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Range of Assessment Requirements

Quarter I	Quarter II
Tests - Unit Tests, Lab Activities (intense) Quizzes - Teacher Discretion, Lab Activities Homework / Classwork / Misc -	Tests - Unit Tests, Lab Activities (intense) Quizzes - Teacher Discretion, Lab Activities Homework / Classwork / Misc -
Quarter III	**Quarter IV**
Tests - Unit Tests, Lab Activities (intense) Quizzes - Teacher Discretion, Lab Activities Homework / Classwork / Misc -	Tests - Unit Tests, Lab Activities (intense) Quizzes - Teacher Discretion, Lab Activities Homework / Classwork / Misc -

Deptford Township School District Grading Scale

Test **(consistent in number and quality)**	**50%**
Quiz	**30%**

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Homework / Classwork / Misc.	20%

	Unit I
Overarching Theme	Cell Specialization and Homeostasis: How do the structures of organisms enable life's functions?
Power/Anchor Standards and Evidence of Learning Must-Do Can-Do	LS1-2: **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.** Unpacked LS1-2: 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. LS1-3: **Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.** Unpacked LS1-3: Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels. LS1-4: **Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms** PS1-5: **Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.** Unpacked PS1-5: Emphasis is on student reasoning that focuses on the number and energy of collisions between molecules.

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	Acquisition (knowledge, skills needed to understand)	Meaning (Why are the students learning this)	Transfer (Evidence of Learning and Performance Tasks)
	Systems of specialized cells within organisms help them perform the essential functions of life. All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. 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 their functions and/or solve a problem. 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. Models (e.g., physical, mathematical, computer models) can be used to	Students must understand that systems of specialized cells within organisms help the organisms perform the essential functions of life. These systems of cells, tissues, and organs work together to meet the needs of the whole organism. Students need an understanding of how external conditions affect the internal conditions of an organism. Feedback mechanisms maintain the internal conditions of living systems and encourage or discourage physiological responses in living systems. Humans, plants and animals are all made up of millions of tiny cells	Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells. Construct an explanation, based on 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, for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells. Conduct a detailed examination of the structure and function of DNA Develop and use a model based on evidence to illustrate hierarchical organization of interacting systems that

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	simulate systems and interactions—including energy, matter, and information flows— within and between systems at different scales 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. Feedback mechanisms maintain a living system's internal conditions within certain limits, and they mediate behaviors, allowing the system 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. Feedback (negative or positive) can stabilize or destabilize a system. In multicellular organisms, individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow.	that perform different jobs to achieve different goals in the ultimate fight for survival. Without cells, life wouldn't exist. It's important to understand the process of cellular development before understanding the depths of cellular specialization. One principle in understanding any system is to know how things enter and exit the system. The cell is a system whose health is partially dependent on what it can get from the outside environment. Thus an understanding of how substances are transported into and out of the cell will aid in students' understanding of the cell as a system. The concept of homeostasis governs many living systems. The cell is one of	provide specific functions within multicellular organism. Develop and use a model based on evidence to illustrate the interaction of functions at the organism system level. Develop and use a model based on evidence to illustrate the flow of matter Plan and conduct an investigation individually and collaboratively to produce evidence that feedback mechanisms (negative and positive) maintain homeostasis. In the planning of the investigation, decide on the types, amount, and accuracy of the data needed to produce reliable measurements, consider limitations on the precision of the data, and refine the design accordingly. Use a model based on evidence to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. Use a model to illustrate the role of

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	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. Models (e.g., physical, mathematical, and computer models) can be used to simulate systems and interactions, including energy, matter, and information flows, within and between systems at different scales.	the smallest units in which to understand this phenomenon. Characteristics of homeostasis in cells can be transferred to many other living systems. In this way, learning about cell homeostasis is giving students a model for understanding other living systems.	cellular division and differentiation in terms of energy, matter, and information flows within and between systems of cells/organisms.
<u>Standards</u>	Remaining standards (the rest of the content standards that aren't power standards) **<u>Disciplinary Core Ideas (DCI)</u>** **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. • 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.		

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	Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. **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. <u>**Crosscutting Concepts**</u> **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. **Stability and Change** • Feedback (negative or positive) can stabilize or destabilize a system. <u>**Technology Standards**</u> **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. **8.2 Technology Education, Engineering, Design, and Computational Thinking / Programming** - All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.

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	<u>21st Century Life and Career Standards</u> **9.1 Personal Financial Literacy** - This standard outlines the important fiscal knowledge, habits, and skills that must be mastered in order for students to make informed decisions about personal finance. Financial literacy is an integral component of a student's college and career readiness, enabling students to achieve fulfilling, financially-secure, and successful careers. **9.2 Career Awareness, Exploration, and Preparation -** This standard outlines the importance of being knowledgeable about one's interests and talents, and being well informed about postsecondary and career options, career planning, and career requirements. **9.3 Career and Technical Education -** This standard outlines what students should know and be able to do upon completion of a CTE Program of Study. **Career Ready Practices** **CRP1.** Act as a responsible and contributing citizen and employee. **CRP2.** Apply appropriate academic and technical skills. **CRP4.** Communicate clearly and effectively and with reason. **CRP6.** Demonstrate creativity and innovation. **CRP7.** Employ valid and reliable research strategies. **CRP8.** Utilize critical thinking to make sense of problems and persevere in solving them. **CRP11.** Use technology to enhance productivity. **CRP12.** Work productively in teams while using cultural global competence
<u>Enduring</u>	

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Understanding	• Students formulate an answer to the question "How do the structures of organisms enable life's functions?" • Students investigate explanations for the structure and functions of cells as the basic unit of life, of hierarchical organization of interacting organ systems, and of the role of specialized cells for maintenance and growth. • All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. • Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.
Essential Questions (3-5 per unit)	• How do the structures of organisms enable life's functions? • What are the explanations for the structure and functions of cells as the basic unit of life? • What are the roles of specialized cells for the maintenance and growth of an organism? • How can disease represent a loss of homeostasis? • What is the hierarchical organization of the specific functions of interacting systems within multicellular organisms?
Differentiation and Support for Learners Must-Do Can-Do (additions made after consensus at district PLC meetings)	**Enrichment** **LS1-2** • Model a chosen organ system of the body using the cellular hierarchy from cell, tissue, organ, system… in an inductive approach • Model a specialized cell using clay for organelles; explain why that particular cell would have more/less of a particular organelle to perform its function in the system. • Hydra/Microscope Lab: Observe and record data of the stimulus-response mechanism for the hydra's neural net microscope. • Pillbug /Characteristics of Life Lab • Cell Staining Lab • Transpiration Pull Lab – visualizing the Structure/function of xylem tissue in plant

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	• Bacterial sampling Lab LS1-3; PS1-5 • Model the lac operon system in clay • Catalase Lab • Tonicities of Solutions Effects on Plant cells Lab **Interventions** • **Nonlinguistic representations** • **Flexible/strategic grouping** • **Graphic organizers** • **Student self-assessment** • **Restructure lesson using UDL principles** **Student Grouping Strategies** • Lab groups (homogeneous, heterogeneous) • Pairs • Cooperative Learning/Lab Groups (each student is assigned a role and responsibility)
Resources **Must-Do** **Can-Do** **(additions made after consensus at district PLC meetings)**	**Technology** • **Smartboard** • **Chromebooks** • **Gizmo** • Chromebooks -student use for Gizmos site - 8.1 - Educational Technology **Readings** Scientific American: What is Homeostasis? University at Buffalo: The Case of the Dividing Cell: Mitosis and Meiosis in the Cellular Court

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	Manipulatives/Lab Activity Resources
	• Human homeostasis Gizmo
	• Cell Division Gizmo
	• Homeostasis lab
	• Interactive Science Notebook
	  ○ Cornell Notes
	  ○ Left Side Processing Activities
	    ■ Experiment Analysis: Miracle Grow
	    ■ Is Sammi Alive?
	    ■ Diamante Poem: Comparing and contrasting prokaryotic and eukaryotic cells
	    ■ Mini Lab: Cell Membranes in Hypotonic & Hypertonic Environments
	    ■ Mini Lab- Dialysis Tubing & Diffusion
	    ■ Manipulatives: Cell transport Lab
	    ■ Graphing Activity- Skin Cancer over time

Assessment Must-Do Can-Do	**Formative (Assessment used by the individual teacher to gather feedback on student progress toward learning targets.)** • Cell Gallery Walk • Mitosis Model • Left Side Processing Activities • Cornell Notes • Graphing Activity • Lab Analysis

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	Summative (Assessment used as a summary measure of what all students should know at the end of a unit. Goes in gradebook for a grade.) **Link Unit 1 Test: [Unit 1 Test: Cell Specialization and Homeostasis]** **Benchmark (Assessment used by the teacher for diagnostic purposes to gather data on student readiness and progress toward grade level standards.)**

	Unit II
Overarching Theme	Matter and Energy Transformations in Ecosystems (Bioenergetics): How do matter and energy cycle through ecosystems?
Power/Anchor Standards and Evidence of Learning **Must-Do** **Can-Do**	LS1-3: **Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.** Unpacked LS1-3: Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels. LS1-5: **Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.** Unpacked LS1-5: 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. LS1-6: **Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.**

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Unpacked LS1-6: Emphasis is on using evidence from models and simulations to support explanations.

LS1-7: **Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.**

Unpacked LS1-7: Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration.

PS1-4: **Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.**

Unpacked PS1-4: Emphasis is on the idea that a chemical reaction is a system that affects the energy change. Examples of models could include molecular-level drawings and diagrams of reactions, graphs showing the relative energies of reactants and products, and representations showing energy is conserved.

Acquisition (knowledge, skills needed to understand)	**Meaning** (Why are the students learning this)	**Transfer** (Evidence of Learning and Performance Tasks)
Energy drives the cycling of matter within and between systems. Energy drives the cycling of matter within and between systems in aerobic and anaerobic conditions. Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes.	It is important for students to understand the two fundamental cellular processes – cellular respiration and photosynthesis and how they cycle carbon through ecosystems to meet the energy needs of all organisms. Students develop their understanding of photosynthesis by	*Develop a model, based on evidence, to illustrate the roles of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere, showing the relationships among variables in systems and their components in the natural and designed world. *Develop a model, based on evidence, to

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	Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems. At each link in an ecosystem, matter and energy are conserved. 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.	constructing and revising an explanation for the cycling of matter and flow of energy in aerobic and anaerobic conditions. Students work with models (e.g., physical, mathematical, computer) to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. Students learn about photosynthesis and cellular respiration in order to have a greater understanding of the carbon cycle, in which these processes help carbon to be exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. Photosynthesis is one of the fundamental processes on our planet.	illustrate the roles of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere at different scales *Support claims for the cycling of matter and flow of energy among organisms in an ecosystem using conceptual thinking and mathematical representations of phenomena. *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. *Use a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and to show how matter and energy are conserved as matter cycles and energy flows through ecosystems

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	<table><tr><td></td><td>The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis</td><td>*Use a mathematical model to describe the conservation of atoms and molecules as they move through an ecosystem. *Use proportional reasoning to describe the cycling of matter and flow of energy through an ecosystem.</td></tr></table>
Standards	**Disciplinary Core Ideas (DCI)** **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. • 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. **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

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	complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. **LS1.C: Organization for Matter and Energy Flow in Organisms** ● The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. ● The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. ● As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. ● As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. **<u>Crosscutting Concepts</u>** **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. **Stability and Change** ● Feedback (negative or positive) can stabilize or destabilize a system. **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. ● Energy cannot be created or destroyed—it only moves between one place and another place, between objects

	and/or fields, or between systems. __Technology 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. **8.2 Technology Education, Engineering, Design, and Computational Thinking / Programming** - All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment. __21st Century Life and Career Standards__ **9.1 Personal Financial Literacy** - This standard outlines the important fiscal knowledge, habits, and skills that must be mastered in order for students to make informed decisions about personal finance. Financial literacy is an integral component of a student's college and career readiness, enabling students to achieve fulfilling, financially-secure, and successful careers. **9.2 Career Awareness, Exploration, and Preparation -** This standard outlines the importance of being knowledgeable about one's interests and talents, and being well informed about postsecondary and career options, career planning, and career requirements. **9.3 Career and Technical Education -** This standard outlines what students should know and be able to do upon completion of a CTE Program of Study. **Career Ready Practices** **CRP1.** Act as a responsible and contributing citizen and employee. **CRP2.** Apply appropriate academic and technical skills. **CRP4.** Communicate clearly and effectively and with reason.

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	CRP6. Demonstrate creativity and innovation. **CRP7.** Employ valid and reliable research strategies. **CRP8.** Utilize critical thinking to make sense of problems and persevere in solving them. **CRP11.** Use technology to enhance productivity. **CRP12.** Work productively in teams while using cultural global competence
Enduring Understanding	• Two fundamental cellular processes – cellular respiration and photosynthesis- cycle carbon through ecosystems to meet the energy needs of all organisms. • Cells carry out a variety of chemical transformations (i.e., cellular respiration, photosynthesis) which allow conversion of energy from one form to another, the breakdown of molecules into smaller units, and the building of larger molecules from smaller ones. • Photosynthesis and cellular respiration are complementary processes resulting in the flow of energy and the cycling of matter in ecosystems. • Organisms obtain and use energy to carry out their life processes.
Essential Questions (3-5 per unit)	• How do the structures of organisms enable life's functions? • How do different organisms obtain and use energy to survive in their environment? • What are the roles of specialized cells for the maintenance and growth of an organism? • Why do astrobiologists look for water on planets and not oxygen when they search for life on other planets? • How can the process of photosynthesis and respiration in a cell impact ALL of Earth's systems?
Differentiation and	**Enrichment**

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Support for Learners Must-Do Can-Do (additions made after consensus at district PLC meetings)	LS1-3 • MiniLab Plant Osmosis • MiniLab Plant Diffusion • CO2 in Exhaled Air Titration Lab LS1-5 • Model photosynthesis by symbolic colors • 2D Chloroplast Model • Modeling the ATP Cycle • Modeling the Calvin Cycle • Input/Output Flow Chart Photosynthesis LS1-6; PS1-4 • Model catabolic-anabolic reactions of metabolism • Lab: Cell Membrane Model • Stomata Lab: Observe Plant's microscopic stomata under different environmental conditions • Gizmo- Photosynthesis • Gizmo- Cellular Respiration LS1-7; PS1-4 • Model cellular respiration and fermentation by symbolic colors • Calorimeter Lab • Lab: Calculating the Energy in a Peanut **Interventions** • **Discovery/Inquiry-based learning** • **Adapting to learning styles/multiple intelligences** • **Role play/simulations**

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	• **Close read** **Student Grouping Strategies** • Lab groups (homogeneous, heterogeneous) • Pairs • Cooperative Learning/Lab Groups (each student is assigned a role and responsibility)

Resources
Must-Do
Can-Do
(additions made after consensus at district PLC meetings)
	Technology
	• **Smartboard**
	• **Chromebooks**
	• **Gizmo**
	  • Chromebooks -student use for Gizmos site - 8.1 - Educational Technology
	
	Readings
	• **Bionic Plants- Scientific American**
	• **How Artificial Photosynthesis Works**
	
	Manipulatives/Lab Activity Resources
	• Photosynthesis Gizmo
	• Cellular Respiration Gizmo
	• **Interactive Science Notebook**
	  ○ **Cornell Notes**
	  ○ **Left Side Processing Activities**
	    ■ **Modeling the ATP Cycle**
	    ■ **2D Modeling of the chloroplast and its internal structures**
	    ■ **Modeling the Calvin Cycle**
	    ■ **Photosynthesis: Graphic Organizer**

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	■ Comparison Chart: Photosynthesis & Cellular Respiration
Assessment Must-Do Can-Do	**Formative (Assessment used by the individual teacher to gather feedback on student progress toward learning targets.)** • Gizmo Lab Student Guide *Photosynthesis *Cellular Respiration • Chloroplast Model • Left Side Processing Activities • Cornell Notes • ATP Cycle Model • Lab Analysis **Summative (Assessment used as a summary measure of what all students should know at the end of a unit. Goes in gradebook for a grade.)** **Link Unit 2 Test:** Matter and Energy Transformations in Ecosystems (Bioenergetics) **Benchmark (Assessment used by the teacher for diagnostic purposes to gather data on student readiness and progress toward grade level standards.)**

	Unit III
Overarching	DNA and Inheritance: How are characteristics from one generation related to the previous generation?

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Theme	(Genetics)
Power/Anchor Standards and Evidence of Learning **Must-Do** **Can-Do**	LS1-1: **Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.** Concepts: DNA structure and history Protein Synthesis LS1-4: **Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms** LS3-1: **Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.** Concepts: Meiosis Mendelian, non Mendelian, and Human genetics Mutations and genetic diseases LS3-2: **Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.** **Concept:** **Meiosis and Karyotype** **DNA structure and replication** Unpacked LS3-2: Emphasis is on using data to support arguments for the way variation occurs. Concept: Gene and mutations

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LS-3-3: Apply concepts of statistics and probability to support explanation that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.

Concept:
Punnett square, Pedigrees, sex-linked, DNA replication, Protein synthesis.

Acquisition (knowledge, skills needed to understand)	**Meaning** (Why are the students learning this)	**Transfer** (Evidence of Learning and Performance Tasks)
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. Each chromosome consists of a single, very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in the 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	Genetics is the study of heredity at multiple levels of understanding, ranging from molecules to populations. Genetics occupies a central position in modern biology, so its understanding is essential for all scholars of the life sciences. The causes of human diseases are being discovered, and therapies developed, based on fundamental genetic investigations. Increasingly, management of human health also depends on genetic and genomic information. These impacts are certain to grow over the coming decades, so genetics is a growth field.	Ask questions that arise from examining models or a theory to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parent to offspring. Use empirical evidence to differentiate between cause and correlation and make claims about the role of DNA and chromosomes in coding the instructions for characteristics passed from parents to offspring Make and defend a claim based on evidence that inheritable genetic variations may result from new genetic combinations through meiosis, viable errors occurring during replication, and/or mutations caused by

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	regulatory or structural functions, and some have, as yet, no known function. Empirical evidence is required to differentiate between cause and correlation and to make claims about the role of DNA and chromosomes in coding the instructions for the characteristic traits passed from parents to offspring. In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. Environmental factors also affect expression of traits, and hence affect the probability of occurrence of traits in a population. Thus the variation and		environmental factors. Use data to support arguments for the ways inheritable genetic variation occurs. Use empirical evidence to differentiate between cause and correlation and Apply concepts of statistics and probability (including determining function fits to data, slope, intercepts, and correlation coefficient for linear fits) to explain the variation and distribution of expressed traits in a population. Use mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits. Use algebraic thinking to examine scientific data on the variation and distribution of traits in a population and predict the effect of a change in probability of traits as it relates to genetic and environmental factors.

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	distribution of traits observed depends on both genetic and environmental factors. Empirical evidence is required to differentiate between cause and correlation and to make claims about inheritable genetic variations resulting from new genetic combinations through meiosis, viable errors occurring during replication, and/or mutations caused by environmental factors. Environmental factors affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variations and distributions of traits observed depend on both genetic and environmental factors. Algebraic thinking is used to examine scientific data and predict the distribution of traits in a population as they relate to the genetic and environmental factors (e.g., linear growth vs. exponential growth). Technological advances have influenced the progress of science, and science has influenced advances in		

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	<table><tr><td>technology. Science and engineering are influenced by society, and society is influenced by science and engineering.</td><td></td><td></td></tr></table>
Standards	Remaining standards (the rest of the content standards that aren't power standards) **Disciplinary Core Ideas (DCI)** **LS1.A: Structure and Function** • Systems of specialized cells within organisms help them perform the essential functions of life. • All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells.*(Note: This Disciplinary Core Idea is also addressed by HS-LS3-1.)* **LS3.A: Inheritance of Traits** • Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. **LS3.B: Variation of Traits** • In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although

	DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. • Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors. **Crosscutting Concepts** **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. **Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. **Technology 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. **8.2 Technology Education, Engineering, Design, and Computational Thinking / Programming** - All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment. **21st Century Life and Career Standards** **9.1 Personal Financial Literacy** - This standard outlines the important fiscal knowledge, habits, and skills that must be mastered in order for students to make informed decisions about personal finance. Financial literacy is

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	an integral component of a student's college and career readiness, enabling students to achieve fulfilling, financially-secure, and successful careers. **9.2 Career Awareness, Exploration, and Preparation -** This standard outlines the importance of being knowledgeable about one's interests and talents, and being well informed about postsecondary and career options, career planning, and career requirements. **9.3 Career and Technical Education -** This standard outlines what students should know and be able to do upon completion of a CTE Program of Study. **Career Ready Practices** **CRP1.** Act as a responsible and contributing citizen and employee. **CRP2.** Apply appropriate academic and technical skills. **CRP4.** Communicate clearly and effectively and with reason. **CRP6.** Demonstrate creativity and innovation. **CRP7.** Employ valid and reliable research strategies. **CRP8.** Utilize critical thinking to make sense of problems and persevere in solving them. **CRP11.** Use technology to enhance productivity. **CRP12.** Work productively in teams while using cultural global competence
Enduring Understanding	• Students analyze data develop models to make sense of the relationship between DNA and chromosomes in the process of cellular division, which passes traits from one generation to the next.

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	• Students determine why individuals of the same species vary in how they look, function, and behave. • Students develop conceptual models of the role of DNA in the unity of life on Earth and use statistical models to explain the importance of variation within populations for the survival and evolution of species. • Ethical issues related to genetic modification of organisms and the nature of science are described. • Students explain the mechanisms of genetic inheritance and describe the environmental and genetic causes of gene mutation and the alteration of gene expressions.
Essential Questions (3-5 per unit)	• How are characteristics from one generation related to the previous generation? • What is the structure of DNA, and how does it function in genetic inheritance? • How does inheritable genetic variation occur? • How does information flow from DNA to RNA to direct the synthesis of proteins? • How and why do scientists manipulate DNA in living cells?
Differentiation and Support for Learners	**Enrichment** **LS1-1** • DNA Extraction from Strawberries • Create a Model of DNA • Predicting Polypeptide Sequences Using a Codon Wheel/Chart • Model DNA structure with wire and beads • Dragon Genetics—Independent Assortment and Gene Linkage • Building DNA Gizmo **LS1-4** • Identify the stage of mitosis and graph results • Gizmo Chicken Genetics • Gizmo Mouse Genetics Two Traits

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	• Design a Species **LS3-1** • DNA Gel Electrophoresis Lab • Genotype to Phenotype Paper plate Face constriction • Penny Genetics Probability Lab • Spongebob Genetics • Gizmo: Hardy-Weinberg Equilibrium **LS3-2** • Construct/Analyze Karyotype Lab • Candy Nondisjunction Mini Lab • Mutation Sentences • Transcription Troubles • The Genetics of Blood Disorders • **Modeling Chromosomal Inheritance** **LS3-3** • Analysis of Corn Genetics Lab • Analysis of Fruit Fly genetics Lab • Create a pedigree of a specific inheritance pattern • Minion Genetics Project • Gizmo: Microevolution **Interventions** • Project-based learning • Document-based questions • Socratic seminar • Targeted feedback

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	Student Grouping Strategies • Lab groups (homogeneous, heterogeneous) • Pairs • Cooperative Learning/Lab Groups (each student is assigned a role and responsibility)

Resources
Must-Do
Can-Do
(additions made after consensus at district PLC meetings)
	Technology
	• **Smartboard**
	• **Chromebooks**
	• **Gizmo**
	• **Genetic Science Learning Center: Virtual DNA Extraction and Gel Electrophoresis**
	
	• Chromebooks -student use for Gizmos and Genetic Science Learning sites - 8.1 - Educational Technology
	
	Read:
	Genetic Science Learning Center: Genetically Modified Food
	Scientific American: Genetic Treatments for Sickle Cell
	
	Manipulatives/Lab Activity Resources
	• **Interactive Science Notebook**
	  ○ **Cornell Notes**
	  ○ **Left Side Processing Activities**
	    ■ **Modeling DNA**
	    ■ **Modeling RNA**
	    ■ **Modeling Transcription**
	    ■ **Translate Translation**

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	■ Mutation Sentences ■ Codon Wheel Translation Practice ■ Pedigree Chart Construction ■ Snapdragon Punnett Squares ■ Data Table Human Blood Type ■ Analyzing Karyotypes ■ MiniLab 13.1: Matching Restriction Enzymes to Cleavage Sites ■ MiniLab 13.2 Storing the Human Genome
Assessment	Formative (Assessment used by the individual teacher to gather feedback on student progress toward learning targets.) • Gizmo Lab Student Guide *Gel Electrophoresis *Virtual DNA Extraction • DNA/RNA Model • Left Side Processing Activities • Cornell Notes • Karyotype • Lab Analysis Summative (Assessment used as a summary measure of what all students should know at the end of a unit. Goes in gradebook for a grade.) UnitTest 3A: Link Test Unit 3A: DNA and Inheritance Link Test Unit 3B: DNA and Inheritance

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	Benchmark (Assessment used by the teacher for diagnostic purposes to gather data on student readiness and progress toward grade level standards.)

	Unit IV
Overarching Theme	Natural selection is a key mechanism of evolution, and over time changes the frequency of many traits within a population. In order for natural selection to operate on a trait, the trait must possess heritable variation and must confer an advantage in the competition for resources.
Power/Anchor Standards and Evidence of Learning Must-Do Can-Do	LS4-4: **Construct an explanation based on evidence for how natural selection leads to adaptation of populations.** Unpacked LS4-4: 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. LS4-3: **Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.** Unpacked LS4-3: Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations. LS4-5: **Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.**

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Unpacked LS4-5: 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.

LS2-8: **Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.**

Unpacked LS2-8: Emphasis is on: (1) distinguishing between group and individual behavior, (2) identifying evidence supporting the outcomes of group behavior, and (3) developing logical and reasonable arguments based on evidence. Examples of group behaviors could include flocking, schooling, herding, and cooperative behaviors such as hunting, migrating, and swarming.

Acquisition **(knowledge, skills needed to understand)**	**Meaning** **(Why are the students learning this)**	**Transfer** **(Evidence of Learning and Performance Tasks)**
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. Empirical evidence is required to differentiate between cause and correlation	Understanding how natural selection occurs is important in the healthcare industry, helping students understand antibiotic resistance, and increases the likelihood of finding effective treatments of bacterial infections. Concepts such as adaptation and mutation inform therapies and strategies to combat pathogens.	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 on 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, for how natural selection leads to adaptation of populations. Apply concepts of statistics and probability (including determining

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	and make claims about how natural selection leads to adaptation of populations. Empirical evidence is required to differentiate between cause and correlation and make claims about how specific biotic and abiotic differences in ecosystems contribute to change in gene frequency over time, leading to adaptation of populations. Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and will continue to do so in the future. Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. 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	Studying evolution and natural selection is an excellent way for students to learn about the process of scientific inquiry. Evolution offers countless and diverse examples of the ways scientists gather and analyze information, test competing hypotheses, and ultimately come to a consensus about explanations for natural phenomena. Understanding science is essential for making informed decisions and has become increasingly important for innovation and competitiveness in the 21st century workplace. Understanding natural selection and evolution is critical for understanding biology. Natural selection gives students a fundamental and unifying scientific concept to explain the natural world. The principles of evolution underlie improvements in crops, livestock, and farming methods. Natural selection accounts for the rise in pesticide resistance among agricultural pests and informs the design of new technologies to protect crops from insects and	function fits to data, slope, intercept, and correlation coefficient for linear fits) to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. • Use quantitative analysis to compare relationships among interdependent factors and represent their effects on the carrying capacity of ecosystems at different scales. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. Determine cause-and-effect relationships for how changes to the

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	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. Adaptation also means that the distribution of traits in a population can change when conditions change. Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. Changes in the physical environment, whether naturally occurring or human induced, have 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. . Empirical evidence is required to differentiate between cause and correlation and make claims that changes in environmental conditions may result in: (1) increases in the number of individuals of	disease. Scientists are applying lessons from evolutionary biology to environmental conservation: plants and bacteria adapted to polluted environments are being used to replenish lost vegetation and to clean up toxic environments. Species from microbes to mammals adapt to climate change; studying the mechanism and rate of these changes can help conservation experts formulate appropriate measures to protect species facing extinction.	environment affect distribution or disappearance of traits in species. Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. Distinguish between group and individual behavior. Develop logical and reasonable arguments based on evidence to evaluate the role of group behavior on individual and species' chances to survive and reproduce.

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	some species, (2) the emergence of new species over time, and (3) the extinction of other species. Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives. Empirical evidence is required to differentiate between cause and correlation and to make claims about the role of group behavior in individual and species' chances to survive and reproduce. Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in the revision of an explanation about the role of group behavior on individual and species' chances to survive and reproduce.		
Standards	**Disciplinary Core Ideas (DCI)** **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.		

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	• The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. **LS4.C: Adaptation** • Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. • Adaptation also means that the distribution of traits in a population can change when conditions change. • Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. • Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost. **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. **Crosscutting Concepts** **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. **Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. **Technology 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

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	knowledge. **8.2 Technology Education, Engineering, Design, and Computational Thinking / Programming** - All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment. <u>21st Century Life and Career Standards</u> **9.1 Personal Financial Literacy** - This standard outlines the important fiscal knowledge, habits, and skills that must be mastered in order for students to make informed decisions about personal finance. Financial literacy is an integral component of a student's college and career readiness, enabling students to achieve fulfilling, financially-secure, and successful careers. **9.2 Career Awareness, Exploration, and Preparation -** This standard outlines the importance of being knowledgeable about one's interests and talents, and being well informed about postsecondary and career options, career planning, and career requirements. **9.3 Career and Technical Education -** This standard outlines what students should know and be able to do upon completion of a CTE Program of Study. **Career Ready Practices** **CRP1.** Act as a responsible and contributing citizen and employee. **CRP2.** Apply appropriate academic and technical skills. **CRP4.** Communicate clearly and effectively and with reason. **CRP6.** Demonstrate creativity and innovation. **CRP7.** Employ valid and reliable research strategies. **CRP8.** Utilize critical thinking to make sense of problems and persevere in solving them.

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	CRP11. Use technology to enhance productivity. **CRP12.** Work productively in teams while using cultural global competence
<u>Enduring Understanding</u>	• Students constructing explanations and designing solutions, analyzing and interpreting data, and engaging in argument from evidence investigate to make sense of the relationship between the environment and natural selection. • Students also develop an understanding of the factors causing natural selection of species over time. • Students also demonstrate and understandings of how multiple lines of evidence contribute to the strength of scientific theories of natural selection
<u>Essential Questions</u> (3-5 per unit)	• How does natural selection lead to adaptations of populations? • Why is it so important to take all of the antibiotics in a prescription if I feel better? • How are species affected by changing environmental conditions? • Why do some species live in groups and others are solitary?
<u>Differentiation and Support for Learners</u> (additions made after consensus at district PLC meetings)	**Enrichment** <u>LS4-3</u> • Virtual Peppered Moth Simulation • Natural Selection Gizmo • Candy Dish Selection Lab • The Chips are Down: A Natural Selection Simulation <u>LS4-4</u> • HHMI Lizard Evolution Virtual Lab • Darwin's Finch Adaptation Lab • Natural Selection in Populations <u>LS4-5</u>

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	• Evolution by Natural Selection • Evolution Card Sort • Evolution Timeline • Gizmo: Rainfall and Bird Beaks LS2-8 • PBS Nova: The Evolution Lab • Biology In Motion: Virtual Evolution Lab • PBS Evolution: Sex and the Single Guppy • Chromosome Connection **Interventions** • **Project-based learning** • **Cooperative learning** • **Flexible/strategic grouping** • **Discovery/Inquiry-based learning** **Student Grouping Strategies** • Lab groups (homogeneous, heterogeneous) • Pairs • Cooperative Learning/Lab Groups (each student is assigned a role and responsibility)
Resources **(additions made after consensus at district PLC meetings)**	**Technology** • **Smartboard** • **Chromebooks** • **Gizmo** ◦ Chromebooks -student use for Gizmos site - 8.1 - Educational Technology **Readings**

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	National Science Foundation: Natural Selection Study Shows Animals Can Adapt Dramatically Fast
	Pbs Nova: How Mosquito Nets Can Shape the Evolution of Behavior
	
	Manipulatives/Lab Activity Resources
	
	• Interactive Science Notebook
	  ○ Cornell Notes
	  ○ Left Side Processing Activities
	    ■ Venn Diagram Divergent & Convergent Evolution
	    ■ Graphing stabilizing, disruptive & directional selection
	    ■ Graphing stabilizing, disruptive & directional selection
	    ■ Foursquare Analogy
	    ■ Folding Fact Sheets
	    ■ Haiku
	    ■ Acrostic Organizer

Assessment
Must-Do
Can-Do
	Formative (Assessment used by the individual teacher to gather feedback on student progress toward learning targets.)
	• Gizmo Lab Student Guide
	  *Natural Selection
	  *Rainfall and Bird Beaks
	• Evolution Card Sort
	• Left Side Processing Activities
	• Cornell Notes

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	• Sex and the Single Guppy
	• Lab Analysis
	  ○ * Peppered Moth Simulation
	  ○ * Candy Dish Selection
	  ○ * The Chips Are Down
	  ○ * Lizard Evolution Lab
	  ○ * PBS Nova: The Evolution Lab
	  ○ * Chromosome Connection
	  ○ * Darwin's Finch Evolution
	
	Summative (Assessment used as a summary measure of what all students should know at the end of a unit. Goes in gradebook for a grade.)
	Unit 4 Test: Natural Selection and Evolution
	
	Benchmark (Assessment used by the teacher for diagnostic purposes to gather data on student readiness and progress toward grade level standards.)

	Unit V
Overarching Theme	Evolution: What evidence shows that different species are related?
Power/Anchor Standards and Evidence of Learning	LS2-6: **Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.** Unpacked LS2-6: Examples of changes in ecosystem conditions could include modest biological or physical

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Must-Do Can-Do	changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise. LS2-8: **Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.** Unpacked LS2-8: Emphasis is on: (1) distinguishing between group and individual behavior, (2) identifying evidence supporting the outcomes of group behavior, and (3) developing logical and reasonable arguments based on evidence. Examples of group behaviors could include flocking, schooling, herding, and cooperative behaviors such as hunting, migrating, and swarming. LS3-1: **Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.** LS3-2: **Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.** Unpacked LS3-2: Emphasis is on using data to support arguments for the way variation occurs. LS3-3: **Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.** Unpacked LS3-3: Emphasis is on the use of mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits. LS4-1: **Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.**

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	Unpacked LS4-1: 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. LS4-2: **Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.** Unpacked LS4-2: 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. LS4-3: **Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.** Unpacked LS4-3: Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations. LS4-4: **Construct an explanation based on evidence for how natural selection leads to adaptation of populations.** Unpacked LS4-4: 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. LS4-5: **Evaluate the evidence supporting claims that changes in environmental conditions may result in:**

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	(1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. Unpacked LS4-5: 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.

Acquisition (knowledge, skills needed to understand)	**Meaning** (Why are the students learning this)	**Transfer** (Evidence of Learning and Performance Tasks)
A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment, and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. 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	Understanding how natural selection occurs is important in the healthcare industry, helping students understand antibiotic resistance, and increases the likelihood of finding effective treatments of bacterial infections. Concepts such as adaptation and mutation inform therapies and strategies to combat pathogens. Studying evolution and natural selection is an excellent way for students to learn about the process of scientific inquiry. Evolution offers countless and diverse examples of the ways scientists gather and analyze	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, 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

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	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. Different patterns in multiple lines of empirical evidence may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of common ancestry and biological evolution. 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. Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply	information, test competing hypotheses, and ultimately come to a consensus about explanations for natural phenomena. Understanding science is essential for making informed decisions and has become increasingly important for innovation and competitiveness in the 21st century workplace. Understanding natural selection and evolution is critical for understanding biology. Natural selection gives students a fundamental and unifying scientific concept to explain the natural world. The principles of evolution underlie improvements in crops, livestock, and farming methods. Natural selection accounts for the rise in pesticide resistance among agricultural pests and informs the design of new technologies to protect crops from insects and disease. Scientists are applying lessons from evolutionary biology to environmental conservation: plants and bacteria adapted to polluted environments are being	reproduce in the environment. Use empirical evidence to explain the influences of: (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, 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.

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	of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. Empirical evidence is required to differentiate between cause and correlation and make claims about the process of evolution.	used to replenish lost vegetation and to clean up toxic environments. Species from microbes to mammals adapt to climate change; studying the mechanism and rate of these changes can help conservation experts formulate appropriate measures to protect species facing extinction.	
Standards	Remaining standards (the rest of the content standards that aren't power standards) **Disciplinary Core Ideas (DCI)** **LS2.C: Ecosystem Dynamics, Functioning, and Resilience** • A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. **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. **LS3.B: Variation of Traits** • In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. • Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors. **LS4.A: Evidence of Common Ancestry and Diversity** • Genetic information, like the fossil record, provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence. **LS4.B: Natural Selection** • Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. • The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. **LS4.C: Adaptation** • Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment.

	• 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. • Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. • Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost. • Adaptation also means that the distribution of traits in a population can change when conditions change. **<u>Crosscutting Concepts</u>** **Stability and Change** • Much of science deals with constructing explanations of how things change and how they remain stable. **Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. **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). **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.

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	<u>**Technology Standards**</u> **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. **8.2 Technology Education, Engineering, Design, and Computational Thinking / Programming** - All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment. <u>**21st Century Life and Career Standards**</u> **9.1 Personal Financial Literacy** - This standard outlines the important fiscal knowledge, habits, and skills that must be mastered in order for students to make informed decisions about personal finance. Financial literacy is an integral component of a student's college and career readiness, enabling students to achieve fulfilling, financially-secure, and successful careers. **9.2 Career Awareness, Exploration, and Preparation -** This standard outlines the importance of being knowledgeable about one's interests and talents, and being well informed about postsecondary and career options, career planning, and career requirements. **9.3 Career and Technical Education -** This standard outlines what students should know and be able to do upon completion of a CTE Program of Study.
<u>**Enduring Understanding**</u>	• Biological evolution is supported by scientific evidence from many disciplines, including mathematics • Variation exists in all species and allows some individuals to be better able to survive in a particular environment than others. • Natural selection is the process by which evolution occurs.

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	• Changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.
Essential Questions (3-5 per unit)	• How does the process of natural selection influence evolution? • What factors cause adaptations in organisms? • How do organisms change over time in response to changes in the environment? • What is the evidence for evolution?
Differentiation and Support for Learners (additions made after consensus at district PLC meetings)	**Enrichment** **LS2-6** • Woolybooger Lab • Thirtsy Bird • Web Lesson: Pbs Nova-Darwin's Diary • Web Lesson: Pbs Nova-What We Learn From Fossils • Web Lesson: PBS Nova- Becoming Human **LS3-3** • Analysis of Corn Genetics Lab • Analysis of Fruit Fly genetics Lab • Create a pedigree of a specific inheritance pattern **LS4-1** • Create a cladogram of evolved character traits over time • Common Ancestry/Evolution Evidence Lab • Biochemical Markers of Evolution • Most Intelligent Mammal Lab • Web Lesson: Understanding Homology and Analogy

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	• Web Lesson: Explorations Through Time **LS4-2** • Adaptation of the Opposable Thumb Lab • Create a tag-line for an Evolution comic **LS4-4** • Evolution Timeline/Calendar with math calculations tracking dominant species • Gizmo: Evolution: Natural and Artificial Selection **LS4-5** • Antibiotic Resistance Lab • Peppered Moth Lab • Sex and The Single Guppy • Virtual Lab: Factors that Influence the Rate of Evolution **Interventions** • **Flexible/strategic grouping** • **Cooperative learning** • **Learning centers** • **Summarizing and note taking** **Student Grouping Strategies** • Lab groups (homogeneous, heterogeneous) • Pairs • Cooperative Learning/Lab Groups (each student is assigned a role and responsibility)
Resources	**Technology** • **Smartboard** • **Chromebooks**

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	• **Gizmo**
	  ○ Chromebooks -student use for Gizmos site - 8.1 - Educational Technology
	
	Readings
	Science Daily: **Animal Evolution: Hot Start Followed by Cold Shock**
	The Scientist: Evolution's Quick Pace Affects Ecosystem Dynamics
	
	Manipulatives/Lab Activity Resources
	
	• **Interactive Science Notebook**
	  ○ **Cornell Notes**
	  ○ **Left Side Processing Activities**
	    ■ **Clock Questions**
	    ■ **Discovery Headline / News Article**
	    ■ **Cinquain**
	    ■ **Song Lyrics**
	    ■ **Cartoon Project**
	    ■ **Visual Illustration**
	    ■ **Riddle Cards**

Assessment	**Formative (Assessment used by the individual teacher to gather feedback on student progress toward learning targets.)** • Gizmo Lab Student Guide *Natural and Artificial Selection • Evolution Timeline Construction

	• Left Side Processing Activities
	• Cornell Notes
	• Sex and the Single Guppy
	• Lab Analysis
	  ○ * Woolybooger
	  ○ * Thirsty Bird
	  ○ * Opposable Thumb
	  ○ * Peppered Moth
	  ○ * Antibiotic Resistance
	  ○ * Factors that Influence the Rate of Evolution
	  ○ *Most Intelligent Mammal
	
	Summative (Assessment used as a summary measure of what all students should know at the end of a unit. Goes in gradebook for a grade.)
	Unit 5 Test: Evolution: Evidence & Complex Interactions
	
	Benchmark (Assessment used by the teacher for diagnostic purposes to gather data on student readiness and progress toward grade level standards.)

	Unit VI
Overarching Theme	Interdependent Relationships in Ecosystems and Human Activity and Biodiversity: How do organisms interact with the living and nonliving environments to obtain matter and energy?

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Power/Anchor Standards and Evidence of Learning Must-Do	LS2-1: **Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.** Unpacked LS2-1: 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. LS2-2: **Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.** Unpacked LS2-2: Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data. LS2-3: **Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.** Unpacked LS2-3: Emphasis is on conceptual understanding of the role of aerobic and anaerobic respiration in different environments. LS2-4: **Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.** Unpacked LS2-4: 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. LS2-5: **Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of**

	carbon among the biosphere, atmosphere, hydrosphere, and geosphere. Unpacked LS2-5: Examples of models could include simulations and mathematical models. LS2-6: **Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.** Unpacked LS2-6: 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. LS2-7: **Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.** Unpacked LS2-7: Examples of human activities can include urbanization, building dams, and dissemination of invasive species. LS4-5: **Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.** Unpacked LS4-5: **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** LS4-6: **Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.**

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	Unpacked LS4-6: 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-ESS3-1: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and [changes in] climate **change** have influenced human activity. (9-12 NJSLS-S, p. 51) ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on **climate change and other** natural systems. (9-12 NJSLS-S, p. 51) ESS2-5: **Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.** Unpacked ESS2-5: Emphasis is on mechanical and chemical investigations with water and a variety of solid materials to provide the evidence for connections between the hydrologic cycle and system interactions commonly known as the rock cycle. Examples of mechanical investigations include stream transportation and deposition using a stream table, erosion using variations in soil moisture content, or frost wedging by the expansion of water as it freezes. Examples of chemical investigations include chemical weathering and recrystallization (by testing the solubility of different materials) or melt generation (by examining how water lowers the melting temperature of most solids. HS-ESS3-6: Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity **(i.e., climate change)**. (9-12 NJSLS-S, p. 51) PS1-2: **Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.**

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Unpacked PS1-2: Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen.

Acquisition (knowledge, skills needed to understand)	**Meaning** (Why are the students learning this)	**Transfer** (Evidence of Learning and Performance Tasks)
Ecosystems have carrying capacities, which are limits to the number 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, completion, 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 (the number of individuals) of species in any given ecosystem. The significance of carrying capacity in ecosystems is dependent on the scale proportion and quantity at	Ecology is the study of the relationships between living organisms, including humans, and their physical environment; it seeks to understand the vital connections between plants and animals and the world around them. Ecology also provides information about the benefits of ecosystems and how we can use Earth's resources in ways that leave the environment healthy for future generations. The many specialties within ecology, such as marine, vegetation, and statistical ecology, provide us with information to better understand the world around us. This information also can help us improve our environment, manage our natural resources, and protect human health.	Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. Use quantitative analysis to compare relationships among interdependent factors and represent their effects on the carrying capacity of ecosystems at different scales. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. Use the concept of orders of magnitude to represent how factors affecting biodiversity and

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	which it occurs. Quantitative analysis can be used to compare and determine relationships among interdependent factors that affect the carrying capacity of ecosystems at different scales. Ecosystems have carrying capacities, which are limits to the number 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, completion, 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. A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time	By carefully using the principles of ecology, we can learn to predict, extinguish, counteract and prevent potentially adverse effect we might have on the globe around us. Ecology helps us to understand how all living and nonliving things relate, and carefully using the principles of ecology, we can learn to anticipate, mitigate, offset and prevent potentially negative impacts we might have on the world around us, as well as to maximize the positive efforts we undertake.	populations in ecosystems at one scale relate to those factors at another scale. Evaluate the claims, evidence, and reasoning that support the contention that complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. Construct explanations of how modest biological or physical changes versus extreme changes affect stability and change in ecosystems. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. Quantify and model change and rates of change in the relationships among management of natural resources, the sustainability of human populations, and biodiversity. Design, evaluate, and refine a solution for reducing the impacts of human

	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. Using the concept of orders of magnitude allows one to understand how a model of factors affecting biodiversity and populations in ecosystems at one scale relates to a model at another scale. 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) as opposed		activities on the environment and biodiversity based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. Construct explanations for how the environment and biodiversity change and stay the same when affected by human activity. Evaluate a solution for reducing the impacts of human activities on the environment and biodiversity based on scientific knowledge, student generated sources of evidence, prioritized criteria, and tradeoff considerations. Analyze costs and benefits of a solution for reducing the impacts of human activities on the environment and biodiversity based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

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	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. The sustainability of human societies and the biodiversity that supports them require responsible management of natural resources. Change and rates of change can be quantified and modeled over very short or very long periods. Some system changes are irreversible. Modern civilization depends on major technological systems. New technologies can have deep impacts on society and the environment including some that are not anticipated.		

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Standards	**Disciplinary Core Ideas (DCI)** **LS2.A: Interdependent Relationships in Ecosystems** ● Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. **LS2.B: Cycles of Matter and Energy Transfer in Ecosystems** ● Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. ● Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. **LS2.C: Ecosystem Dynamics, Functioning, and Resilience** ● A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.

	• Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. **LS4.C: Adaptation** • Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. • Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost. **LS4.D: Biodiversity and Humans** • Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction).*(secondary)* • Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. *(secondary) (Note: This Disciplinary Core Idea is also addressed by HS-LS4-6.)* **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. • Both physical models and computers can be used in various ways to aid in the engineering design

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	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)* **PS3.D: Energy in Chemical Processes** • The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis.*(secondary)* **<u>Crosscutting Concepts</u>** **Scale, Proportion, and Quantity** • The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. • Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale. **Energy and Matter** • Energy drives the cycling of matter within and between systems. • Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems. **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. **Stability and Change** • Much of science deals with constructing explanations of how things change and how they remain stable. **Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims

	about specific causes and effects. <u>Technology Standards</u> **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. **8.2 Technology Education, Engineering, Design, and Computational Thinking / Programming** - All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment. <u>21st Century Life and Career Standards</u> **9.1 Personal Financial Literacy** - This standard outlines the important fiscal knowledge, habits, and skills that must be mastered in order for students to make informed decisions about personal finance. Financial literacy is an integral component of a student's college and career readiness, enabling students to achieve fulfilling, financially-secure, and successful careers. **9.2 Career Awareness, Exploration, and Preparation –** This standard outlines the importance of being knowledgeable about one's interests and talents, and being well informed about postsecondary and career options, career planning, and career requirements. **9.3 Career and Technical Education –** This standard outlines what students should know and be able to do upon completion of a CTE Program of Study. **Career Ready Practices** **CRP1.** Act as a responsible and contributing citizen and employee. **CRP2.** Apply appropriate academic and technical skills.

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	CRP4. Communicate clearly and effectively and with reason. **CRP6.** Demonstrate creativity and innovation. **CRP7.** Employ valid and reliable research strategies. **CRP8.** Utilize critical thinking to make sense of problems and persevere in solving them. **CRP11.** Use technology to enhance productivity. **CRP12.** Work productively in teams while using cultural global competence
Enduring Understanding	• Earth's ecosystems are interconnected by biological, chemical, and physical processes. Changes in one ecosystem may have local and/or global consequences. • Ecosystems undergo major changes as a result of such factors as climate change, introduction of new species, and habitat destruction. These can be the result of natural processes and/ or human impact. • Changes in the physical, chemical, or biological conditions of an ecosystem can alter the diversity of species in the system. Over time, ecosystems change and populations of organisms adapt, move, or become extinct. • Organisms both cooperate and compete in ecosystems. The interrelationships and interdependencies of these organisms may generate complex ecosystems that are stable over long periods of time and tend to have cyclic fluctuations around an equilibrium. • Populations can increase through exponential growth. Higher populations result in competition for limited resources and increases in environmental pollution. • The carrying capacity for a specific population in an ecosystem depends on the resources available. Given adequate biotic and abiotic resources and no disease or predators, populations increase at rapid rates. Resources, (limiting factors), predation and climate, limit the growth of populations in specific niches in an ecosystem.

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Essential Questions (3-5 per unit)	• How do organisms interact with the living and nonliving environments to obtain matter and energy? • How do humans have an impact on the diversity and stability of ecosystems? • What limits the number and types of different organisms that live in one place? • How do matter and energy link organisms to each other and their environments? • How is energy flow in an ecosystem modeled? • How do nutrients like nitrogen and carbon move through an ecosystem? • What controls the size of a population in an ecosystem?
Differentiation and Support for Learners (additions made after consensus at district PLC meetings)	**Enrichment** **LS2-1** • Graphing carrying capacity of an ecosystem • Outdoor ecological scavenger hunt/ecological concept poster • Overpopulation of Plants Lab • **Virtual Lab: Population Biology** • **Gizmo: Food Chain** • **Gizmo: Forest Ecosystem** • **Gizmo: Pond Ecosystem** **LS2C:** • **Mark and recapture Lab** • **Random Sampling Lab** • **Biome Brochure** • **Lesson of the Kaibab** • **Density Dependent/Independent Activity** • **Age Structure Graphing Activity** • **Predator/Prey Population Cycles** • **Energy Efficiencies through Ecosystems Calculations**

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	• **LS2-4** • Math computation tracking energy and matter in the discuss and show data changes with human interference • Food Chain/Food Web Lab • Create a poster modeling the carbon cycle • Graphic Organizer- Water Cycle • Virtual Fieldtrip- Nitrogen Cycle • Flow Chart- Phosphorus Cycle **LS2-7** • **Effects of Fertilizer on Algae Growth (Spectrophotometer) Lab** • Endangered Species Web Activity • Invasive Species Article Review • **Endangered/Invasive Species Game** **ESS2-5,** HS-ESS3-1 • Adhesion/Cohesion of Water • Acid Rain Lab **PS1-2** • pH Lab: pH & Plant Growth • Properties of Water activity **Interventions** • **Cooperative learning** • **Cues, questions, activating prior knowledge** • **Notebooking/journaling** • **Discovery/Inquiry-based learning** **Student Grouping Strategies** • Lab groups (homogeneous, heterogeneous)

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	• Pairs • Cooperative Learning/Lab Groups (each student is assigned a role and responsibility)

Resources
 	
(additions made after consensus at district PLC meetings)
	Technology
	• **Smartboard**
	• **Chromebooks**
	• **Gizmo**
	
	  • Chromebooks -student use for Gizmos site - 8.1 - Educational Technology
	
	Readings
	• **Journal of Ecology:** Benefits of plant diversity to ecosystems: immediate, filter and founder effects
	• **Journal of Ecology:** Impact of invasive plants on the species richness, diversity and composition of invaded communities
	
	Manipulatives/Lab Activity Resources
	• **Interactive Science Notebook**
	  ○ **Cornell Notes**
	  ○ **Left Side Processing Activities**
	    ■ **Visual Biosphere Representation**
	    ■ **Personification: Lake Letter**
	    ■ **Vocab Cards: root, definition, illustration, sentence**
	    ■ **Cycle Diagrams**
	    ■ **Clue Cards**
	    ■ **Trading Cards**
	    ■ **PSA (Public Service Announcement)**

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Assessment Must-Do Can-Do	Formative (Assessment used by the individual teacher to gather feedback on student progress toward learning targets.) • Gizmo Lab Student Guide * Forest Ecosystem * Pond Ecosystem * Food Chain • Endangered/Invasive Species Game • Biome Brochure • Left Side Processing Activities • Cornell Notes • Sex and the Single Guppy • Lab Analysis ○ * Adhesion/Cohesion of Water ○ * Lesson of the Kaibab ○ * Effects of Fertilizer on Algae Growth (Spectrophotometer) Lab ○ * pH Lab: pH & Plant Growth ○ * Acid Rain Lab ○ Summative (Assessment used as a summary measure of what all students should know at the end of a unit. Goes in gradebook for a grade.) Unit 6 Test: Ecology Benchmark (Assessment used by the teacher for diagnostic purposes to gather data on student readiness and progress toward grade level standards.)

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