VERNON TOWNSHIP
SCHOOL DISTRICT

Biology ACP
Curriculum Map

Adapted from:
Understanding By Design

Reviewed by:
Vincent Gagliostro - Director of Curriculum & Instruction

Adopted:
March 2025

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Course Description

Biology ACP is designed to prepare students for college/career by emphasizing key skills and practices (NGSS, STEM) and encouraging students to become lifelong learners and engaged citizens. Students use their understanding of biological processes to explain natural phenomena. This course centers on the four themes of Biology: 1 - All levels of life have systems of related parts, 2 - Structure and function are related, 3 - Organisms must maintain homeostasis, 4 - Evolution explains the unity and diversity of life.

Based upon the following list of proficiencies, each student must demonstrate a minimum competency level of 65%. Competencies will be measured by way of an evaluation program consisting of teacher observations of student performance, tests, quizzes, classwork, homework, projects, and class participation, as well as class attendance in accordance with the high school's attendance policy.

Successful completion of this course earns 6 credits toward graduation.

Various Levels of Text: Supplemental text and audio visual materials are provided for above grade level and below grade level for students who need them.

AI tools and Text to Speech tools may be used to adapt the lexile level of grade level materials.

New Jersey learning Standards covered throughout the course

In conjunction with the New Jersey Student Learning Standards, students enrolled in the **Biology ACP** courses will demonstrate the ability to:

HS-LS1 From Molecules to Organisms: Structures and Processes

- HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
- HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
- HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
- HS-LS1-4. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
- HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
- HS-LS1-6. Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
- HS-LS1-7. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy

HS-LS2 Ecosystems: Interactions, Energy, and Dynamics

- HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
- HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
- HS-LS2-3. Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
- HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
- HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
- HS-LS2-6. Evaluate 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.
- HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
- HS-LS2-8. Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.

HS-LS3 Heredity: Inheritance and Variation of Traits

- HS-LS3-1. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
- HS-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.
- HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

HS-LS4 Biological Evolution: Unity and Diversity

- HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
- HS-LS4-2. Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.
- HS-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
- HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
- HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.
- HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

HS-ESS3 Earth and Human Activity

- HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
- HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

- HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity
- HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
- HS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.
- 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.

HS-ETS1 Engineering Design

- HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
- HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Grading Criteria
• Major Grades - 70% • Minor Grades - 30%

Course Resources
Core Text: Biology 2e Online OpenStax Rice University - 2020 **Technologies:** BenQ Interactive Display, Chromebooks **Supplemental Materials:** • For phenomena ideas: www.NGSSPhenomena.com • For readings, quizzes, and simulations: www.ck12.org

- For simulation labs: https://learn.concord.org/collections, http://exeplorelearning.com/
- Text: HMH Science Dimensions Biology 2018 NGSS

Scope and Sequence- Topical Outline		
Unit	Title	Time
1	Introduction (with DEI mandate)	3 Weeks
2	Matter and Energy in Ecosystems	5 Weeks
3	Interdependent Relationships in Ecosystems	4 Weeks
4	Human Activity and Climate Change (with Climate Change mandate)	4 Weeks
5	Human Activity and Biodiversity	4 Weeks
6	Cell Specialization and Homeostasis	4 Weeks
7	DNA and Inheritance	4 Weeks
8	Natural Selection	4 Weeks
9	Evolution	4 Weeks

The timeline is only an approximation. The inclusion of a classroom project in any one of the above units would extend the time allotment.

Subject Area: Science Grade Level: Biology ACP	
Unit	**1 Introduction to Biology**
Timeframe	3 Weeks
Established Goals	*Students will understand that…* ● 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. ● Scientific knowledge can be used to generate design solutions. ● Solutions to complex real-world problems are evaluated based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. ● Science is a way of knowing the natural world through observation and inquiry. ● Scientific knowledge is built and evolves over time through social practice involving critical analysis. ● Measurement and observation tools are used to categorize, represent, and interpret the natural world. ● Evidence is used for building, refining, and/or critiquing scientific claims and explanations. ● Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence. ● 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. ● 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. *CCC-Systems and System Models* ● Feedback (negative or positive) can stabilize or destabilize a system. CCC-Stability and Change
NJSLS	● HS-LS1-2. Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. ● HS-ETS 1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. ● HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and

	trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.
Essential Questions	• What is science? • What are phenomena? • What is biology? • How does Earth support life? • What does it mean to be alive? • How do the structures of organisms enable life's functions? • How can life be examined at different levels? • How can we use a controlled experiment to better understand our world? • How do we build and refine models that describe and explain the natural world? • What constitutes useful scientific evidence?
Content Knowledge	*Students will learn:* • 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. LS1.A • Controlled experiments isolate one variable and test a hypothesis. • Data collected from an experiment can be displayed using graphs and analyzed to form conclusions. • A theory explains a wide range of observations. • Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade offs) may be needed. ETS1.C • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. ETS1.B • Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. ETS1.B • Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. ETS1.C • 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. ETS1.B *Example Content Outline* I. What is life?

	A. Can we define it? B. Characteristics of living things II. Life in the Earth System A. Systems 1. Definition of system 2. Properties of systems a) Inputs and outputs b) System classification (1) Open (2) Closed (3) Isolated c) Controls (1) Positive feedback (2) Negative feedback 3. Systems models a) Physical models b) Conceptual models (analogies) c) Mathematical models (1) Equations (2) Graphs d) Simulations B. Organization of the Earth system C. Organization of the biosphere III. Studying the biosphere A. Science vs. engineering B. Argumentation (CER) 1. Claim 2. Evidence 3. Reasoning C. Experimental design 1. Observations 2. Variables and controls 3. Types of hypotheses (claim) 4. Quantitative data analysis (evidence) 5. Analysis of hypothesis (reasoning)
Skills	*Students will be able to:* ● Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. ● Define and describe biology and its branches.

	• list and describe common life processes. • Explain how living things are: made of cells, reproduce, grow and develop, respond to stimuli, use materials and energy, evolve over time, and adapt to their environment. • Utilize the scientific method in solving biological problems and use mathematical operations where appropriate for solving those problems. • Identify ways in which the study of biology serves as a foundation for many career opportunities in science and technology. • Use correctly the instruments, apparatus, and technologies of biology (such as the microscope) and demonstrate the procedures of biology (preparation of wet mount slides, use of laboratory materials and protective equipment) in a safe manner. • 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. • ***Reference*** Goal 4 Opportunities ***when designing lessons to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all***
Performance Tasks	• Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence. • 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. • Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon or a solution to a problem. • Develop a model that identifies and describes the relevant parts (e.g., organ system, organs, and their component tissues) and processes (e.g., transport of fluids, motion) of body systems in multicellular organisms. HS-LS1-2 LS Evidence Statements • Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-2 ETS Evidence Statements • Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. HS-ETS1-3 ETS Evidence Statements
Other Assessment Evidence	***Formative Assessment*** • Do nows, teacher check ins, exit tickets, observations of student groups, student conferences, science journal, lab reflections, concept mapping, quizzes, class discussions, skill/homework, Socratic discussion, and gamification (e.g., Kahoot, Quizizz, Blooket, etc) on Unit 1 topics

	Summative Assessment students will be assessed in the following ways, and will be differentiated accordingly: ● CERs ● Simulations (https://concord.org/ and http://exeplorelearning.com/) ● Lab activities, experimental design, and reports ● Unit Exam on Unit 1 topics ● Current Event Article(s) ***Alternative Assessment*** Assessments will be differentiated in various ways based on the needs of the students. For example, differentiation could be in… ● Content (texts, phenomena, graphs, datatables, vocabulary, etc.) ● Process (scaffolding, guiding questions, small group instruction, etc.) ● Product (individual components,student choice modality such as video, skit, etc) ***Benchmark (pre)*** Planning and Carrying out a Biological Investigation: Students are presented with a biological problem. They will design and conduct an experiment testing how to most effectively determine solutions to a real world problem. ● Students will be able to design and conduct a controlled experiment in order to solve a real world biological phenomena. ● Students will be able to effectively analyze and draw conclusions from their dataset. ● Students will be able to make strong predictions based on trends in the data. ● Students will be able to evaluate the effectiveness of their experimental design and reflect upon it. ***During each common, formative, and summative assessment, teachers will provide alternative assessment opportunities that adhere to 504 and IEP requirements. Alternative assessments are individualized for the needs of all students.***
Resources/Materials	**Core Text:** Biology 2e Online OpenStax Rice University - 2020 Chapter 1: The Study of Life **Technologies:** BenQ Interactive Display, Chromebooks **Supplemental Materials:** ● For phenomena ideas: www.NGSSPhenomena.com ● For readings, quizzes, and simulations: www.ck12.org ● For simulation labs: https://learn.concord.org/collections, http://exeplorelearning.com/ ● Text: HMH Science Dimensions Biology 2018 NGSS

Learning Activities	• Introduction to the Microscope Lab • Measuring Microscopic Objects Lab • Characteristics of Life Lab - The Yeast of our Worries (HS-LS1-3) • Surveying Kingdom Diversity • CER - Spontaneous Generation and the Scientific Method
Interdisciplinary Connections	*ELA/Literacy* • RI.CR.11-12.1. Accurately cite a range of thorough textual evidence and make relevant connections to strongly support a comprehensive analysis of multiple aspects of what an informational text says explicitly and inferentially, as well as interpretations of the text. (HS-LS2-3) • SL.UM.9–12.5. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance findings, reasoning, and evidence and to add interest. 🌿(HS-LS1-5) *Mathematics* • ***Activity: Measuring Microscopic Objects Lab*** Reason abstractly and quantitatively. MP.2 (HS-LS2-4) Model with mathematics. MP.4 (HS-LS2-4) • Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.1 (HS-LS2-4) • Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.2 (HS-LS2-4) • HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HSLS2-4)

Subject Area: Science **Grade Level: Biology ACP**	
Unit	**2 Matter and Energy in Ecosystems**
Timeframe	5 Weeks

Established Goals	*Students will understand that…* ● Models can be used to illustrate how photosynthesis transforms light energy into stored chemical energy. ● Carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. ● 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. ● Matter cycles and energy flows in aerobic and anaerobic conditions. 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. Mathematical representations can be used to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. ● Photosynthesis and cellular respiration cycle materials (e.g., oxygen, carbon dioxide, and sugar) among the biosphere, atmosphere, hydrosphere, and geosphere. ● 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. *CCC-Systems and System Models*
NJSLS	● HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. ● HS-LS1-6. Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. ● HS-LS1-7. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy. ● HS-LS2-3. Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions. ● HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. ● HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
Essential Questions	● How are the elements in our bodies used to make the larger molecules that make up our structure? ● How does the structure of molecules affect their function and role in living things? ● What functions do carbohydrates, proteins, lipids, and nucleic acids have in all living organisms?

	• How do enzymes impact an organism's metabolism? • How does the structure of water make life on Earth possible? • How do changes in the environment affect the function of molecules and the stability of an organism? • How are matter and energy transferred/transformed in living systems? • How do the processes of photosynthesis and respiration transfer/transform energy and cycle materials on Earth?
Content Knowledge	*Students will learn:* • The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. LS1.C • The sugar molecules formed from photosynthesis contain carbon, hydrogen, and oxygen. Sugars' 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. LS1.C • Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. LS2.B • 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.B • 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. LS2.B • Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. LS2.B • Each class of organic compounds has unique properties, structures, and functions in living things. • Chemical reactions release or absorb energy. • 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. *CCC-Energy and Matter* • Enzymes carry out metabolic processes such as aiding in digestion (e.g., lactase). • Enzymes are catalysts that speed up and lower activation energy needed for chemical reactions. • Hydrogen bonding and the structure of water allow for its unique properties. • The pH of substances varies between 0-14 and living things tend to thrive in a neutral environment.

- All cells need chemical energy.
- The chemical energy used for most cell processes is carried by ATP.
- Organisms break down carbon-based molecules through cellular respiration to produce ATP.
- Fermentation allows the production of a small amount of ATP without oxygen.
- Fermentation and its products are important in many ways (e.g., cheese, yogurt, beer/wine, soy sauce).
- Plants have special structures that aid in the process of photosynthesis and in the conservation of water.

Example Content Outline

I. Matter and energy in photosynthesis [HS-LS1-5]
    A. Modeling photosynthesis
        1. Inputs
        2. Outputs
        3. Light (intensity; color)
    B. Diagram of process of photosynthesis
        1. Light dependent phase
        2. Light independent phase
    C. Leaf Structure
II. Matter and energy in cellular respiration [HS-LS2-3]
    A. Energy in living systems
        1. Origin
        2. Stored in chemical bonds [LS1.A]
            a. monosaccharides
            b. disaccharides
            c. polysaccharides
    B. The process of cellular respiration
        1. Inputs
        2. Outputs
        3. Process
            a. Glycolysis
            b. Aerobic pathway
            c. Anaerobic pathway
                i. Lactic acid formation
                ii. Alcoholic fermentation
                iii. Anaerobic respiration
III. Modeling matter and energy in ecosystems [HS-LS2-4]
    A. Energy in ecosystems
        1. Food chains
        2. Trophic levels

	3. Food webs 4. Loss of available energy B. Pyramid models 1. Energy pyramids 2. Biomass pyramid 3. Pyramid of numbers C. Biomagnification IV. Cycling matter and energy in ecosystems [HS-LS2-4] A. Water cycle B. Biogeochemical cycles 1. carbon cycle [HS-LS2-5] 2. nitrogen cycle 3. phosphorus cycle
Skills	*Students will be able to:* ● Interpret and compare nutritional labels and assess the nutritional value of foods with respect to carbohydrates, fats, and proteins and the needs of our cells. ● Form hypotheses about the organic composition in food samples. ● Test and assess the presence of organic compounds in food samples. ● Test, assess and form conclusions regarding enzymatic action. ● Recognize terminology, specific facts, and general concepts related to basic and organic chemistry related to the biology of living things. ● Identify the substrate and enzyme in chemical reactions. ● Predict the behavior of water in different situations during experimental lab exercises. ● Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. ● Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions. ● Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. ● Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. ● Use mathematical representations of phenomena or design solutions to support claims. ● ***Reference*** Goal 4 Opportunities ***when designing lessons to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all***
Performance Tasks	● Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. Examples of models could include diagrams, chemical equations, and conceptual models. HS-LS1-5 LS Evidence Statements

	• Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. Examples of models could include simulations and mathematical models. HS-LS2-5 LS Evidence Statements • Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions. HS-LS2-3 LS Evidence Statements • Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. HS-LS1-6 LS Evidence Statements • Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy. HS-LS1-7 LS Evidence Statements
Other Assessment Evidence	***Formative Assessment*** • Do nows, teacher check ins, exit tickets, observations of student groups, student conferences, science journal, lab reflections, concept mapping, quizzes, class discussions, skill/homework, Socratic discussion, and gamification (e.g., Kahoot, Quizizz, Blooket, etc)on Unit 2 topics ***Summative Assessment*** students will be assessed in the following ways, and will be differentiated accordingly: • CERs • Simulations (https://concord.org/ and http://exeplorelearning.com/) • Lab activities, experimental design, and reports • Unit Exam on Unit 2 topics • Current Event Article(s) ***Alternative Assessment*** Assessments will be differentiated in various ways based on the needs of the students. For example, differentiation could be in… • Content (texts, phenomena, graphs, datatables, vocabulary, etc.) • Process (scaffolding, guiding questions, small group instruction, etc.) • Product (individual components,student choice modality such as video, skit, etc) ***During each common, formative, and summative assessment, teachers will provide alternative assessment opportunities that adhere to 504 and IEP requirements. Alternative assessments are individualized for the needs of all students.***
Resources/Materials	**Core Text:** Biology 2e Online OpenStax Rice University - 2020 Chapter 2: The Chemical Foundation of Life

	Chapter 3: Biological Macromolecules Chapter 6: Metabolism Chapter 7: Cellular Respiration Chapter 8: Photosynthesis **Technologies:** BenQ Interactive Display, Chromebooks **Supplemental Materials:** • For phenomena ideas: www.NGSSPhenomena.com • For readings, quizzes, and simulations: www.ck12.org • For simulation labs: https://learn.concord.org/collections, http://exeplorelearning.com/ • Text: HMH Science Dimensions Biology 2018 NGSS
Learning Activities	• Observing Leaf Structure Lab • Fantastic Fluorescing Chlorophyll Lab • Plant Chromatography Lab • Effect of exercise on respiration Lab • Modeling Ecological Pyramids • Food Chains and Webs Lab • What to Alligators Eat? - Lab • Lungs of the Planet - Lab • Plants and Snails Gizmo
Interdisciplinary Connections	*ELA/Literacy* • ***Activity: Plants and Snails Gizmo*** SL.UM.9–12.5. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance findings, reasoning, and evidence and to add interest. 🌿(HS-LS1-5) • RI.CR.11-12.1. Accurately cite a range of thorough textual evidence and make relevant connections to strongly support a comprehensive analysis of multiple aspects of what an informational text says explicitly and inferentially, as well as interpretations of the text.(HS-LS2-3) *Mathematics* • Reason abstractly and quantitatively. MP.2 (HS-LS2-4) • Model with mathematics. MP.4 (HS-LS2-4)

	• Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.1 (HS-LS2-4) • Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.2 (HS-LS2-4) • HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HSLS2-4)

Subject Area: Science **Grade Level: Biology ACP**	
Unit	**3 Interdependent Relationships in Ecosystems**
Timeframe	4 weeks
Established Goals	*Students will understand that…* • Mathematical and/or computational representations can be used to support explanations of factors that affect carrying capacity of ecosystems at different scales. • Mathematical representations can be used to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. • Complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. • Interactions among living systems and with their environment result in the movement of matter and energy. LS2.A • Population growth is limited by access to resources. Selective pressures may reduce the number of organisms or eliminate whole populations of organisms. LS2.A • The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. *CCC-Scale, Proportion, and Quantity* • Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale. *CCC-Scale, Proportion, and Quantity* • Much of science deals with constructing explanations of how things change and how they remain stable. *CCC-Stability and Change*
NJSLS	• HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. • HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence

	about factors affecting biodiversity and populations in ecosystems of different scales. ● HS-LS2-6. 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.
Essential Questions	● How do organisms interact with the living and nonliving environments to obtain matter and energy? ● What factors cause living organisms to respond and change? ● How do matter and energy move through ecosystems? ● How can there be so many similarities among organisms yet so many diverse kinds of plants, animals, and microorganisms? ● What happens to populations when their environment changes?
Content Knowledge	*Students will learn:* ● 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. LS2.A ● Organisms 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.A ● 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. LS2.C ● 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. LS2.C ● 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.C *Example Content Outline* I. Population dynamics A. Population density B. Population dispersion C. Population growth 1. Factors 2. Curves [HS-LS2-1] a. Exponential b. Logistic

	3. Limiting factors a. Carrying capacity b. Density – dependent c. Density – independent II. Ecosystem dynamics A. Differentiate habitat vs. niche B. Relationships 1. Predation 2. Competition for limited resources a. Intraspecific b. Interspecific 3. Symbiosis a. Mutualism b. Commensalism c. Parasitism C. Keystone species III. Disturbances in ecosystems [HS-LS2-6] A. Types 1. Natural 2. Human-influenced B. Ecosystem responses 1. Ecosystem stability 2. Ecosystem resilience 3. Ecosystem resistance C. Ecological succession 1. Primary 2. Secondary
Skills	*Students will be able to:* ● Develop and use a model based on evidence to illustrate the organization of the Earth system. *SEP-Developing and Using Models* ● Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. *SEP-Engaging in Argument from Evidence* ● Illustrate how interactions among living systems and with their environment result in the movement of matter and energy. ● Graph real or simulated populations and analyze the trends to understand consumption patterns and resource availability, and make predictions as to what will happen to the population in the future. ● Provide evidence that the growth of populations are limited by access to resources, and how selective

	pressures may reduce the number of organisms or eliminate whole populations of organisms. • Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. *SEP-Using Mathematics and Computational Thinking* • Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. *SEP-Using Mathematics and Computational Thinking* • Provide evidence that the growth of populations are limited by access to resources, and how selective pressures may reduce the number of organisms or eliminate whole populations of organisms. LS2.A • ***Reference Goal 4 Opportunities when designing lessons to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all***
Performance Tasks	• 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. Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise. HS-LS2-6 LS Evidence Statements • Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data. HS-LS2-2 LS Evidence Statements • Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from simulations or historical data sets. HS-LS2-1 LS Evidence Statements • Graph real or simulated populations and analyze the trends to understand consumption patterns and resource availability, and make predictions as to what will happen to the population in the future. LS2.A • Provide evidence that the growth of populations are limited by access to resources, and how selective pressures may reduce the number of organisms or eliminate whole populations of organisms. LS2.A
Other Assessment Evidence	***Formative Assessment*** • Do nows, teacher check ins, exit tickets, observations of student groups, student conferences, science journal, lab reflections, concept mapping, quizzes, class discussions, skill/homework, Socratic discussion, and gamification (e.g., Kahoot, Quizizz, Blooket, etc)on Unit 3 topics ***Summative Assessment***

	students will be assessed in the following ways, and will be differentiated accordingly: ● CERs ● Simulations (https://concord.org/ and http://exeplorelearning.com/) ● Lab activities, experimental design, and reports ● Unit Exam on Unit 3 topics ● Current Event Article(s) ***Alternative Assessment*** Assessments will be differentiated in various ways based on the needs of the students. For example, differentiation could be in… ● Content (texts, phenomena, graphs, datatables, vocabulary, etc.) ● Process (scaffolding, guiding questions, small group instruction, etc.) ● Product (individual components,student choice modality such as video, skit, etc) ***During each common, formative, and summative assessment, teachers will provide alternative assessment opportunities that adhere to 504 and IEP requirements. Alternative assessments are individualized for the needs of all students.***
Resources/Materials	**Core Text:** Biology 2e Online OpenStax Rice University - 2020 Chapter 44: Ecology and the Biosphere Chapter 45: Population and Community Ecology Chapter 46: Ecosystems **Technologies:** BenQ Interactive Display, Chromebooks **Supplemental Materials:** ● For phenomena ideas: www.NGSSPhenomena.com ● For readings, quizzes, and simulations: www.ck12.org ● For simulation labs: https://learn.concord.org/collections, http://exeplorelearning.com/ ● Text: HMH Science Dimensions Biology 2018 NGSS
Learning Activities	● Biotic Potential of Rabbits Gizmo ● Bison Population and Carrying Capacity - graphing data ● Diversity in a Jar - Comparing Biome Diversity ● Ecological Interactions in the Sonoran Desert ● Ecological Succession Graphic Organizer

Interdisciplinary Connections	*ELA/Literacy* ● ***Activity: Bison Population and Carrying Capacity - graphing data*** RI.MF.9–10.6. Analyze, integrate, and evaluate multiple interpretations (e.g., charts, graphs, diagrams, videos) of a single text or text/s presented in different formats (visually, quantitatively) as well as in words in order to address a question or solve a problem. (HS-LS2-6) ● RI.CR.11-12.1. Accurately cite a range of thorough textual evidence and make relevant connections to strongly support a comprehensive analysis of multiple aspects of what an informational text says explicitly and inferentially, as well as interpretations of the text.(HS-LS2-1), (HS-LS2-2), (HS-LS2-6) ● RI.CT.9–10.8. Analyze and reflect on (e.g., practical knowledge, historical/cultural context, and background knowledge) seminal and informational text of historical and scientific significance, including how they relate in terms of themes and significant concepts. 🌿(HS-LS2-6) ● W.IW.9-12.2. Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content. (HS-LS2-1) (HS-LS2-2) *Mathematics* ● Reason abstractly and quantitatively. MP.2 (HS-LS2-1), (HS-LS2-2), (HS-LS2-6) ● Model with mathematics. MP.4 (HS-LS2-1), (HS-LS2-2) ● Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN.Q.A.1 (HS-LS2-1), (HS-LS2-2)

Subject Area: Science **Grade Level: Biology ACP**	
Unit	**4 Human Activity and Climate Change**
Timeframe	4 Weeks
Established Goals	*Students will understand that…* ● Resource availability has guided the development of human society. ESS3.A ● Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations. ESS3.B ● Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. ESS3.C

	• 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. ETS1.B • Variations in the flow of energy into and out of Earth's systems result in changes in climate. • Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. ESS3.D • Earth systems are interrelated and these relationships are being modified due to human activity. • Solutions to complex, real-world problems can be evaluated based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. • Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. ESS2.D • Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. ESS3.D
NJSLS	• HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. • HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. • HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. • HS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. • 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. • HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
Essential Questions	• How do humans depend on Earth's resources? • How and why do humans interact with their environment? • What are the effects of humans' interactions with their environment?

	● How do human activities influence the global ecosystem?
Content Knowledge	*Students will learn:* ● Human activity has been influenced by the availability of natural resources, occurrence of natural hazards, and changes in climate. ● Human activities impact natural systems. ● Resource vitality has guided the development of human society. ● Natural hazards and other geologic events have shaped the course of human history. ● Natural hazards and other geologic events have significantly altered the sizes of human populations and have driven human migration. ● Empirical evidence is required to differentiate between cause and correlation and make claims about how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activities. ● Modern civilization depends on major technological systems. ● Changes in climate can affect population or drive mass migration. ● Although the magnitude of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. ● Change in rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. ● Science investigations use diverse methods and do not always use the same set of procedures to obtain data. ● Science knowledge is based on empirical evidence. ● Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. ● Engineers continuously modify these systems to increase benefits while decreasing costs and risks. ● Feedback (negative or positive) can stabilize or destabilize natural systems. ● When evaluating solutions, it is important to take into account a range of constraints, including costs, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. ● New technologies can have deep impacts on society and the environment, including some that are not anticipated. ● Analysis of costs and benefits is a critical aspect of decisions about technology. *Example Content Outline* I. Human Population Growth [HS-ESS3-1] A. History of human population

	1. Patterns of human settlement 2. Size 3. Growth pattern B. Ecological footprint II. Human Impacts on Natural Resources [HS-ESS3-6] (use case studies to illustrate impacts on different systems/levels) A. Types and availability B. Human impacts on nutrient cycling C. Fire D. Floods E. Deforestation F. Water availability III. Climate Change [HS-ESS3-5] A. Evidence B. Models C. Impacts 1. Changes in sea level 2. Glacial ice 3. Atmosphere & Ocean Composition IV. Reducing Human Impact [HS-ESS3-4] A. Alternative Energy 1. examining tradeoffs a. Constraints b. Impacts B. Ecosystem Services C. Case Studies
Skills	*Students will be able to:* ● Describe the boundaries of Earth systems. ● Analyze and describe the inputs and outputs of Earth systems. ● Quantify and model change and rates of change in geosciences data and rates of global or regional climate change and associated impacts to Earth systems. ● Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. ● Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity. ● Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. ● Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that

	account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. • Evaluate or refine a technological solution that reduces impacts of human activities on natural systems based on scientific knowledge and student-generated sources of evidence; prioritize criteria and trade off considerations. • ***Reference Goal 4 Opportunities when designing lessons to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all***
Performance Tasks	• Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. HS-ESS2-4 ESS Evidence Statements • Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. HS-ESS3-1 ESS Evidence Statements • Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. HS-ESS3-4 ESS Evidence Statements • Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. HS-ESS3-5 ESS Evidence Statements • Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity. HS-ESS3-6 ESS Evidence Statements • Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. HS-ETS1-3 ETS Evidence Statements • Design or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
Other Assessment Evidence	***Formative Assessment*** • Do nows, teacher check ins, exit tickets, observations of student groups, student conferences, science journal, lab reflections, concept mapping, quizzes, class discussions, skill/homework, Socratic discussion, and gamification (e.g., Kahoot, Quizizz, Blooket, etc)on Unit 4 topics ***Summative Assessment*** students will be assessed in the following ways, and will be differentiated accordingly: • CERs • Simulations (https://concord.org/ and http://exeplorelearning.com/) • Lab activities, experimental design, and reports

	• Unit Exam on Unit 4 topics • Current Event Article(s) ***Alternative Assessment*** Assessments will be differentiated in various ways based on the needs of the students. For example, differentiation could be in… • Content (texts, phenomena, graphs, datatables, vocabulary, etc.) • Process (scaffolding, guiding questions, small group instruction, etc.) • Product (individual components,student choice modality such as video, skit, etc) ***Benchmark (climate change mandate)*** Climate Change Impacts on Ecosystem Model: Students will research how climate change has impacted the life cycle, habitat, resources, etc. of an organism. • Students will be able to make predictions about how a change to one species impacts ecological relationships within an ecosystem. • Students will be able to illustrate trends and fluctuations in populations over time. • Students will be able to propose and evaluate solutions to reduce the human impact on the environment. ***During each common, formative, and summative assessment, teachers will provide alternative assessment opportunities that adhere to 504 and IEP requirements. Alternative assessments are individualized for the needs of all students.***
Resources/Materials	**Core Text:** Biology 2e Online OpenStax Rice University - 2020 Chapter 47: Conservation Biology and Biodiversity **Technologies:** BenQ Interactive Display, Chromebooks **Supplemental Materials:** • For phenomena ideas: www.NGSSPhenomena.com • For readings, quizzes, and simulations: www.ck12.org • For simulation labs: https://learn.concord.org/collections, http://exeplorelearning.com/ • Text: HMH Science Dimensions Biology 2018 NGSS
Learning Activities	• Climate Change - Interpreting Graphs • Calculating your Ecological Footprint • Greenhouse gases graphing • Predicting impacts of climate change

Interdisciplinary Connections	*ELA/Literacy* ● ***Activity: Predicting impacts of climate change*** RI.MF.11–12.6. Synthesize complex information across multiple sources and formats to develop ideas, resolve conflicting information, or develop an interpretation that goes beyond explicit text information (e.g., express a personal point of view, new interpretation of the concept).(HS-ETS1-3). ● RI.CR.11-12.1. Accurately cite a range of thorough textual evidence and make relevant connections to strongly support a comprehensive analysis of multiple aspects of what an informational text says explicitly and inferentially, as well as interpretations of the text. (HS-ETS1-3) ● RI.MF.9–10.6. Analyze, integrate, and evaluate multiple interpretations (e.g., charts, graphs, diagrams, videos) of a single text or text/s presented in different formats (visually, quantitatively) as well as in words in order to address a question or solve a problem. (HS-ETS1-3) ● RI.CT.9–10.8. Analyze and reflect on (e.g., practical knowledge, historical/cultural context, and background knowledge) seminal and informational text of historical and scientific significance, including how they relate in terms of themes and significant concepts. 🌿(HS-ETS1-3) *Mathematics* ● Reasoning abstractly and quantitatively. MP.2 (HS-LS2-1),(HS-LS2-2),(HS-LS2-6),(HS-LS2-7) ● Model with mathematics. MP.4 (HS-ETS1-3) ● Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN.Q.A.1 (HS-ETS1-3). ● Define appropriate quantities for the purpose of descriptive modeling. HSN.Q.A.2 (HS-ETS1-3). ● Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. HSN.Q.A.3 (HS-ETS1-3).

Subject Area: Science **Grade Level: Biology ACP**	
Unit	**5 Human Activity and Biodiversity**
Timeframe	4 Weeks

Established Goals	*Students will understand that…* ● The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. ESS3.C ● 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. LS2.C ● Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). LS4.D ● 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. LS4.D ● Criteria and constraints include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. ETS1.A ● Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. ETS1.A ● 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. ETS1.B ● Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. ETS1.B ● .Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. ETS1.C ● Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. *CCC-Stability and Change* ● Modern civilization depends on major technological systems. New technologies can have deep impacts on society and the environment, including some that were not anticipated. *CCC-Connections to Engineering, Technology, and Applications of Science*

NJSLS	• HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. • HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. • HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity. • HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. • HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. • HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. • HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
Essential Questions	• How and why do humans interact with their environment? • What are the effects of humans' interactions with their environment? • How might we change habits if we replaced the word "environment" with the word "life support system"? • Does reducing human impacts on our global life support system require social engineering or mechanical engineering? • Is the damage done to the global life support system permanent?
Content Knowledge	*Students will learn:* • 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. • Scientific knowledge is a result of human endeavors imagination and creativity. • 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. ● Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). ● 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. ● Much of science deals with constructing explanations of how things change and how they remain stable. ● When evaluating solutions, it is important to take into account a range of constraints—including costs, safety, reliability, and aesthetics—and to consider social, cultural, and environmental impacts. ● Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. ● New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of cost and benefits is critical. ● 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. ● 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. ● Sustaining biodiversity so that ecosystems' 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. ● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. ● 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 the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test 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. ● Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. ● New technologies can have deep impacts on society and the environment, including some that were not anticipated. ● Analysis of costs and benefits is a critical aspect of decisions about technology. *Sample Content Outline* I. Measuring Biodiversity [HS-LS4-6] A. Levels B. Speciation C. Extinction 1. Natural vs Anthropogenic D. Importance II. Human Impacts on Biodiversity A. Habitat destruction B. Invasive species C. Pollution (smog, acid rain, eutrophication, HAB) D. Climate change E. Overexploitation III. Reducing Human Impacts on Biodiversity [HS-LS2-7] A. Sustainability [HS-ESS3-3] B. Examining trade-offs 1. Constraints 2. Impacts
Skills	*Students will be able to:* ● 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 activities on the environment and biodiversity based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off 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 generated sources of evidence, prioritized criteria, and trade off 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 trade off considerations. • Create or revise a simulation based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations to test a solution to mitigate adverse impacts of human activity on biodiversity. • Use empirical evidence to make claims about the impacts of human activity on biodiversity. • Break down the criteria for the design of a simulation to test a solution for mitigating adverse impacts of human activity on biodiversity into simpler ones that can be approached systematically based on consideration of trade-offs. • Design a solution for a proposed problem related to threatened or endangered species or to genetic variation of organisms for multiple species. • Analyze costs and benefits of a solution to mitigate adverse impacts of human activity on biodiversity. • ***Reference Goal 4 Opportunities when designing lessons to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all***
Performance Tasks	• Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. HS-ESS3-3 ESS Evidence Statements • Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. HS-LS2-7 LS Evidence Statements • Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity. HS-LS4-6 LS Evidence Statements • Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1-1 ETS Evidence Statements • Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-2 ETS Evidence Statements • Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. HS-ETS1-3 ETS Evidence Statements • Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. HS-ETS1-4 ETS Evidence Statements
Other Assessment Evidence	***Formative Assessment*** • Do nows, teacher check ins, exit tickets, observations of student groups, student conferences, science journal, lab reflections, concept mapping, quizzes, class discussions, skill/homework, Socratic

	discussion, and gamification (e.g., Kahoot, Quizizz, Blooket, etc) on Unit 5 topics ***Summative Assessment*** students will be assessed in the following ways, and will be differentiated accordingly: ● CERs ● Simulations (https://concord.org/ and http://exeplorelearning.com/) ● Lab activities, experimental design, and reports ● Unit Exam on Unit 5 topics ● Current Event Article(s) ***Alternative Assessment*** Assessments will be differentiated in various ways based on the needs of the students. For example, differentiation could be in… ● Content (texts, phenomena, graphs, datatables, vocabulary, etc.) ● Process (scaffolding, guiding questions, small group instruction, etc.) ● Product (individual components,student choice modality such as video, skit, etc) ***During each common, formative, and summative assessment, teachers will provide alternative assessment opportunities that adhere to 504 and IEP requirements. Alternative assessments are individualized for the needs of all students.***
Resources/Materials	**Core Text:** Biology 2e Online OpenStax Rice University - 2020 Chapter 47: Conservation Biology and Biodiversity **Technologies:** BenQ Interactive Display, Chromebooks **Supplemental Materials:** ● For phenomena ideas: www.NGSSPhenomena.com ● For readings, quizzes, and simulations: www.ck12.org ● For simulation labs: https://learn.concord.org/collections, http://exeplorelearning.com/ ● Text: HMH Science Dimensions Biology 2018 NGSS
Learning Activities	● Species Diversity Lab ● What is sustainability - graphic organizer ● Spread of Africanized Honey Bees - Lab ● Frog Populations and the Effects of Pollutants ● Modeling the Effects of Habitat Fragmentation - lab ● Endangered Species Research Project

Interdisciplinary Connections	*ELA/Literacy* ● ***Activity: Endangered Species Research Project*** RI.MF.9–10.6. Analyze, integrate, and evaluate multiple interpretations (e.g., charts, graphs, diagrams, videos) of a single text or text/s presented in different formats (visually, quantitatively) as well as in words in order to address a question or solve a problem. (HS-LS2-7) ● RI.CT.9–10.8. Analyze and reflect on (e.g., practical knowledge, historical/cultural context, and background knowledge) seminal and informational text of historical and scientific significance, including how they relate in terms of themes and significant concepts. 🌿(HS-ETS1-3) ● RI.MF.11–12.6. Synthesize complex information across multiple sources and formats to develop ideas, resolve conflicting information, or develop an interpretation that goes beyond explicit text information (e.g., express a personal point of view, new interpretation of the concept).(HS-ETS1-3). ● W.WP.9–12.4. Develop and strengthen writing as needed by planning, revising, editing, rewriting, trying a new approach; sustaining effort to complete complex writing tasks; seeking out feedback and reflecting on personal writing progress; consulting a style manual (such as MLA or APA Style), focusing on addressing what is most significant for a specific purpose and audience.(H- LS4-6). *Mathematics* ● Reason abstractly and quantitatively. MP.2 (HS-LS2-7), (HS-ETS1-3) ● Model with mathematics. MP.4 (HS-ETS1-3) ● Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN.Q.A.1 (HS-LS2-7) ● Define appropriate quantities for the purpose of descriptive modeling. HSN.Q.A.2 (HS-ETS1-3) ● Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. HSN.Q.A.3 (HS-ETS1-3)

Subject Area: Science **Grade Level: Biology ACP**	
Unit	**6 Cell Specialization and Homeostasis**
Timeframe	4 Weeks
Established Goals	*Students will understand that…* ● Systems of specialized cells within organisms help them perform the essential functions of life. LS1.A

	• 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. LS1.A • 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. LS1.A • 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.A • 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. LS1.B • 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. *CCC-Systems and System Models* • 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. *CCC-Structure and Function*
NJSLS	• HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. • HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. • HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. • HS-LS1-4. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
Essential Questions	• How do the structures of organisms enable life's functions? • How does the structure of DNA determine the structure of proteins, and what is the function of proteins? • What do you mean they say that people are made of a system of systems?

	● How do feedback mechanisms maintain homeostasis? ● Why aren't all elephants the same size?
Content Knowledge	*Students will learn:* ● 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 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. ● 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. *Sample Content Outline* I. Genetic material [HS-LS1-1] A. DNA 1. History of discovery 2. structure [LS1.A] 3. function B. RNA 1. types

	2. function C. Protein Synthesis 1. Transcription 2. Translation II. Proteins A. Structure [LS1.A] B. Function C. Enzymes 1. structure 2. function 3. factors impacting enzyme function III. Homeostasis with the cell A. Cell membrane [HS-LS1-2] 1. structure 2. function B. Movement across the membrane [HS-LS1-3] 1. Diffusion 2. Osmosis 3. Facilitated diffusion 4. Active transport 5. Bulk transport IV. Cell Division and Differentiation [HS-LS1-4] A. Overview of cell cycle 1. stages a. interphase b. mitosis c. cytokinesis 2. factors affecting division B. Differentiation C. Importance of cell size
Skills	*Students will be able to:* ● Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. *SEP-Developing and Using Models* ● Use a model based on evidence to illustrate the relationships between systems or between components of a system. *SEP-Developing and Using Models* ● Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost,

	risk, time), and refine the design accordingly. *SEP-Planning and Carrying Out Investigations* • 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. *SEP-Constructing Explanations and Designing Solutions* • Explain the connection between the sequence and the subcomponents of a biomolecule and its properties. • ***Reference Goal 4 Opportunities when designing lessons to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all***
Performance Tasks	• 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. HS-LS1-1 LS Evidence Statements • Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. HS-LS1-2 LS Evidence Statements • Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. HS-LS1-3 LS Evidence Statements • Provide examples and explain how organisms use feedback systems to maintain their internal environments. • Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. HS-LS1-4 LS Evidence Statements • Develop and use a model based on evidence to illustrate the flow of matter and energy within and between systems of an organism at different scales. • Use a model to illustrate the role of cellular division and differentiation in terms of energy, matter, and information flows within and between systems of cells/organisms. • Create representations that explain how genetic information flows from a sequence of nucleotides in a gene to a sequence of amino acids in a protein. (LS1.A) • Construct models that explain the movement of molecules across membranes with membrane structure and function. • Conduct a detailed examination of the structure and function of DNA. • 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.

Other Assessment Evidence	***Formative Assessment*** ● Do nows, teacher check ins, exit tickets, observations of student groups, student conferences, science journal, lab reflections, concept mapping, quizzes, class discussions, skill/homework, Socratic discussion, and gamification (e.g., Kahoot, Quizizz, Blooket, etc) on Unit 6 topics ***Summative Assessment*** students will be assessed in the following ways, and will be differentiated accordingly: ● CERs ● Simulations (https://concord.org/ and http://exeplorelearning.com/) ● Lab activities, experimental design, and reports ● Unit Exam on Unit 6 topics ● Current Event Article(s) ***Alternative Assessment*** Assessments will be differentiated in various ways based on the needs of the students. For example, differentiation could be in… ● Content (texts, phenomena, graphs, datatables, vocabulary, etc.) ● Process (scaffolding, guiding questions, small group instruction, etc.) ● Product (individual components,student choice modality such as video, skit, etc) ***During each common, formative, and summative assessment, teachers will provide alternative assessment opportunities that adhere to 504 and IEP requirements. Alternative assessments are individualized for the needs of all students.***
Resources/Materials	**Core Text:** Biology 2e Online OpenStax Rice University - 2020 Chapter 4: Cell Structure Chapter 5: Structure and Function of Plasma Membranes Chapter 10: Cell Reproduction Chapter 14: DNA Structure and Function **Technologies:** BenQ Interactive Display, Chromebooks **Supplemental Materials:** ● For phenomena ideas: www.NGSSPhenomena.com ● For readings, quizzes, and simulations: www.ck12.org ● For simulation labs: https://learn.concord.org/collections, http://exeplorelearning.com/ ● Text: HMH Science Dimensions Biology 2018 NGSS

Learning Activities	• Modeling DNA • Lego protein synthesis lab • My Little Chnopsy- protein synthesis lab • Factors affecting enzyme activity lab • Why can't I have pineapple in my Jello lab • DNA extraction from strawberries • Osmosis lab (potatoes) • Diffusion lab (dialysis tubing) • Time for mitosis - lab • Importance of cell size - lab
Interdisciplinary Connections	ELA/Literacy • ***Activity: Factors affecting enzyme activity lab*** W.WR.9–12.5. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. 🌿(HS-LS1-3) • W.SE.11–12.6. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation (MLA or APA Style Manuals). (HS-LS1-3) • SL.UM.9–12.5. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance findings, reasoning, and evidence and to add interest. 🌿(HS-LS1-2) Mathematics • N/A

Subject Area: Science **Grade Level: Biology ACP**	
Unit	**7 DNA and Inheritance**
Timeframe	4 Weeks

Established Goals	*Students will understand that…* ● 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. LS1.B ● 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. LS1.A ● 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.A ● 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. LS3.B ● 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. LS3.B ● 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. *CCC-Systems and System Models* ● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. *CCC-Cause and Effect*
NJSLS	● HS-LS1-4. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. ● HS-LS3-1. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. ● HS-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.

Essential Questions	• How are characteristics from one generation related to the previous generation? • Why can't two roses ever be identical? • How does inheritable genetic variation occur? • Can a zoologist predict the distribution of expressed traits in a population? • What causes genetic disorders?
Content Knowledge	*Students will learn:* • 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 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. • 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 occurrences of traits in a population. Thus the variation and 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. • 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). *Sample Content Outline* I. Chromosomal Inheritance [HS-LS3-1]

	A. Chromosomes B. Gene expression II. Sources of Variation [HS-LS3-2] A. Meiosis 1. chromosome number 2. crossing over B. Mutations 1. errors in replication 2. environment 3. cancer C. Fertilization [LS1.B] III. Patterns of Inheritance A. Mendelian genetics 1. Mendel's experiments 2. Mendel's conclusions 3. Modern explanations a. genes, alleles, traits B. Exceptions to Mendelian genetics 1. incomplete dominance 2. codominance 3. sex-linked traits 4. polygenic traits IV. Biotechnology A. Gene Therapy B. Genetic Engineering
Skills	*Students will be able to:* ● Use a model based on evidence to illustrate the relationships between systems or between components of a system. *SEP-Developing and Using Models* ● Ask questions that arise from examining models or a theory to clarify relationships. *SEP-Asking Questions and Defining Problems* ● Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence. *SEP-Engaging in Argument from Evidence* ● Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. ● Use an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. ● 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. *SEP-Constructing Explanations and Designing Solutions* • ***Reference Goal 4 Opportunities when designing lessons to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all***
Performance Tasks	• Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. HS-LS1-4 LS Evidence Statements • 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. HS-LS3-1 LS Evidence Statements • Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. HS-LS3-2 LS Evidence Statements • Explain how the process of meiosis results in the passage of traits from parent to offspring, and how that results in increased genetic diversity necessary for evolution. LS1.B • Create a visual representation to illustrate how changes in a DNA nucleotide sequence can result in a change in the polypeptide produced. LS3.B • 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. • Use data to support arguments for the ways inheritable genetic variation occurs. • Use empirical evidence to differentiate between cause and correlation and make claims about the ways inheritable genetic variation occurs. • 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.
Other Assessment Evidence	***Formative Assessment*** • Do nows, teacher check ins, exit tickets, observations of student groups, student conferences, science journal, lab reflections, concept mapping, quizzes, class discussions, skill/homework, Socratic

	discussion, and gamification (e.g., Kahoot, Quizizz, Blooket, etc) on Unit 7 topics ***Summative Assessment*** students will be assessed in the following ways, and will be differentiated accordingly: ● CERs ● Simulations (https://concord.org/ and http://exeplorelearning.com/) ● Lab activities, experimental design, and reports ● Unit Exam on Unit 7 topics ● Current Event Article(s) ***Alternative Assessment*** Assessments will be differentiated in various ways based on the needs of the students. For example, differentiation could be in… ● Content (texts, phenomena, graphs, datatables, vocabulary, etc.) ● Process (scaffolding, guiding questions, small group instruction, etc.) ● Product (individual components,student choice modality such as video, skit, etc) ***Benchmark*** Claim, Evidence, Reasoning: Students will conduct research on a real world phenomena in order to illustrate how a change in DNA leads to an altered protein, which manifests itself into physiological symptoms. ● Students will be able to examine how DNA mutations lead to changes in protein shape or expression. ● Students will be able to explain how the structure of proteins determine their function, and changes to proteins can disrupt bodily processes. ● Students will be able to make predictions about the inheritance of this genetic disorder within the family. ***During each common, formative, and summative assessment, teachers will provide alternative assessment opportunities that adhere to 504 and IEP requirements. Alternative assessments are individualized for the needs of all students.***
Resources/Materials	**Core Text:** Biology 2e Online OpenStax Rice University - 2020 Chapter 12: Mendel's Experiments and Heredity Chapter 13: Modern Understandings of Inheritance **Technologies:** BenQ Interactive Display, Chromebooks **Supplemental Materials:** ● For phenomena ideas: www.NGSSPhenomena.com ● For readings, quizzes, and simulations: www.ck12.org

	• For simulation labs: https://learn.concord.org/collections, http://exeplorelearning.com/ • Text: HMH Science Dimensions Biology 2018 NGSS
Learning Activities	• Catching some killer rays - cancer activity • Meiosis simulation with pipe cleaners - lab • Inventory of Human Genetic Traits - lab • Sickle Cell Anemia and Allele Frequencies - lab • Genetics with a Smile - activity • HHMI Genes as Medicine • Dragon genetics - lab • How Much Risk - polygenic inheritance - lab
Interdisciplinary Connections	*ELA/Literacy* • ***Activity: Catching some killer rays - cancer activity*** SL.UM.9–12.5. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance findings, reasoning, and evidence and to add interest. 🌿(HS-LS1-2) • W.WR.9–12.5. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. 🌿(HS-LS1-3) • W.SE.11–12.6. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation (MLA or APA Style Manuals). (HS-LS1-3) *Mathematics* • N/A

Subject Area: Science **Grade Level: Biology ACP**	
Unit	**8 Natural Selection**
Timeframe	4 Weeks

Established Goals	*Students will understand that…* ● Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives. LS2.D: ● Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information — that is, trait variation — that leads to differences in performance among individuals. LS4.B ● The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. LS4.B ● 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. LS4.C ● Adaptation also means that the distribution of traits in a population can change when conditions change. LS4.C ● Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline — and sometimes the extinction — of some species. LS4.C ● 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.C ● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. *CCC-Cause and Effect* ● Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in revision of an explanation. *SEP-NOS* ● 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. *CCC-Patterns* ● Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future.*CCC-NOS*
NJSLS	● HS-LS2-8. Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. ● HS-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.

	• HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations. • HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.
Essential Questions	• How can there be so many similarities among organisms yet so many different plants, animals, and microorganisms? • 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?
Content Knowledge	*Students will learn:* • 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 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 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.
- 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.
- 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 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.

Sample Content Outline

I. Natural Selection leads to adaptation [HS-LS4-4]
    A. Darwin's observations
    B. Conditions necessary for natural selection
    C. Modern evolution
        1. Changes in gene pool

II. Adaptations of populations [HS-LS4-3]
    A. Types of adaptations
    B. Artificial selection [LS4.C]
    C. Distribution of traits [HS-LS4-2]
        1. Normal distribution
        2. Stabilizing selection
        3. Directional selection
        4. Disruptive selection

	D. Gene flow 1. Genetic bottleneck 2. Founder effect III. Populations influence selection [HS-LS2-8] A. Sexual selection B. Group behavior
Skills	*Students will be able to:* ● Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments. *SEP-Engaging in Argument from Evidence* ● Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. ● 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. *SEP-Constructing Explanations and Designing Solutions* ● ***Reference Goal 4 Opportunities when designing lessons to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all***
Performance Tasks	● Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. HS-LS2-8 LS Evidence Statements ● Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. HS-LS4-3 LS Evidence Statements ● Construct an explanation based on evidence for how natural selection leads to adaptation of populations. HS-LS4-4 LS Evidence Statements ● Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. HS-LS4-5 LS Evidence Statements ● 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. *SEP-Analyzing and Interpreting Data* ● Analyze shifts in numerical distribution of traits and, using these shifts as evidence, support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.

	• Make predictions about the effects of artificial selection on the genetic makeup of a population over time. • Use data to differentiate between cause and correlation and to make claims about how specific biotic and abiotic differences in ecosystems contribute to change in gene frequency over time, leading to adaptation of populations. • Observe patterns at each of the scales at which a system is studied to provide evidence for causality in explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. • Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. • Distinguish between group and individual behavior. • Identify evidence supporting the outcome of group 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. • Use empirical evidence to differentiate between cause and correlation and to make claims about the role of group behavior on individual and species' chances to survive and reproduce.
Other Assessment Evidence	***Formative Assessment*** • Do nows, teacher check ins, exit tickets, observations of student groups, student conferences, science journal, lab reflections, concept mapping, quizzes, class discussions, skill/homework, Socratic discussion, and gamification (e.g., Kahoot, Quizizz, Blooket, etc) on Unit 8 topics ***Summative Assessment*** students will be assessed in the following ways, and will be differentiated accordingly: • CERs • Simulations (https://concord.org/ and http://exeplorelearning.com/) • Lab activities, experimental design, and reports • Unit Exam on Unit 8 topics • Current Event Article(s) ***Alternative Assessment*** Assessments will be differentiated in various ways based on the needs of the students. For example, differentiation could be in… • Content (texts, phenomena, graphs, datatables, vocabulary, etc.) • Process (scaffolding, guiding questions, small group instruction, etc.) • Product (individual components,student choice modality such as video, skit, etc) ***During each common, formative, and summative assessment, teachers will provide alternative assessment***

	opportunities that adhere to 504 and IEP requirements. Alternative assessments are individualized for the needs of all students.
Resources/Materials	**Core Text:** Biology 2e Online OpenStax Rice University - 2020 Chapter 18: Evolution and the Origin of Species Chapter 19: The Evolution of Populations **Technologies:** BenQ Interactive Display, Chromebooks **Supplemental Materials:** ● For phenomena ideas: www.NGSSPhenomena.com ● For readings, quizzes, and simulations: www.ck12.org ● For simulation labs: https://learn.concord.org/collections, http://exeplorelearning.com/ ● Text: HMH Science Dimensions Biology 2018 NGSS
Learning Activities	● Sickle Cell Anemia - Allele frequencies and natural selection - lab ● All Thumbs - natural selection - lab ● Methods of Seed Dispersal - lab ● Evolution of a human adaptive trait - lab
Interdisciplinary Connections	ELA/Literacy ● ***Activity: Methods of Seed Dispersal - lab*** RI.MF.9–10.6. Analyze, integrate, and evaluate multiple interpretations (e.g., charts, graphs, diagrams, videos) of a single text or text/s presented in different formats (visually, quantitatively) as well as in words in order to address a question or solve a problem. (HS-LS2-8) ● W.WR.9–12.5. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. 🌿(HS-LS4-5) ● SL.UM.9–12.5. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance findings, reasoning, and evidence and to add interest. 🌿(HS-LS1-2) ● RI.CT.9–10.8. Analyze and reflect on (e.g., practical knowledge, historical/cultural context, and background knowledge) seminal and informational text of historical and scientific significance, including how they relate in terms of themes and significant concepts. 🌿(HS-LS4-5)(HS-LS2-8)

	• RI.AA.9–10.7. Describe and evaluate the argument and specific claims in an informational text, assessing whether the reasoning is valid and the evidence is relevant and sufficient; identify false statements and reasoning.(HS-LS2-8) • RI.CR.11-12.1. Accurately cite a range of thorough textual evidence and make relevant connections to strongly support a comprehensive analysis of multiple aspects of what an informational text says explicitly and inferentially, as well as interpretations of the text.(HS-LS2-8) Mathematics • Reason abstractly and quantitatively. MP.2 (HS-LS4-5)

Subject Area: Science **Grade Level: Biology ACP**	
Unit	**9 Evolution of Populations**
Timeframe	4 Weeks
Established Goals	*Students will understand that…* • 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.A • Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information — that is, trait variation — that leads to differences in performance among individuals. LS4.B • 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. LS4.C • 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. *CCC-Patterns* • Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. *CCC-NOS*

	• 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. *SEP-NOS* • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. *CCC-Cause and Effects*
NJSLS	• HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. • HS-LS4-2. Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.
Essential Questions	• What evidence shows that different species are related? • How can someone prove that birds and dinosaurs are related? • What is the relationship between natural selection and evolution?
Content Knowledge	*Students will learn:* • 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 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 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. *Sample Content Outline* I. History of Life A. Big Bang Theory B. Conditions of Early Earth C. Origins of Life D. Heterotroph Hypothesis E. Endosymbiotic Theory II. Evidence of Evolution [HS-LS4-1] A. Fossils B. Anatomical C. Molecular III. Forces Driving Evolution [HS-LS4-2] A. Speciation B. Adaptive radiation C. Convergent evolution D. Coevolution IV. Evolutionary Relationships [LS4.A] A. Rate of evolution B. Phylogeny
Skills	*Students will be able to:* ● Communicate scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). *SEP-Obtaining, Evaluating, and Communicating Information* ● 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. *SEP-Constructing Explanations and Designing Solutions* ● ***Reference Goal 4 Opportunities when designing lessons to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all***

Performance Tasks	• Examine a group of related organisms using a phylogenetic tree or cladogram in order to (1) identify shared characteristics, (2) make inferences about the evolutionary history of the group, and (3) identify character data that could extend or improve the phylogenetic tree. LS4.A • Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. HS-LS4-1LS Evidence Statements • Understand the role each line of evidence has relating to common ancestry and biological evolution. • Observe patterns in multiple lines of empirical evidence at different scales and provide evidence for causality in explanations of common ancestry and biological evolution. • Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment. HS-LS4-2 LS Evidence Statements
Other Assessment Evidence	***Formative Assessment*** • Do nows, teacher check ins, exit tickets, observations of student groups, student conferences, science journal, lab reflections, concept mapping, quizzes, class discussions, skill/homework, Socratic discussion, and gamification (e.g., Kahoot, Quizizz, Blooket, etc) on Unit 9 topics ***Summative Assessment*** students will be assessed in the following ways, and will be differentiated accordingly: • CERs • Simulations (https://concord.org/ and http://exeplorelearning.com/) • Lab activities, experimental design, and reports • Unit Exam on Unit 9 topics • Current Event Article(s) ***Alternative Assessment*** Assessments will be differentiated in various ways based on the needs of the students. For example, differentiation could be in… • Content (texts, phenomena, graphs, datatables, vocabulary, etc.) • Process (scaffolding, guiding questions, small group instruction, etc.) • Product (individual components,student choice modality such as video, skit, etc) ***Benchmark (post)*** Planning and Carrying out a Biological Investigation: Students are presented with a biological problem. They will design and conduct an experiment testing how to most effectively determine solutions to a real world problem.

	• Students will be able to design and conduct a controlled experiment in order to solve a real world biological phenomena. • Students will be able to effectively analyze and draw conclusions from their dataset. • Students will be able to make strong predictions based on trends in the data. • Students will be able to evaluate the effectiveness of their experimental design and reflect upon it. ***During each common, formative, and summative assessment, teachers will provide alternative assessment opportunities that adhere to 504 and IEP requirements. Alternative assessments are individualized for the needs of all students.***
Resources/Materials	**Core Text:** Biology 2e Online OpenStax Rice University - 2020 Chapter 18: Evolution and the Origin of Species Chapter 19: The Evolution of Populations **Technologies:** BenQ Interactive Display, Chromebooks **Supplemental Materials:** • For phenomena ideas: www.NGSSPhenomena.com • For readings, quizzes, and simulations: www.ck12.org • For simulation labs: https://learn.concord.org/collections, http://exeplorelearning.com/ • Text: HMH Science Dimensions Biology 2018 NGSS • Text: Life Science Concepts and Challenges 4th Edition - 2009
Learning Activities	• Evidence of evolution - lab • Bird beaks - lab • Dissection - Fish, Rat • Interpreting Cladograms
Interdisciplinary Connections	*ELA/Literacy* • ***Activity: Evidence of evolution - lab*** SL.PI.9–12.4 Present information, findings and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience. (HS-LS4-1),(HS-LS4-2) • RI.CR.11-12.1. Accurately cite a range of thorough textual evidence and make relevant connections to strongly support a comprehensive analysis of multiple aspects of what an informational text says explicitly and inferentially, as well as interpretations of the text.(HS-LS4-1),(HS-LS4-2) • W.IW.9-12.2. Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of

	content.(HS-LS4-1),(HS-LS4-2) *Mathematics* ● Reason abstractly and quantitatively. MP.2 (HS-LS4-1),(HS-LS4-2) ● Model with mathematics. MP.4 (HS-LS4-2)

Additional Information

21st Century Skills Integration: Career Readiness, Life Literacies, and Key Skills	● 9.1.12.CFR.1: Compare and contrast the role of philanthropy, volunteer service, and charities in community development and quality of life in a variety of cultures. ● 9.1.12.CFR.2: Summarize causes important to you and compare organizations you seek to support to other organizations with similar missions. ● 9.1.12.CFR.3: Research companies with corporate governance policies supporting the common good and human rights. ● 9.2.12.CAP.2: Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs. ● 9.2.12.CAP.5: Assess and modify a personal plan to support current interests and postsecondary plans. ● 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a). ● 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3). • 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a). ● Our CTE offerings are extensive at the high school level. Currently, we offer 7 CTE programs at Vernon Township High School including: Engineering, Hospitality, Allied Health, Marketing, Computer Science, Cosmetology, and Graphic Design.
Use of Technology	● Course catalog includes CTE programs such as Engineering, Computer Science, and Graphic Arts to provide technological opportunities to prepare for careers ● All students are one-to-one with Chromebooks for day-to-day use in the classroom ● All classrooms have access to an interactive BenQ or Promethean Board with speaker system so lessons can include video, sound, and interactive lessons for all learners

Technology Integration: Computer Science & Design Thinking	• 8.1.12.IC.1: Evaluate the ways computing impacts personal, ethical, social, economic, and cultural practices. • 8.2.12.ED.6: Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor). • 8.2.12.ITH.1: Analyze a product to determine the impact that economic, political, social, and/or cultural factors have had on its design, including its design constraints. • 8.2.12.ITH.3: Analyze the impact that globalization, social media, and access to open source technologies has had on innovation and on a society's economy, politics, and culture

Career Education with Diversity, Equity and Inclusion	• Temple Grandin (1947-present) - Autism
	  ○ Profession: Animal Scientist
	  ○ Temple Grandin is renowned for her work in animal behavior, particularly in designing humane livestock handling systems. Diagnosed with autism, she has provided valuable insights into animal psychology, leading to significant improvements in animal welfare standards.
	• Ben Barres (1954 – 2017) - Transgender
	  ○ Profession: Neuroscientist
	  ○ Ben Barres made groundbreaking contributions to neurobiology, focusing on the role of glial cells in the nervous system. As a transgender man, he was a vocal advocate for diversity and inclusion in science, working to improve opportunities for underrepresented groups.
	• Florence B. Seibert (1897 –1991) - Polio / Female in science
	  ○ Profession: Biochemist
	  ○ Despite contracting polio in her youth, which led to mobility challenges, Seibert developed a groundbreaking method to purify tuberculin, leading to the first reliable tuberculosis test. Her work significantly advanced the field of biochemistry and public health.
	• Edwin G. Krebs (1918–2009) - Hearing Impairment
	  ○ Profession: Biochemist
	  ○ Krebs, who had a hearing impairment, was awarded the Nobel Prize in Physiology or Medicine in 1992 for his discovery of reversible protein phosphorylation, a fundamental mechanism in cellular regulation.
	• Ernest Everett Just (1883-1941) - Racial discrimination
	  ○ Profession: Developmental Biologist
	  ○ Just is best known for his pioneering work in cell biology, particularly regarding the role of the cell surface in development. Despite facing racial discrimination, he made significant contributions to marine biology and fertilization research.

Access to Various levels of text	Various Levels of Text: • Grade level material is used for teaching whole group • various text levels used for small group and individual students depending on needs: above grade level, below grade level, on grade level • Use of AI tools to generate versions of text on various complexity levels to meet student needs for students who require above or below grade level text

	• Use of Text to Speech, such as Read and Write for Google, to allow students to listen to texts that are above their readability level.
Accommodations for: Special Education & 504	• Special Education modifications will be implemented as per the Individualized Education Programs of the students in the class. • Please click here for an overview of the variety of accommodations set in place. • Accommodations will be dictated by the general makeup of the class. Possible Science Instructional adjustments • small group instruction • modeling • Alternate assessments and class activities: drawing, discussion, performances, etc. • Speech to text (to listen to text) • Text to speech (to dictate essays or writing) POSSIBLE CONTENT ADJUSTMENTS - based on pre-assessment and benchmark assessment data • Provide copies of Periodic Table • Post formulas in areas visible to students • Provide formula sheets • Provide guided notes or outlines • Model concepts using manipulatives and technology • increase or decrease frequency of vocabulary instruction based on student need
Multilingual Learners	• Coordinate activities with ESL teacher to accommodate individual learning needs • Provide appropriate leveled texts • Students complete the ACCESS 2.0 test yearly to measure growth and guide instruction
Risk for School-Failure	• Credit Retrieval Programs • Apex - virtual • Viking Success Academy • Counseling interventions • Parent meetings • Student meetings • Individual and Group counseling
Gifted and Talented Learners	• Inclusive Identification process that depicts the child as a whole in order to provide the best learning environment possible for each student. Click here for Identification Profile Sample • Tiered Services utilizing NAGC K-12 Programming standards to ensure individual needs are being met. Click here for services map. • Formative Assessment utilized in order to promote acceleration, curriculum compacting, grouping, and asynchronous learning where appropriate. • Dynamic Model for Gifted Program Improvement is utilized in order to verify that our program is employing not

	only up to date methods, but also effective ones. ● Teacher training in Gifted Education. ● Curriculum Compacting based on pre-assessments ● Passion projects and presentations
MTSS/RTI	The VTSD Response to Intervention and MTSS Manual and the NJTSS Early Reading Screening Guidelines outline the policies and procedures that 'exist to ensure a coordinated system for planning, delivering, measurement, and modification of intervention and referral services implemented in each school by a multidisciplinary team to address the learning, behavioral, and health needs of all students. (N.J.A.C. 6A:16-8)' This requirement is fulfilled through the district New Jersey Tiered System of Support (NJTSS) Early Reading grant initiative and our Multi-Tiered Systems of Support (MTSS) Response to Intervention plan which includes a. A continuum of supports and interventions available in each school to support learning, behavior, and health needs; b. Action plans for interventions based on student data and desired outcomes; c. Professional development for multidisciplinary teams and staff who provide interventions; and d. Review and assessment of effectiveness of interventions (e.g., progress monitoring).
Diversity Equity and Inclusion Mandate (DEI)	(In Unit 1) ● Explore the lives of scientists who faced significant hardships yet achieved remarkable success and inspiring insights into resilience and determination. Conduct a webquest and discuss the following: ○ Choose a scientist relevant to this field of science. ○ When did the scientist conduct their research? ○ What were their scientific discoveries or awards received? ○ What hardships regarding disabilities, race, culture, or gender were dealt with.
Interdisciplinary Mandates	See Unit 4: Human Activity and Climate Change ● RI.CT.11–12.8. Analyze and reflect on (e.g., practical knowledge, historical/cultural context, and background knowledge) documents of historical and scientific significance for their purposes, including primary source documents relevant to U.S. and/or global history and texts proposing scientific or technical advancements. **Climate Change Example: Students may analyze scientific and related informational texts for evidence-based explanations for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.** ● W.WR.11–12.5. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. **Climate Change Example: Students may research, analyze, and critique the role of the petroleum industry in world politics, the global economy, and global climate change.** ● SL.UM.11–12.5. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.