA, and Technology.*

This document is a tool that will provide an overview as to what to teach, when to teach it, and how to assess student progress. With considerations made for altered pacing, modifications, and accommodations; this document is to be utilized for all students enrolled in this course, regardless of ability level, native language, or classification. It is meant to be a dynamic tool that we, as educators, will revise and modify as it is used during the course of the school year.

Mapping/Sequence: The curriculum is written following the parameters of *Understanding by Design* using the New Jersey Model Curriculum for Biology. The document is written as a series of units containing established transfer goals, enduring understandings, essential questions, and the necessary skills and knowledge a student must attain in a school year. The document includes units of study so that all students that all teachers must follow. Culminating assessments are a method for students to show attainment of set goals.

Pacing:

Unit 1: Ecosystems

Unit 2: Human Activity, Climate, and Biodiversity

Unit 3: Cell Specialization and Homeostasis

Unit 4: DNA and Inheritance

Unit 5: Natural Selection and Evolution

Resources: Electronic and text resources are listed in each unit. Teachers will be able to access the curriculum document on the district website.

Textbook: Biology, Holt McDougal, 2012

Established Goals: New Jersey Student Learning Standards

Science: **http://www.nextgenscience.org/next-generation-science-standards**

Math Standards: **http://www.**state.nj.us/education/aps/ccs/math/

ELA Standards: **http://www.**state.nj.us/education/aps/ccs/lal/

Technology: **http://www.state.nj.us/education/cccs/2014/tech/**

Modifications:
- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.   - Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).   - Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).   - Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).   - Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.   - Use project-based science learning to connect science with observable phenomena.   - Structure the learning around explaining or solving a social or community-based issue.   - Provide ELL students with multiple literacy strategies.   - Collaborate with after-school programs or clubs to extend learning opportunities.   - Restructure lesson using UDL principles (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA).

Unit #: 1	Unit Name: Ecosystems	Unit Length: 20 days

ESSENTIAL QUESTIONS:

How do matter and energy cycle through ecosystems?

How do organisms interact with the living and nonliving environments to obtain matter and energy?

#	STUDENT LEARNING OBJECTIVES (SLO)	Corresponding DCIs and PEs
1	**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-LS1-5**
2	**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 respiration.]*	**HS-LS2-3**
3	**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-LS2-4**

4	**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 models.] [Assessment Boundary: Assessment does not include the specific chemical steps of photosynthesis and respiration.]*	**HS-LS2-5**
5	**Illustrate how interactions among living systems and with their environment result in the movement of matter and energy.**	**LS2.A**
6	**Graph real or simulated populations and analyze the trends to understand consumption patterns and resource availability, and make predictions as to what will happen to the population in the future.**	**LS2.A**
7	**Provide evidence that the growth of populations are limited by access to resources, and how selective pressures may reduce the number of organisms or eliminate whole populations of organisms.**	**LS2.A**
8	**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 sets.] [Assessment Boundary: Assessment does not include deriving mathematical equations to make comparisons.]*	**HS-LS2-1**
9	**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-LS2-2**
10	**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 hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise.]*	**HS-LS2-6**

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:		
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts

Constructing Explanations and Designing Solutions • 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-LS2-3) **Using Mathematics and Computational Thinking** • Use mathematical representations of phenomena or design solutions to support claims. (HS-LS2-4) **Developing and Using Models** • Develop a model based on evidence to illustrate the relationships between systems or components of a system. (HS-LS1-5), (HS-LS2-5) **Using Mathematics and Computational Thinking**	**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-LS1-1) **LS2.B: Cycles of Matter and Energy Transfer in Ecosystems** • Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. (HS-LS2-3) • Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem,	**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-LS1-1) • Energy drives the cycling of matter within and between systems. (HS-LS2-3) • Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems. (HS-LS2-4) **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) - ***Connections to Nature of Science*** **Scientific Knowledge is Open to Revision in Light of New Evidence**

• 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) **Engaging in Argument from Evidence** • Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS2-6)	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) **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. (HS-LS2-1),(HS-LS2-2) **LS2.C: Ecosystem Dynamics, Functioning, and Resilience**	• 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) **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)

	• 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)	

Connections to other DCIs in this grade-band: HS.PS1.B (HS-LS1-5),(HS-LS1-6),(HS-LS1-7),(HS-LS2-3),(HS-LS2-5); HS.PS2.B (HS-LS1-7); HS.PS3.B (HS-LS1-5),(HS-LS1-7),(HS-LS2-3),(HS-LS2-4); HS.PS3.D (HS-LS2-3),(HS-LS2-4); HS.ESS2.A (HS-LS2-3); HS.ESS2.D (HS-LS2-5)
Articulation of DCIs across grade-bands: MS.PS1.A (HS-LS1-6); MS.PS1.B (HS-LS1-5),(HS-LS1-6),(HS-LS1-7),(HS-LS2-3); MS.PS3.D (HS-LS1-5),(HS-LS1-6),(HS-LS1-7),(HS-LS2-3),(HS-LS2- 4),(HS-LS2-5); MS.LS1.C (HS-LS1-5),(HS-LS1-6),(HS-LS1-7),(HS-LS2-3),(HS-LS2-4),(HS-LS2-5); MS.LS2.B (HS-LS1-5),(HS-LS1-7),(HS-LS2-3),(HS-LS2-4),(HS-LS2-5); MS.ESS2.A (HSLS2-5); MS.ESS2.E (HS-LS1-6)

Connections to Math & ELA Standards:

ELA:

RL.9-10.1	Cite strong and thorough textual evidence and make relevant connections to support analysis of what the text says explicitly as well as inferentially, including determining where the text leaves matters uncertain. (HS-LS1-6),(HS-LS2-3)
W.9-10.2.	Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content. A. Introduce a topic; organize complex ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. B. Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. C. Use appropriate and varied transitions to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts. D. Use precise language and domain-specific vocabulary to manage the complexity of the topic. E. Establish and maintain a style and tone appropriate to the audience and purpose (e.g. formal and objective for academic writing) while attending to the norms and conventions of the discipline in which they are writing. F. Provide a concluding paragraph or section that supports the argument presented (e.g., articulating implications or the significance of the topic). (HS-LS1-6),(HS-LS2- 3)
W.9-10.5	Develop and strengthen writing as needed by planning, revising, editing, rewriting, trying a new approach, or consulting a style manual (such as MLA or APA Style), focusing on addressing what is most significant for a specific purpose and audience. (Editing for conventions should demonstrate command of Language standards 1–3 up to and including grades 9–10). (HS-LS1-6),(HS-LS2-3)
W.9-10.9	Draw evidence from literary or nonfiction informational texts to support analysis, reflection, and research. A. Apply grades 9–10 Reading standards to literature (e.g., "Analyze how an author draws on and transforms source material in a specific work [e.g., how Shakespeare treats a theme or topic from mythology or the Bible or how a later author draws on a play by Shakespeare]"). B. Apply grades 9–10 Reading standards to nonfiction informational (e.g., "Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is valid and the evidence is relevant and sufficient; identify false statements and fallacious reasoning").(HS-LS1-5),(HS-LS1-7)

MATH:

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. (HSLS2-4)

Technology & Career Standards: **8.1 Educational Technology:** All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge. **Career Ready Practices:** 1-12

Unit Plan		
Content Vocabulary	**Academic Vocabulary**	**Required Resources**
Photosynthesis, light dependent, light independent, pigment, light, cellular respiration, aerobic, anaerobic, fermentation, carbon cycle, glucose, ATP, kinetic energy, potential energy, chemical equation, food chain, food web, trophic levels, producer, consumer, autotrophic, heterotrophic, biotic, abiotic, biodiversity, population growth, invasive species	* question *demonstrate * describe * explain * predict * infer * conclude * evidence * graphical analysis * statistical analysis * cause and effect * structure * function * proportion * evaluate * identify * construct * example * apply * data * support * investigate * pattern *model	Text *Biology* (Holt McDougal , 2012) Ch 4- Photosynthesis and Respiration Ch 13- Principles of Ecology Ch 15- The Biosphere Online access to internet websites and readings required below. Biology lab manual

THE 5 "E"s	Examples of Learning Activities for the specified "E"	SLO's and Engineering Practices
ENGAGE	**Examples of Engaging Activities:**	
	Demo: Breathe into bromothymol blue	Asking questions (for science) and defining problems (for engineering) Planning and carrying out investigations **SLO's:** 1,2
	Quick introduction to ecology: http://www.interactive-biology.com/category/games/	Analyzing and interpreting data Obtaining, evaluating, and communicating information **SLO's:** 4,5
	Surveying Elephants *In this interactive, students explore the methods scientists use to survey elephants and learn about the current state of the elephant population in Africa.* https://www.hhmi.org/biointeractive/surveying-elephants	Developing and using models Analyzing and interpreting data **SLO's:** 5,6,7
EXPLORE	**Examples of Exploring Activities:**	
	Plant various seeds and observe growth *Students will choose seeds/multiple seed types to plant over a set amount of weeks, collect and analyze data, compare with other students/groups.*	Asking questions (for science) and defining problems (for engineering) Planning and carrying out investigations **SLO's:** 2,4

	Case Study: Loggerhead Turtles and Population Models https://drive.google.com/file/d/0Bx72aSXCBO09UTMtdU5iVWdOV3c/view *This case study focuses on survivorship curves and population models by examining a case about loggerhead turtles.*	Developing and using models Analyzing and interpreting data **SLO's:** 5,6
	Leaf Photosynthesis NetLogo Model: This Java-based NetLogo model allows students to investigate the chemical and energy inputs and outputs of photosynthesis through an interactive simulation.	Asking questions (for science) and defining problems (for engineering) Planning and carrying out investigations **SLO's:** 1,2
EXPLAIN	**Examples of Explaining Activities:**	
	Elodea/Bromothymol Blue Lab *Students investigate the process of photosynthesis by performing experiments using indicators of gas exchange within the plant, and are able to explain the process of photosynthesis using the lab as evidence.*	Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Constructing explanations (for science) and designing solutions (for engineering Engaging in argument from evidence **SLO's:** 1, 2, 3, 4
	Create a food web model and explain how organisms are interconnected. Ex: http://www.bigelow.org/foodweb/chain1.html	Asking questions (for science) and defining problems (for engineering) Developing and using models Analyzing and interpreting data

		Obtaining, evaluating, and communicating information **SLO's:** 1, 2, 3, 4
	Creating Chains and Webs to Model Ecological Relationships *Students use cards to build model food webs and evaluate how ecological disturbances affect each trophic level.* http://www.hhmi.org/biointeractive/creating-chains-and-webs-model-ecological-relationships	Asking questions (for science) and defining problems (for engineering) **SLO's:** 1-5
	Of Microbes and Men: Students will develop a model to show the relationships among nitrogen and the ecosystem including parts that are not observable but predict observable phenomena. They will then construct an explanation of the effects of the environmental and human factors on this cycle.	Asking questions (for science) and defining problems (for engineering) **SLO's:** 1-5
ELABORATE	**Examples of Elaborating Activities:**	
	Virtual Photosynthesis Lab http://www.reading.ac.uk/virtualexperiments/ves/preloader-photosynthesis-full.html *Students measure the rate of photosynthesis happening in elodea in this interactive lab that allows students to manipulate variables and measure/collect/analyze data.*	Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Constructing explanations (for science) and designing solutions (for engineering Engaging in argument from evidence Obtaining, evaluating, and communicating information **SLO's:** 1-5

	The Mystery of the Seven Deaths Case Study http://sciencecases.lib.buffalo.edu/cs/files/cellular_respiration.pdf *In this interrupted case study, students learn about the function of cellular respiration and the electron transport chain and what happens when that function is impaired. The case is loosely based on the real-life 1982 Chicago Tylenol murders where seven people died when Tylenol capsules were laced with cyanide. Students play the role of medical examiner as they analyze the autopsy results to determine the cause of the mysterious deaths of these seven victims.*	Asking questions (for science) and defining problems (for engineering) Analyzing and interpreting data **SLO's:** 2
EVALUATE	**Examples of Evaluating Activities:**	
	Ecosystem project	Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering Engaging in argument from evidence Obtaining, evaluating, and communicating information **SLO's:** 1-10

	Surviving Winter in the Dust Bowl (Food Chains and Trophic Levels): This is one of 30 lessons from the NSTA Press Book Scientific Argumentation in Biology. The lesson engages students in an argumentation cycle based on an engaging scenario in which their group is a farm family trying to survive a dust bowl winter with limited food and water resources. The family has a bull, a cow, and limited amounts of water and wheat. Students are presented with four options that include various combinations of eating or keeping the animals alive and eating the wheat. Within this scenario, the lesson provides data on nutritional requirements of cows and humans, along with nutritional contents of wheat, milk, and beef. Students then use this data to construct an argument for the best strategy to allow their family to survive. As they construct this argument, students build and apply knowledge of food chains, trophic levels, interdependence among organisms, and energy transfers within ecosystems. This lesson is intended for middle or high school students. Teachers are encouraged to refer to the preface, introduction, student assessment samples, and appendix provided in the full book for important background on the practice of argumentation and resources for classroom implementation.	Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering Engaging in argument from evidence Obtaining, evaluating, and communicating information **SLO's:** 1-10

Unit #: 2	Unit Name: Human Activity, Climate and Biodiversity	Unit Length: 30

ESSENTIAL QUESTIONS:

How do humans depend on Earth's resources?

How and why do humans interact with their environment and what are the effects of these interactions?

Would we treat our resources and life support system if we were on a rocket headed for Mars as we do in our community right now?

#	STUDENT LEARNING OBJECTIVES (SLO)	Corresponding DCIs and PEs
1	**Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.** *[Clarification Statement: Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting and soil erosion), and severe weather (such as hurricanes, floods, and droughts). Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.]* **(HS-ESS3-1)**	**HS-ESS3-1**
2	**Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.** *[Clarification Statement: Examples of Earth systems to be considered are the hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere. An example of the far-reaching impacts from a human activity is how an increase in atmospheric carbon dioxide results in an increase in photosynthetic biomass on land and an increase in ocean acidification, with resulting impacts on sea organism health and marine populations.] [Assessment Boundary: Assessment does not include running computational representations but is limited to using the published results of scientific computational models.]* **(HS-ESS3-6)**	**HS-ESS3-6**

3	Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. *[Clarification Statement: Examples of evidence, for both data and climate model outputs, are for climate changes (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmosphere and ocean composition).] [Assessment Boundary: Assessment is limited to one example of a climate change and its associated impacts.]* **(HS-ESS3-5)**	**HS-ESS3-5**
4	**Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*** *[Clarification Statement: Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).]* **(HS-ESS3-4)**	**HS-ESS3-4**
5	**Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. (HS-ETS1-3)**	**HS-ETS1-3**
6	**Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.** *[Clarification Statement: Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning.] [Assessment Boundary: Assessment for computational simulations is limited to using provided multi-parameter programs or constructing simplified spreadsheet calculations.]* **(HS-ESS3-3)**	**HS-ESS3-3**
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-LS2-7)**	**HS-LS2-7**
8	**Create or revise a 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.]***(HS-LS4-6)**	**HS-LS4-6**
9	**Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. (HS-ETS1-1)**	**HS-ETS1-1**

10	**Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. (HS-ETS1-3)**	HS-ETS1-3
11	**Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. (HS-ETS1-4)**	HS-ETS1-4

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:		
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions ● 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-ESS3-1) ● Design or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ESS3-4) **Analyzing and Interpreting Data**	**ESS3.A: Natural Resources** ● Resource availability has guided the development of human society. (HS-ESS3-1) **ESS3.B: Natural Hazards** ● Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations. (HS-ESS3-1) **ESS2.D: Weather and Climate** ● Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and	**Cause and Effect** ● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS3-1) **Systems and System Models** ● When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (HS-ESS3-6) **Stability and Change** ● Feedback (negative or positive) can stabilize or destabilize a system. (HSESS3-4) -

• Analyze data using computational models in order to make valid and reliable scientific claims. (HS-ESS3-5) **Using Mathematics and Computational Thinking** • Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-ESS3-6)	by the ways in which these gases are absorbed by the ocean and biosphere. (secondary to HS-ESS3-6) **ESS3.D: Global Climate Change** • Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (HS-ESS3-6) **ETS1.B: Developing Possible Solutions** • When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3) **ESS3.C: Human Impacts on Earth Systems** • The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. (HS-ESS3-3) **LS2.C: Ecosystem Dynamics, Functioning, and Resilience**	***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** • New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. (HS-ETS1-1) (HS-ETS1-3)

	- Anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. (HS-LS2-7) **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 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. (*secondary to HS-LS2-7*) ● Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (*secondary to HS-LS2-7*) **ETS1.B: Developing Possible Solutions** ● When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (*secondary to HS-LS4-6*), (HS-ETS1-2) ● 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*),(HS-ETS1-2) **ETS1.C: Optimizing the Design Solution** Criteria may need to be broken down into simpler ones that can be approached	

	systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed. (HS-ETS1-2)	

Connections to other DCIs in this grade-band: HS.PS1.B (HS-LS1-5),(HS-LS1-6),(HS-LS1-7),(HS-LS2-3),(HS-LS2-5); HS.PS2.B (HS-LS1-7); HS.PS3.B (HS-LS1-5),(HS-LS1-7),(HS-LS2-3),(HS-LS2-4); HS.PS3.D (HS-LS2-3),(HS-LS2-4); HS.ESS2.A (HS-LS2-3); HS.ESS2.D (HS-LS2-5)

Articulation of DCIs across grade-bands: MS.PS1.A (HS-LS1-6); MS.PS1.B (HS-LS1-5),(HS-LS1-6),(HS-LS1-7),(HS-LS2-3); MS.PS3.D (HS-LS1-5),(HS-LS1-6),(HS-LS1-7),(HS-LS2-3),(HS-LS2- 4),(HS-LS2-5); MS.LS1.C (HS-LS1-5),(HS-LS1-6),(HS-LS1-7),(HS-LS2-3),(HS-LS2-4),(HS-LS2-5); MS.LS2.B (HS-LS1-5),(HS-LS1-7),(HS-LS2-3),(HS-LS2-4),(HS-LS2-5); MS.ESS2.A (HSLS2-5); MS.ESS2.E (HS-LS1-6)

Connections to Math & ELA Standards:

ELA:

RST.9-10.1.	Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions. (HS-ETS1-3)
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-ETS1-3)
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-ETS1-3)
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-ETS1-3).

MATH:

MP.2	Reason abstractly and quantitatively. (HS-LS2-1),(HS-LS2-2),(HS-LS2-6),(HS-LS2-7)
MP.4	Model with mathematics. (HS-ETS1-3)
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-ETS1-3).
HSN.Q.A.2	Define appropriate quantities for the purpose of descriptive modeling. (HS-ETS1-3).
HSN.Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-ETS1-3).

Technology & Career Standards:

8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

Career Ready Practices: 1-12

Unit Plan		
Content Vocabulary	**Academic Vocabulary**	**Required Resources**
invasive species, habitat loss, conservation biology, endangered species, indicator species, habitat loss, ecoregion, ecotourism, sustainable, climate change, cycles, biosphere, renewable or replicable	* question *demonstrate * describe * explain * predict * infer * conclude * evidence * graphical analysis * statistical analysis * cause and effect * structure * function * proportion * evaluate * identify * construct * example * apply * data * support * investigate * pattern *model	Text *Biology* (Holt McDougal , 2012) Ch 16- Human Impact on Ecosystems Online access to internet websites and readings required below. Biology lab manual

THE 5 "E"s	Examples of Learning Activities for the specified "E"	SLO's and Engineering Practices
ENGAGE	**Examples of Engaging Activities:**	
	Earth: Planet of Altered States: Watch a segment of a NASA video and discuss how the earth is constantly changing.	Constructing explanations (for science) and designing solutions (for engineering Engaging in argument from evidence Obtaining, evaluating, and communicating information **SLOs: 1**
	NSA Challenge: Recycling for a Cleaner World: Students will develop a strategy to increase recycling and waste diversion for their school.	Constructing explanations (for science) and designing solutions (for engineering Engaging in argument from evidence Obtaining, evaluating, and communicating information Analyzing and interpreting data Using mathematics and computational thinking **SLOs: 1,7,10**
	The Bean Game: Exploring Human Interactions with Natural Resources: This activity explores the various influences of human consumption of natural resources over time. (use this as a primer for making a computational model).	Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data

		Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering Engaging in argument from evidence Obtaining, evaluating, and communicating information **SLOs:1, 2, 4, 6, 11**
	National Climate Assessment: Students explore the simulations found at this website in order to create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.	Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering Engaging in argument from evidence Obtaining, evaluating, and communicating information **SLOs:1-11**

EXPLORE	Examples of Exploring Activities:	
	Read and react- pick one invasive species to research and present findings to class http://www.washingtonpost.com/news/energy-environment/wp/2015/02/23/like-most-invasive-species-pythons-are-in-the-u-s-to-stay/ **Rainforest carbon cycling and biodiversity:** Students apply this model to simulate how atmospheric CO2 concentrations influence global climate.	Analyzing and interpreting data **SLOs: 1, 10**
	One For All: A Natural Resources Game: Identify a strategy that would produce a sustainable use of resources in a simulation game. Draw parallels between the chips used in the game and renewable resources upon which people depend. Draw parallels between the actions of participants in the game and the actions of people or governments in real-world situations.	Developing and using models Planning and carrying out investigations Analyzing and interpreting data Constructing explanations (for science) and designing solutions (for engineering Engaging in argument from evidence **SLOs: 1, 5, 9**
	Cost-Benefit Analysis Primer: Students read this explanation about how cost-benefit analysis is derived and applied in order to apply this model to design solutions related to human sustainability. Students then read the application of CBA to water sanitation.	Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking

		Constructing explanations (for science) and designing solutions (for engineering Engaging in argument from evidence Obtaining, evaluating, and communicating information **SLOs: 1-11**
EXPLAIN	**Examples of Explaining Activities:**	
	Know Your Energy Costs: The goal of this activity is to become aware of how much energy you use at school — and the financial and environmental costs.	Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering Engaging in argument from evidence Obtaining, evaluating, and communicating information **SLOs: 1-11**

	I=P*A*T Equation and Its Variants: Students read this article to learn how ecological economics models are developed and applied to further understand human impacts on our environment.	Asking questions (for science) and defining problems (for engineering) Developing and using models Analyzing and interpreting data Using mathematics and computational thinking Engaging in argument from evidence **SLOs: 2,6, 9, 10,11**
	Building Biodiversity and the PREDICTS project and GLOBIO project: Students explore this website to develop an understanding of how computational models of the impacts on biodiversity are created. Next, they explore Conservation Maps for a global perspective of land use and conservation efforts.	Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering Engaging in argument from evidence Obtaining, evaluating, and communicating information **SLOs: 1-11**
	Digital Library for Earth System Education: DLESE is the Digital Library for Earth System Education, a free resource that	Engaging in argument from evidence

	supports teaching and learning about the Earth system. DLESE's development was funded by the National Science Foundation and continues to be built by a distributed community of educators, students, and scientists to support Earth system education at all levels. DLESE is operated by the National Center for Atmospheric Research (NCAR) Computational and Information Systems Laboratory and the NCAR Library on behalf of the education community.	Obtaining, evaluating, and communicating information **SLOs: 9**
ELABORATE	**Examples of Elaborating Activities:**	
	Play game to create sustainable environment for the population (outtake of SimCity): http://electrocity.co.nz/Game/game.aspx	Analyzing and interpreting data **SLOs: 11**
	Reefs at Risk: and NOAA Coral Reefs at Risk: Students access and explore a series of interactive maps displaying coral reef data from around the globe and develop hypotheses related to the impacts of climate change (i.e. increased levels of carbon dioxide in our atmosphere) on coral reef health.	Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering **SLOs: 1-11**
	Stormwater Calculator or the Water Erosion Prediction Project: Students apply the stormwater runoff calculator to determine	Asking questions (for science) and defining problems (for engineering)

	the impacts of land use change, precipitation variations, and other parameters on runoff. Alternatively, Catch It If You Can: students are scaffolded through the process of calculating stormwater runoff by exploring and applying this case study.	Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering **SLOs: 2-8, 11**
EVALUATE	**Examples of Evaluating Activities:**	
	Research and present an ecological problem caused by humans and suggest possible solutions.	Asking questions (for science) and defining problems (for engineering) Analyzing and interpreting data Engaging in argument from evidence **SLOs: 4, 5, 9, 10**
	GLOBE Carbon Cycle: Students collect data about their school field site through existing GLOBE protocols of phenology, land cover and soils as well as through new protocols focused on biomass and carbon stocks in vegetation. Students participate in classroom activities to understand carbon cycling at local and global scales. Students expand their scientific thinking through the use of systems models.	Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking

		Constructing explanations (for science) and designing solutions (for engineering Engaging in argument from evidence Obtaining, evaluating, and communicating information **SLOs: 1-11**
	Land and People: Finding a Balance: This environmental study project allows a group of students to consider real environmental dilemmas concerning water use and provide solutions to these dilemmas.	Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering **SLOs: 2-8, 11**
	Carbon Stabilization Wedge: Students play this game in order to evaluate competing design solutions for developing, managing, and utilizing energy resources based on cost-benefit ratios.	Developing and using models Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering **SLOs: 2-8, 11**

Unit #: 3	Unit Name: Cell Specialization and Homeostasis	Unit Length: 25 Days

ESSENTIAL QUESTIONS:

How do the structures of organisms enable life's functions?

#	STUDENT LEARNING OBJECTIVES (SLO)	Corresponding DCIs and PEs
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-LS1-1**
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 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-LS1-2**
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.*]	**HS-LS1-3**

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. • 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)	**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 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)	**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)

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) - ***Connections to Nature of Science*** **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)		

Connections to other DCIs in this grade-band:
HS.LS3.A (HS-LS1-1)

Articulation of DCIs across grade-bands:
MS.LS1.A (HS-LS1-1),(HS-LS1-2),(HS-LS1-3); **MS.LS3.A** (HS-LS1-1); **MS.LS3.B** (HS-LS1-1)

Connections to Math & ELA Standards:
ELA:

RST.9-10.1	Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions
WHST.9-10.1.	Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence. A. Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence. B. Develop claim(s) and counterclaims using sound reasoning, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline appropriate form and in a manner that anticipates the audience's knowledge level and concerns. C. Use transitions (e.g. words, phrases, clauses) to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims. D. Establish and maintain a style and tone appropriate to the audience and purpose (e.g. formal and objective for academic writing) while attending to the norms and conventions of the discipline in which they are writing. E. Provide a concluding. (HS-LS1-1)
WHST.9-10.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (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 maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. *(HS-LS1-3)*

WHST.9-10.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS1-1) **SL.9-10.2.** Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, qualitatively, orally) evaluating the credibility and accuracy of each source *(HS-LS1-2)*
Technology & Career Standards: **8.1 Educational Technology:** All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge. **Career Ready Practices:** 1-12

Unit Plan		
Content Vocabulary	**Academic Vocabulary**	**Required Resources**
Atom, molecule, macromolecule, organelle, cell, tissue, organ, organ system, organism, biotic, abiotic, cell organelles and functions, diffusion, osmosis, passive transport, active transport, semipermeable, hypotonic, hypertonic, isotonic, DNA, genes, nucleotides, amino acids, protein, unicellular, multicellular, homeostasis, pH, buffer, electron orbital, ionic bond, covalent bond, isotope, acid, base, Enzymes, proteins, lipids, carbohydrates, nucleic acids, organic molecule, hydrolysis, dehydration synthesis, functional groups, ATP, kinetic energy, potential energy, chemical equation	* question *demonstrate * describe * explain * predict * infer * conclude * evidence * graphical analysis * statistical analysis * cause and effect * structure * function * proportion * evaluate * identify * construct * example * apply * data * support * investigate * pattern *model	Text *Biology* (Holt McDougal , 2012) Ch 2 – organic chemistry Ch 3- cells Diffusion/ osmosis Online access to internet websites required below. Biology lab manual Molecular modeling building kits

THE 5 "E"s	Examples of Learning Activities for the specified "E"	SLO's and Engineering Practices
ENGAGE	**Examples of Engaging Activities:**	
	Food lab survey Observe various PDV of biomolecules on a variety of food labels: What do these vast differences represent? How does your diet compare to a healthy one? http://twhs9.conroeisd.net/Teachers/kmcnamee/downloads/FOV1-0010F11D/FoodLabelLab.pdf	Analyzing and interpreting data Using mathematics and computational thinking **SLOs: 3**
	Carbohydrate demo: sugar in sulfuric acid	Planning and carrying out investigations **SLOs: 3**
	Why/how do biomolecules react? Introduction using water lab stations Biology lab manual	Asking questions (for science) and defining problems (for engineering Planning and carrying out investigations Constructing explanations (for science) and designing solutions (for engineering Engaging in argument from evidence **SLOs:2,3**

EXPLORE	Examples of Exploring Activities:	
	Cells alive organelle webquest http://www.cellsalive.com/ *Students read/discuss organelles and make connections between which organelles work together and the relationship between cell structure to cell function.*	Asking questions (for science) and defining problems (for engineering) Analyzing and interpreting data **SLOs: 1, 2, 3**
	Molecular modeling of hydration and dehydration synthesis reactions Model building kits or paper models	Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data **SLOs: 2, 3**
	Preparation and observation of wetmount slides: cheek and elodea- Focus on similarities and differences Biology lab manual- wetmount materials in prep rooms and prepared slides found in B381	Developing and using models **SLOs: 2**

EXPLAIN	Examples of Explaining Activities:	
	Enzyme substrate penny lab https://prezi.com/ibq8u21celjd/penny-enzyme-lab/	Asking questions (for science) and defining problems (for engineering) Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering Engaging in argument from evidence **SLOs: 2, 3**
	Osmosis demonstration using eggs, vinegar, and syrup: why does the egg change sizes? Give explanations Biology lab manual	Asking questions (for science) and defining problems (for engineering) Planning and carrying out investigations Analyzing and interpreting data Engaging in argument from evidence Obtaining, evaluating, and communicating information **SLOs: 2,3**

ELABORATE	Examples of Elaborating Activities:	
	Fold proteins virtually and help create real medical cures by submitting results to scientific research when complete. http://fold.it/portal/info/about#whygame	Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Constructing explanations (for science) and designing solutions (for engineering Engaging in argument from evidence Obtaining, evaluating, and communicating information **SLOs: 1-3**
EVALUATE	**Examples of Evaluating Activities:**	
	Cell project- create video, book, or game	Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data **SLOs: 1-3**

Unit #: 4	Unit Name: DNA and Inheritance	Unit Length: 30 days

ESSENTIAL QUESTIONS: *How are the characteristics from one generation related to the previous generation?*		
#	**STUDENT LEARNING OBJECTIVES (SLO)**	**Corresponding DCIs and PEs**
1	**Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.** [*Assessment Boundary: Assessment does not include specific gene control mechanisms or rote memorization of the steps of mitosis.*]	**HS-LS1-1**
2	**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-LS1-2**
3	**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.]	**HS-LS1-3**
4	**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	**HS-LS1-4**

	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.*]	

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:		
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts

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 probability (including determining function fits to data, slope, intercept, and correlation

LS1.A: Structure and Function

- All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. *(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 consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of

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)

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Connections to Nature of Science

Science is a Human Endeavor

- Technological advances have influenced the progress of science and science has influenced advances in technology. (HS-LS3-3)

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)	that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. (HS-LS3-1) **LS3.B: Variation of Traits** • In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. (HS-LS3-2) • Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on	• Science and engineering are influenced by society and society is influenced by science and engineering. (HS-LS3-3)

	both genetic and environmental factors. (HS-LS3-2),(HS-LS3-3)	

Connections to other DCIs in this grade-band:
HS.LS2.A (HS-LS3-3); **HS.LS2.C** (HS-LS3-3); **HS.LS4.B** (HS-LS3-3); **HS.LS4.C** (HS-LS3-3)

Articulation of DCIs across grade-bands:
MS.LS1.A (HS-LS1-4); **MS.LS1.B** (HS-LS1-4); **MS.LS2.A** (HS-LS3-3); **MS.LS3.A** (HS-LS1-4),(HS-LS3-1),(HS-LS3-2); **MS.LS3.B** (HS-LS3-1),(HS-LS3-2),(HS-LS3-3);**MS.LS4.C** (HS-LS3-3)

Connections to Math & ELA Standards:
ELA:

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.9-10.5 Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). *(HS-LS3-1)*

WHST.9-10.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence. A. Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence. B. Develop claim(s) and counterclaims using sound reasoning, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns. C. Use transitions (e.g. words, phrases, clauses) to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims. D. Establish and maintain a style and tone appropriate to the audience and purpose (e.g. formal and objective for academic writing) while attending to the norms and conventions of the discipline in which they are writing. E. Provide a concluding paragraph or section that supports the argument presented. (HS-LS3-2)

SL.11-12.2.	Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, qualitatively, orally) evaluating the credibility and accuracy of each source. *(HS-LS1-4)*
MATH:	
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)*

Technology & Career Standards:
8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
Career Ready Practices: 1-12

Unit Plan		
Content Vocabulary	**Academic Vocabulary**	**Required Resources**
Mitosis, meiosis, cell cycle, nucleotide, deoxyribose, nitrogenous base, complementary base pairs, base sequence, base-pairing rules, DNA replication, helicase, replication fork, mutation, proofreading and repair enzymes, RNA, transcription, ribose, mRNA, rRNA, tRNA, promoter, termination sequence, genetic code, codon, cancer, carcinogens, oncology, chromosomes, recombinant DNA, restriction enzymes, chromosomes, sex chromosomes, autosomes, homologous	* question *demonstrate * describe * explain * predict * infer * conclude * evidence * graphical analysis * statistical analysis * cause and effect * structure	Text *Biology* (Holt McDougal , 2012) Ch 5- Cell growth and division Ch 6- Meiosis and Mendel Ch 7- Mendelian Genetics Ch 8- From DNA to Proteins Ch 9- Frontiers of Biotechnology Online access to internet websites required below. Biology lab manual

chromosomes, karyotype, haploid, and diploid, ova and sperm, heredity, trait, pollination, P generation, F_1 generation, F_2 generation, dominant and recessive alleles, independent assortment, alleles, genotype, phenotype, homozygous, heterozygous, probability, various crosses, sex linked genes, gene and chromosomal mutations, deletion, inversion, translocation, nondisjunction, karyotype, pedigree, multiple alleles, amniocentesis, amino acids, protein synthesis, transcription, translation, gene expression, gene technology, recombinant DNA, PCR, electrophoresis, DNA analysis	* function * proportion * evaluate * identify * construct * example * apply * data * support * investigate * pattern *model	

THE 5 "E"s	Examples of Learning Activities for the specified "E"	SLO's and Engineering Practices
ENGAGE	**Examples of Engaging Activities:**	
	Use interactive DNA timeline to read history of DNA structure http://www.dnai.org/timeline/	Analyzing and interpreting data **SLOs: 2**
	DNA extraction lab Use either wheat germ, any fruit or human cheek cells to extract DNA Biology Lab manual	Planning and carrying out investigations **SLOs: 2**
	Investigate probabilities using Monty's probability game http://www.theproblemsite.com/games/monty_hall_game.asp#gameTop	Using mathematics and computational thinking **SLOs: 3**
EXPLORE	**Examples of Exploring Activities:**	
	Identify stages and graph: Mitosis vs, Meiosis stages	Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data **SLOs: 1, 2**
	Constructing a model of DNA or RNA: How would this puzzle best fit together? Use paper lab, model kits, or box of Styrofoam	Asking questions (for science) and defining problems (for engineering) Developing and using models

		SLOs: 2
EXPLAIN	**Examples of Explaining Activities:**	
	Observe and analyze mitosis stages using prepared onion root tip, ascaris, and fish blastula slides Prepared slides can be found in room B381	Developing and using models Planning and carrying out investigations Analyzing and interpreting data **SLOs: 1**
	Karyotype lab: create a karyotype and identify disorders using chromosomal analysis Biology lab manual	Planning and carrying out investigations Analyzing and interpreting data **SLOs: 2, 3, 4**
	Genetics lab: Mating lab to identify alleles inherited by the next generation Biology lab manual	Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking **SLOs: 2, 3, 4**
ELABORATE	**Examples of Elaborating Activities:**	
	Interactive Gel electrophoresis and PCR http://learn.genetics.utah.edu/content/labs/	Asking questions (for science) and defining problems (for engineering Planning and carrying out investigations Analyzing and interpreting data

		Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering **SLOs: 2, 3, 4**
	Bacterial ID lab http://media.hhmi.org/biointeractive/vlabs/bacterial_id/index.html	Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking **SLOs: 3, 4**
EVALUATE	**Examples of Evaluating Activities:**	
	Research GM food pros and cons and write at least 3 of each http://www.csa.com/discoveryguides/gmfood/overview.php http://www.discovery.com/tv-shows/curiosity/topics/10-genetically-modified-food-products.htm http://www.who.int/topics/food_genetically_modified/en/	Asking questions (for science) and defining problems (for engineering) Analyzing and interpreting data Constructing explanations (for science) and designing solutions (for engineering Engaging in argument from evidence Obtaining, evaluating, and communicating information **SLOs: 2, 3, 4**

Unit #: 5	Unit Name: Natural selection and Evolution	Unit Length: 30 days

ESSENTIAL QUESTIONS:

How can there be so many similarities among organisms yet so many different plants, animals, and microorganisms?

What evidence shows that different species are related?

#	STUDENT LEARNING OBJECTIVES (SLO)	Corresponding DCIs and PEs
1	Make predictions about the effects of artificial selection on the genetic makeup of a population over time. (LS4.C)	LS4.C
2	**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-LS4-4)**	HS- LS4-4
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: Assessment is limited to basic statistical and graphical analysis. Assessment does not include allele frequency calculations.]* **(HS-LS4-3)**	HS-LS4-3
4	**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**	HS-LS4-5

	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 distribution or disappearance of traits in species.]* **(HS-LS4-5)**	
5	**Examine a group of related organisms using a phylogenic tree or cladogram in order to (1) identify shared characteristics, (2) make inferences about the evolutionary history of the group, and (3) identify character data that could extend or improve the phylogenetic tree.** (LS4.A)	LS4.A
6	**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-LS4-1)**	HS-LS4-1
7	**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.** *[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-LS4-2)**	HS-LS4-2

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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** ● 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-LS4-4)	**LS1.A: Structure and Function** ● 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) **LS4.B: Natural Selection** ● Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. (HS-LS4-3) ● The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. (HSLS4-3) ● Adaptation also means that the distribution of traits in a population can change when conditions change. (HS-LS4-3) **LS4.C: Adaptation**	**Cause and Effect** ● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (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-LS4-3)

Obtaining, Evaluating, and Communicating Information ● 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) **Engaging in Argument from Evidence** ● Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS4-5)	● Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. (HS-LS4-4) ● **LS2.D: Social Interactions and Group Behavior** ● Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives. (HSLS2-8) **LS4.A: Evidence of Common Ancestry and Diversity** ● Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and	

	from anatomical and embryological evidence. (HS-LS4-1)	

Connections to other DCIs in this grade-band: HS.LS2.A (HS-LS4-2),(HS-LS4-3),(HS-LS4-4),(HS-LS4-5); HS.LS2.D (HS-LS4-2),(HS-LS4-3),(HS-LS4-4),(HS-LS4-5); HS.LS3.A (HS-LS4- 1); HS.LS3.B (HS-LS4-1),(HS-LS4-2) (HS-LS4-3),(HS-LS4-5); HS.ESS1.C (HS-LS4-1); HS.ESS2.E (HS-LS4-2),(HS-LS4-5); HS.ESS3.A (HS-LS4-2),(HS-LS4-5)
Articulation of DCIs across grade-bands: MS.LS2.A (HS-LS4-2),(HS-LS4-3),(HS-LS4-5); MS.LS2.C (HS-LS4-5); MS.LS3.A (HS-LS4-1); MS.LS3.B (HS-LS4-1),(HS-LS4-2),(HS-LS4-3); MS.LS4.A (HS-LS4-1); MS.LS4.B (HS-LS4-2),(HS-LS4-3),(HS-LS4-4); MS.LS4.C (HS-LS4-2),(HS-LS4-3),(HS-LS4-4),(HS-LS4-5); MS.ESS1.C (HS-LS4-1); MS.ESS3.C (HS-LS4-5)
Connections to Math & ELA Standards: **ELA:** **RST.9-10.1.** Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions. (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.9-10.2.** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. A. Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. B. Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience’s knowledge of the topic. C. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts. D. Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers. E. Establish and maintain a style and tone appropriate to the audience and purpose (e.g. formal and objective for academic writing) while attending to the norms and conventions of the discipline in which they are writing. F. Provide a concluding paragraph or section that supports the argument presented. HS-LS4-1),(HS-LS4- 2),(HS-LS4-3),(HS-LS4-4)

WHST .9-10.9	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 information, findings and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience. (HS-LS4-1),(HS-LS4-2)
MATH:	
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)

Technology & Career Standards:
8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
Career Ready Practices: 1-12

Unit Plan		
Content Vocabulary	**Academic Vocabulary**	**Required Resources**
Evolution, natural selection, artificial selection, DNA, gene, homologous structures, analogous structures, vestigial structures, variation, fossilization, phylogenetic tree, populations, reproduction, kingdoms, classification, taxonomy, cladograms, binomials, dichotomous key, gene pool, mutations, genetic equilibrium, directional selection, stabilizing selection, artificial selection, disruptive selection, sexual selection, genetic drift, gene flow, postzygotic isolation, prezygotic isolation, hybrid, adaptation, speciation , biodiversity,	* question *demonstrate * describe * explain * predict * infer * conclude * evidence * graphical analysis * statistical analysis * cause and effect * structure * function * proportion * evaluate * identify	Text *Biology* (Holt McDougal , 2012) Ch 10- Principles of Evolution Ch 11- Evolution of Populations Ch 17- Tree of Life Online access to internet websites required below. Biology lab manual

habitat, adaptive radiation, comparative anatomy, comparative embryology, anatomical, sedimentary rock , chronological, embryological development , amino acid sequences	* construct * example * apply * data * support * investigate * pattern *model	

THE 5 "E"s	Examples of Learning Activities for the specified "E"	SLO's and Engineering Practices
ENGAGE	**Examples of Engaging Activities:**	
	Geologic timeline activity: Students work in small groups to develop geologic timeline to develop idea of the scale of time and various life forms on Earth.	Asking questions (for science) and defining problems (for engineering) Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering **SLOs:** 2
	Evolution Misconception Survey: Assessing our students' misconceptions: After a brief KWL session, assess student misconceptions anonymously to share with class	Engaging in argument from evidence **SLOs:** 1,2
	Deep History of Life on Earth: Interactive timeline via HHMI may assist with above.	Asking questions (for science) and defining problems (for engineering) Constructing explanations (for science) and designing solutions (for engineering Engaging in argument from evidence **SLOs:** 2
	Theory of Evolution by Natural Selection To encourage students critical thinking about vocabulary concepts, to allow students to reflect on their knowledge of individual vocabulary words, and to increase vocabulary comprehension using the vocabulary self-rate.	Asking questions (for science) and defining problems (for engineering) **SLOs:** 1,2,3
	Vestigial Structure analysis: What is similar about all these features?	Analyzing and interpreting data

		Constructing explanations (for science) and designing solutions (for engineering Engaging in argument from evidence Obtaining, evaluating, and communicating information **SLOs:** 3,4,6,7
	Group items- Give students a set of random items and have them group them according to any characteristics	Analyzing and interpreting data **SLOs:** 5
EXPLORE	**Examples of Exploring Activities:**	
	Sorting Finch Species: This is an interactive web program that allows students to collect various pieces of data related to finches (including auditory clues) in order to construct cladograms.	Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering **SLOs:** 1,2,3,4
	Peppered Moth Simulation: Simulate changes in moth population due to pollution and predation, and observe how species can change over time(or other Natural Selection Simulations)	Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering

		SLOs: 1,2,3,4,7
	Adaptations of Darwin's Finches Lab: Students "prey" on various foods and then use the data they generate to examine how environmental pressures affect the phenotype (and gene pool) of a given population.	Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking **SLOs:** 1,2,3,4,7
	Salamander Dichotomous Key: students classify various traits of salamanders to identify them	Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data **SLOs:** 5
	Creating a Cladogram: students examine fictional organisms "in order to identify shared characteristics" and "to make inferences about the evolutionary history of the group."	Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering **SLOs:** 5

	Anolis lizards: using phylogeny to test hypotheses	Developing and using models Planning and carrying out investigations **SLOs:** 5,6
EXPLAIN	**Examples of Explaining Activities:**	
	Pocket Mouse evolution Use videos and explanation sheet from below http://www.hhmi.org/biointeractive/pocket-mouse-evolution http://serendip.brynmawr.edu/sci_edu/waldron/pdf/NaturalSelectionProtocol.pdf	Asking questions (for science) and defining problems (for engineering) Analyzing and interpreting data Using mathematics and computational thinking **SLOs:** 4,5,6,7
ELABORATE	**Examples of Elaborating Activities:**	
	Students examine different modes of evidence to support evolution- Evidence will be given and students must try and analyze it	Analyzing and interpreting data Engaging in argument from evidence Obtaining, evaluating, and communicating information **SLOs:** 3,4,7
	Changes in the Environment: students learn that different species can arise from a common ancestor.	Analyzing and interpreting data Engaging in argument from evidence Obtaining, evaluating, and communicating information **SLOs:** 1,2,3,4,7
	Smithsonian Interactive Fossil Lab: read excerpts, look, and analyze human fossils	Analyzing and interpreting data Engaging in argument from evidence

		Obtaining, evaluating, and communicating information **SLOs:** 3,4,7
EVALUATE	**Examples of Evaluating Activities:**	
	Evolution and Selection POGIL: This is a student driven program where students work in small groups to work through evidence shown in the POGIL activity.	Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering Engaging in argument from evidence **SLOs:** 1-7
	Decisive paper with evidence: Have students save everything portfolio style and have them pick their 3 favorite activities to support their explanation to the question posed regarding evolution	Asking questions (for science) and defining problems (for engineering) Constructing explanations (for science) and designing solutions (for engineering Engaging in argument from evidence Obtaining, evaluating, and communicating information **SLOs:** 1-7