NEW MILFORD PUBLIC SCHOOLS

New Milford, Connecticut

Honors Biology

June 2022

BOE Approved September 2023

New Milford Board of Education

Wendy Faulenbach, Chairperson

Pete Helmus , Vice Chairperson

Olga I. Rella, Secretary

Tammy McInerney, Assistant Secretary

Eric Hansell

Brian McCauley

Tom O'Brien

Leslie Sarich

Keith A. Swanhall Jr.

Interim Superintendent of Schools

Dr. JeanAnn C. Paddyfote

Assistant Superintendent

Mrs. Holly Hollander

Authors of Course Guide

John Boothby

BOE Approved September 2023

New Milford's Mission Statement

The mission of the New Milford Public Schools, a collaborative partnership of students, educators, family and community, is to prepare each and every student to compete and excel in an ever-changing world, embrace challenges with vigor, respect and appreciate the worth of every human being, and contribute to society by providing effective instruction and dynamic curriculum, offering a wide range of valuable experiences, and inspiring students to pursue their dreams and aspirations.

Honors Biology

Grade 10

Biology is a lab-oriented course that involves the study of the living world. Major concepts include general and biochemistry, cell structure and function, genetics, biotechnology, evolution, and ecology. Science process skills and inquiry are emphasized, and students are encouraged to connect major concepts and to consider their real-world applications. At the honors level, this course is more rigorous and moves at a faster pace than at the college prep level, with an increased focus on data analysis and critical thinking.

Pacing Guide

Units	Number of Blocks
Unit 1: Ecology	9 blocks
Unit 2: Cell Chemistry	12 blocks
Unit 3: Cell Structure & Function	12 blocks
Unit 4: Cell Transport	8 blocks
Midterm Exam	
Unit 5: Cell Division	8 blocks
Unit 6: Genetics	12 blocks
Unit 7: DNA Structure and Protein Synthesis	12 blocks
Unit 8: Evolution	9 blocks
Final Exam	

Key for National and State Standards

HS-LS = Next Generation Science Standards: Life Sciences

HS-ES = Next Generation Science Standards: Earth Sciences

HS-ETS = Next Generation Science Standards: Engineering, Technology, and Applications of Science

RST = Common Core Reading Standards for Literacy in Science 6-12

WHST = Common Core Writing Standards for Science and Technology

5E Model
E1- Engage
E2 - Explore
E3 - Explain
E4 - Extend
E5 - Evaluate

Unit 1: Ecology

Phenomenon: Graph/image of population explosion in certain species (could be human population)
Gorongosa National Park

Stage 1 Desired Results

ESTABLISHED GOALS

HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. [Clarification Statement: Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate, and competition. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from simulations or historical data sets.]

HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. [Clarification Statement: Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data.]

Transfer

Students will be able to independently use their learning to…

- SEP 1 - Ask Questions and Define Problems
- SEP 2 - Develop and Use Models
- SEP 3 - Plan and Carry Out Investigations
- SEP 4 - Analyze and Interpret Data
- SEP 5 - Use Mathematics and Computational Thinking
- SEP 6 - Construct Explanations
- SEP 7 - Engage in Argument from Evidence

Meaning

UNDERSTANDINGS
Students will understand that…

- **LS2.A: Interdependent Relationships in Ecosystems**
  - Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of

ESSENTIAL QUESTIONS
Students will keep considering…

- How and why do organisms interact in their environment? What are the effects of these interactions?
- How are energy and matter transferred and conserved?
- How do humans impact biodiversity?

HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. [Clarification Statement: Emphasis is on using a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and that matter and energy are conserved as matter cycles and energy flows through ecosystems. Emphasis is on atoms and molecules such as carbon, oxygen, hydrogen and nitrogen being conserved as they move through an ecosystem.] HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. [Clarification Statement: Examples of models could include simulations and mathematical models.] [Assessment Boundary: Assessment does not include the specific chemical steps of photosynthesis and respiration.] HS-LS2-6.Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a	great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. ● **LS2.B: Cycles of Matter and Energy Transfer in Ecosystems** o Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. ● **LS2.B: Cycles of Matter and Energy Transfer in Ecosystems** o 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.C: Ecosystem Dynamics, Functioning, and Resilience** o A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological	

new ecosystem. [Clarification Statement: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise.] HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.* [Clarification Statement: Emphasis is on designing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of organisms for multiple species.] RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.	or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability ● **PS3.D: Energy in Chemical Processes** o The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis.	
	Acquisition	
	Students will know… ● How energy flows and matter cycles through ecosystems (CCC Energy and Matter) ● The difference between autotrophs and heterotrophs ● 10% rule of energy transfer between trophic levels ● Predator/prey dynamics (CCC: Cause and Effect) ● How limiting factors affecting carrying capacity (CCC: Cause and Effect) ● The difference between logistic and exponential growth ● The difference between density dependent and density-independent factors	*Students will be skilled at…* ● Describing the dynamics of energy flow through ecosystems ● Modeling energy flow through ecosystems using trophic pyramids ● Describing predator/prey dynamics ● Describing the factors affecting carrying capacity ● Describing how emigration, immigration , birth/death rate affect the growth of populations ● Explaining how technology has affected size and growth rate of human populations ● Analyzing age structure diagrams to predict the future needs of a country

	● Factors that affect human population growth trends in developed versus developing countries. ● The effects of human activity on biodiversity of ecosystems (CCC: Systems and System Models)	

Stage 2 – Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
A, M, T	- Accurately describing ecological relationships between trophic levels. - Accurately predicting impacts of ecological disturbances on different trophic levels. - Calculating loss of energy as it flows through the food web. - (Sample student responses in HHMI teacher's guide)	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* **Modeling Ecological Relationships Activity (HHMI)** - Identifying producers and consumers in the savanna ecosystem of Gorongosa National Park in Mozambique. Using a set of "Gorongosa cards," they create food chains to show the flow of energy in the system, introduce an ecological force or disturbance (e.g., fire), and predict how that force would impact animals in the chain. Lastly, students will construct a more complex model of the flow of energy by depicting multiple relationships in a food web and again make a prediction about the impact of introducing an ecological force on the trophic levels within a community..

		OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…* ● Quizzes and Tests ● Verbal Questioning / Class Discussions ● Kahoot, Peardeck, Edpuzzle Assessments ● Lab analysis questions ● Warm-ups and exit tickets ● Article readings/summaries ● Homework assignments ● Self-reflection

Stage 3 – Learning Plan

Code		
	Pre-Assessment ● Brainstorming at the start of the unit ● Informal assessment of prior knowledge ● Formal pre-assessments to match the post assessment (optional)	
	Summary of Key Learning Events and Instruction *Student success at transfer meaning and acquisition depends on…*	Progress Monitoring
A	- **Taking notes** from lecture, class discussions, videos and textbook readings on each topic (E2, E3)	● Warm-Up / Exit tickets ● Monitor progress for depth and accuracy ● Kahoot, Peardeck, Edpuzzle Assessments ● Quizzes on content ● Questions on activities and projects ● Verbal questions for comprehension ● End of unit assessment
A, M	- **Working collaboratively** with partners or small groups to complete graphic organizers to summarize major concepts (E1, E2, E3, E4)	
A, M	- **Analyzing** logistic and exponential growth graphs (E3, E4)	
A, M, T	- **Investigating** the cause of the exponential growth of the water buffalo and wildebeest (HHMI: Mystery of the Buffalo Boom	

	Video) (E3, E4)	
A, M, T	- **Developing/Analyzing a model** to illustrate the role of photosynthesis and cellular respiration in the biosphere. (E2, E3, E4)	
A, M, T	- **Constructing** food webs to model ecological relationships and the effect of ecological disturbances (HHMI: Gorongosa Food Web Activity) (E4, E5)	
A, M, T	- **Completing Case Study:** Krill as a Keystone Species (E1, E2, E3, E4, E5)	
A, M, T	- **Investigate** what invasive species are found in CT, their effects, and what can be done to minimize their impact. (E1, E2, E3, E4, E5)	
A, M, T	- **Designing** a thought experiment proposing what would happen if all humans vanished (see book: *The World Without Us)* (E1, E2, E3, E4, E5)	

Unit 2: Biochemistry

Phenomenon: Jello with canned vs. fresh pineapple

Stage 1 Desired Results

ESTABLISHED GOALS

HS-LS1-6.Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.[Clarification Statement: Emphasis is on using evidence from models and simulations to support explanations.] [Assessment Boundary: Assessment does not include the details of the specific chemical reactions or identification of macromolecules.]

RST.9-10.3
Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

Transfer

Students will be able to independently use their learning to…

- SEP 2 - Develop and Use Models.
- SEP 3 - Plan and Carry Out Investigations
- SEP 4 - Analyze and Interpret Data
- SEP 6 - Construct Explanations
- SEP 7 - Engage in Argument from Evidence
- SEP 8 - Obtain, Evaluate, and Communicate Information.

Meaning

UNDERSTANDINGS
Students will understand that…

- LS1.C: Organization for Matter and Energy Flow in Organisms
  - The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells.
  - As matter and energy flow through different organizational levels of living

ESSENTIAL QUESTIONS
Students will keep considering…

- How are organisms structured to ensure efficiency and survival?
- How does the chemical make-up of organisms determine their properties?
- How do matter and energy behave in living systems?

	systems, chemical elements are recombined in different ways to form different products. ● LS1.C: Organization for Matter and Energy Flow in Organisms ○ As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.	
	Acquisition	
	Students will know… ● The structure of organic molecules and how it impacts function (CCC: Structure and Function) ● How hydrolysis/dehydration synthesis break down/form molecules ● Energy transformations that occur in chemical reactions and how this relates to a molecular change (CCC: Energy and Matter)	*Students will be skilled at…* ● Describing properties of water ● Building structures of organic molecules ● Demonstrating how hydrolysis/dehydration synthesis break down/form molecules ● Describing/explaining behavior of enzymes in chemical reactions

Stage 2 – Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
A, M, T	Students are assessed on their understanding of core concepts of molecular structure, chemical reactions, amino acid chain determines protein shape, effects of temperature and pH and critical thinking skills including data analysis, data interpretation, hypothesis and reasoning, predictions and communicating findings. Using GIZMO rubrics.	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* Analyzing veterinary patient data to determine how various conditions can alter protein molecule structure and function. Students will make a claim about the cause of the patient's symptoms, justify with evidence and provide counterevidence to rule out alternative hypotheses. **GIZMO STEM CASE - Enzyme STEM Case** Claire, a Great Dane, is experiencing extreme weight loss and lethargy despite maintaining a normal appetite. As a veterinary technician, students must learn about metabolism, digestion, and enzymes to help Claire. They must then examine Claire, run lab tests, and analyze data to determine the cause and treat her weight loss.
		OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…* ● Quizzes and Tests ● Verbal Questioning / Class Discussions ● Kahoot, Peardeck, Edpuzzle Assessments ● Lab analysis questions ● Warm-ups and exit tickets ● Article readings/summaries ● Homework assignments ● Self-reflection

Stage 3 – Learning Plan

Code		
	Pre-Assessment ● Brainstorming at the start of the unit ● Informal assessment of prior knowledge ● Formal pre-assessments to match the post assessment (optional)	
	Summary of Key Learning Events and Instruction *Student success at transfer meaning and acquisition depends on…*	Progress Monitoring ● Warm-Up / Exit tickets ● Monitor progress for depth and accuracy ● Kahoot, Peardeck, Edpuzzle Assessments ● Quizzes on content ● Questions on activities and projects ● Verbal questions for comprehension ● End of unit assessment
A	- **Taking notes** from lecture, class discussion, and videos on each topic (E2, E3)	
A, M	- **Working collaboratively** with partners or small groups to complete graphic organizers to summarize major concepts (E1, E2, E3, E4)	
A, M	- **Completing Graphic Organizer** - compare the structure and function of organic macromolecules (E3, E4)	
A, M	**Analyzing** nutritional information in foods we eat (E1, E2, E3)	
A, M	- **Modeling** - model the processes of dehydration synthesis and hydrolysis to show how macromolecules are built and broken down (E2, E3)	
A, M	- **Modeling: POGIL** - Factors affecting enzyme function (E2, E3, E4)	
A, M, T	- **Investigating** various factors that affect the reaction rate of enzymes: **Lab**: **Enzyme Reaction Rate** (E4, E5)	
A, M, T	- **Investigating GIZMO Enzyme STEM Case** (E1, E2, E3, E4, E5)	

Unit 3: Cell Structure and Function

Phenomenon: Genetic disease that causes malfunctioning organelles

Stage 1 Desired Results

ESTABLISHED GOALS

HS-LS1-2 Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] [Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.]LS1.A

HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored
chemical energy. [Clarification Statement: Emphasis is on illustrating inputs and outputs

Transfer

Students will be able to independently use their learning to…

- SEP1 - Ask Questions and Define Problems
- SEP 2 - Develop and Use Models.
- SEP 6 - Construct Explanations
- SEP 7 - Engage in Argument from Evidence
- SEP 8 - Obtain, Evaluate, and Communicate Information.

Meaning

UNDERSTANDINGS

Students will understand that…

- LS1.A: Structure and Function
  - Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.
- LS1.C: Organization for Matter and Energy Flow in Organisms
  - The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus

ESSENTIAL QUESTIONS

Students will keep considering…

- How are organisms structured to ensure efficiency and survival?
- In the hierarchical organization of multicellular organisms, how do complex properties emerge from simpler properties?

of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Examples of models could include diagrams, chemical equations, and conceptual models.] HS-LS1-7. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.[Clarification Statement: Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration.] RST.9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.	released oxygen. ○ As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment.	
	Acquisition	
	Students will know… ● The similarities and differences between plant and animal cells. (CCC: Structure and Function) ● The similarities and differences between prokaryotes and eukaryotes. (CCC: Structure and Function) ● The biochemical contribution of different organelle processes to the overall cell function (CCC: Structure and Function) ● The similarities and differences between bacteria and viruses (CCC: Structure and Function) ● The differences between bacterial reproduction and viral replication ● how organisms are structured in a hierarchy of increasingly complex components working together to carry out the functions of life	*Students will be skilled at…* ● Comparing and contrasting prokaryotic and eukaryotic cells. ● Explaining how a cell responds to changes in its environment. ● Comparing and contrasting plant and animal cells. ● Explaining the biochemical role of each organelle ● Explaining the difference between bacterial reproduction and viral replication

	(cells, tissues, organs, organ systems, organisms*)* • How energy flows and matter cycles through ecosystems (CCC Energy and Matter)	

Stage 2 – Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
A, M, T	- Correctly describing the structure of various cell parts and explaining how the particular structure allows for its specific function. - Relating cell functions to the 7 characteristics of life. - Accurately comparing cell functions to the proper functioning of a city. - Accurately depicting cell organelles in a diagram or model	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* Making analogies between cell parts and a city. **Cell City Analogy Project** – students create analogies comparing cell organelles to parts of a city based on structure and function.
		OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…* ● Quizzes and Tests ● Verbal Questioning / Class Discussions ● Kahoot, Peardeck, Edpuzzle Assessments ● Lab analysis questions ● Warm-ups and exit tickets ● Article readings/summaries ● Homework assignments ● Self-reflection

Stage 3 – Learning Plan		
Code	***Pre-Assessment*** ● Brainstorming at the start of the unit ● Informal assessment of prior knowledge ● Formal pre-assessments to match the post assessment (optional)	
	Summary of Key Learning Events and Instruction *Student success at transfer meaning and acquisition depends on…*	Progress Monitoring
A	- **Taking notes** from lecture, class discussions, videos and textbook readings on each topic (E2, E3)	● Warm-Up / Exit tickets ● Monitor progress for depth and accuracy ● Kahoot, Peardeck, Edpuzzle Assessments ● Quizzes on content ● Questions on activities and projects ● Verbal questions for comprehension ● End of unit assessment
A, M	- **Working collaboratively** with partners or small groups to complete graphic organizers to summarize major concepts (E1, E2, E3, E4)	
A, M	- **Completing Graphic Organizer** - compare the structure and function of prokaryotic vs. eukaryotic cells; plant vs. animal cells (E2, E3)	
A, M	- **Calculating** cell surface area to volume ratio and relate to the need for cells to be small (E2, E3)	
A, M	- **Completing card sort and organizer** on biological hierarchy of life (E2, E3)	
A, M	- **Exploring and describing** how an organism's components work together to carry out life's functions (E2, E3)	
A, M, T	- **Modeling** - model the structure and function of a cell (E4)	
A, M, T	- **Completing POGIL** - Eukaryotic cell structures - what would happen if an organelle was missing? (E4, E5)	
A, M, T	- **Completing Case Study** - Little Girl Lost (mitochondrial disease)	

	(E4, E5)	
A, M, T	- **Completing Cell City Analogy Project** (E1, E2, E3, E4, E5)	
A, M, T	- **Conducting Photosynthesis vs. Respiration Lab** to show how the two processes are interdependent and power life on the planet (E1, E2, E3, E4, E5)	

Unit 4: Cell Transport

Phenomenon: Water intoxication (hyponatremia)

Stage 1 Desired Results

ESTABLISHED GOALS

HS-LS1-3 Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.[Clarification Statement: Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels.] [Assessment Boundary: Assessment does not include the cellular processes involved in the feedback mechanism.]

RST.9-10.3
Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

Transfer

Students will be able to independently use their learning to…

- SEP 2 - Develop and Use Models
- SEP 3 - Plan and Carry Out Investigations
- SEP 4 - Analyze and Interpret Data
- SEP 6 - Construct Explanations
- SEP 7 - Engage in Argument from Evidence
- SEP 8 - Obtain, Evaluate, and Communicate Information

Meaning

UNDERSTANDINGS

Students will understand that…

- LS1.A: Structure and Function
  - 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.

ESSENTIAL QUESTIONS

Students will keep considering…

- How do organisms maintain homeostasis in the face of changing environmental conditions?

Acquisition

	Students will know… ● How the structure of the cell membrane allows cells to maintain homeostasis. (CCC: Stability and Change) ● The types of passive and active cell transport ● The difference between hypertonic, isotonic, and hypotonic solutions (CCC: Stability and Change) ● How solute concentration impacts to direction of osmosis and diffusion (CCC: Stability and Change) ● How plant and animal cells respond to changing environmental concentrations (CCC: Stability and Change)	*Students will be skilled at…* ● Comparing passive and active transport methods ● Modeling a cell membrane structure and function ● Predicting the impact of the environmental concentration on cell homeostasis

Stage 2 – Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
A, M, T	Constructed response rubric to assess for claim accuracy, appropriate evidence, and reasoning that connects to content accurately, based on GIZMO rubric.	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* The effect solute concentration has on cell transport mechanisms and therefore cellular function and its ability to maintain homeostasis **GIZMO Case Study: Osmosis** - Analyzing and interpreting data on sodium and pressure levels in the brain, neuron firing rate and free water movement. Students will compare this to normal levels, forming a diagnosis on whether cerebral edema or epilepsy is the cause of the seizures. After being presented with 3 saline treatment options students hypothesize which will be the most effective. Students then observe how the treatment affects the data and are given explanations of the effect of the treatment on the data and can try a different treatment.
		OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…* ● Quizzes and Tests ● Verbal Questioning / Class Discussions ● Kahoot, Peardeck, Edpuzzle Assessments ● Lab analysis questions ● Warm-ups and exit tickets ● Article readings/summaries ● Homework assignments ● Self-reflection

Stage 3 – Learning Plan		
Code	***Pre-Assessment*** ● Brainstorming at the start of the unit ● Informal assessment of prior knowledge ● Formal pre-assessments to match the post assessment (optional)	
	Summary of Key Learning Events and Instruction *Student success at transfer meaning and acquisition depends on…*	Progress Monitoring
A	- **Taking notes** from lecture, class discussion, videos and textbook readings on each topic (E2, E3)	● Warm-Up / Exit tickets ● Monitor progress for depth and accuracy ● Kahoot, Peardeck, Edpuzzle Assessments ● Quizzes on content ● Questions on activities and projects ● Exit tickets ● Verbal questions for comprehension ● End of unit assessment
A, M	- **Working collaboratively** with partners or small groups to complete graphic organizers to summarize major concepts (E1, E2, E3, E4)	
A, M	- **Modeling** of diffusion, osmosis, and active transport (cell membrane structure POGIL, membrane diagrams, egg demo) (E1, E2, E3, E4)	
A, M, T	- **Performing Cell Transport Lab** - Investigate the effect of solute concentration on the direction of osmosis across a simulated cell membrane using dialysis tubing or potato cores(E1, E2, E3, E4)	
A, M, T	- **Synthesizing and evaluating information** -Osmosis Gizmo STEM Case Study (E1, E2, E3, E4, E5)	
A, M, T	- **Synthesizing and evaluating information -**Water Intoxication/Soy Sauce Cleanse Case Study E1, E2, E3, E4, E5)	

Unit 5: Cell Division

Phenomenon: Cancer

Stage 1 Desired Results

ESTABLISHED GOALS

HS-LS1-4. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. [Assessment Boundary: Assessment does not include specific gene control mechanisms or rote memorization of the steps of mitosis.]

HS-LS3-1. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]

HS-LS3-2 Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through

Transfer

Students will be able to independently use their learning to…

- SEP1 - Ask Questions and Define Problems
- SEP 3 - Plan and Carry Out Investigations
- SEP 4 - Analyze and Interpret Data
- SEP 6 - Construct Explanations
- SEP 7 - Engage in Argument from Evidence

Meaning

UNDERSTANDINGS

Students will understand that…

- LS1.B: Growth and Development of Organisms
  - In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each

ESSENTIAL QUESTIONS

Students will keep considering…

- How are organisms structured to ensure efficiency and survival? (LS1.A)
- How do organisms grow and develop? (LS1.B)

meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. [Clarification Statement: Emphasis is on using data to support arguments for the way variation occurs.] [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.] RST.9-10.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).	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.A: Structure and Function ○ All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. (secondary) (Note: This Disciplinary Core Idea is also addressed by HS-LS1-1.) ● LS3.A: Inheritance of Traits ○ Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. ● LS3.B: Variation of Traits ○ In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably	

	accurate, errors do occur and result in mutations, which are also a source of genetic variation.	
	Acquisition	
	Students will know… ● the structure of a chromosome ● How mitosis produces cells for growth and development (CCC: Structure and Function) ● How cell division and differentiation lead to tissue, organ, and organ systems in multicellular organisms. (CCC: Cause and Effect) ● How Meiosis produces gametes and contributes to genetic variation in offspring(CCC: Stability and Change) ● The possible errors that can occur during meiosis that contribute to chromosomal mutations ● Errors of the cell cycle that may lead to cancer	*Students will be skilled at…* ● Explaining the role of mitosis in growth and development of an organism. ● Creating a model to demonstrate mitosis. ● Explaining the benefits of cell division by meiosis. ● Creating a model to demonstrate the importance of mitosis and meiosis for sexually reproducing organmisms.

Stage 2 – Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
A, M, T	Accuracy in drawing and correctly showing the process, as well as correctly labeling the following terms: haploid, diploid, mitosis, meiosis, fertilization, growth/development	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms, as well as the role of meiosis in creating new offspring. Students will model the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms, as well as the role of meiosis in creating new offspring. Students will examine the importance of changing from haploid to diploid and vice versa in the continuation of the species, and the way in which mitosis and meiosis are interdependent.
		OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…* ● Quizzes and Tests ● Verbal Questioning / Class Discussions ● Kahoot, Peardeck, Edpuzzle Assessments ● Lab analysis questions ● Warm-ups and exit tickets ● Article readings/summaries ● Homework assignments ● Self-reflection

Stage 3 – Learning Plan		
Code	***Pre-Assessment*** ● Brainstorming at the start of the unit ● Informal assessment of prior knowledge ● Formal pre-assessments to match the post assessment (optional)	
	Summary of Key Learning Events and Instruction *Student success at transfer meaning and acquisition depends on…*	Progress Monitoring ● Warm-Up / Exit tickets ● Monitor progress for depth and accuracy ● Kahoot, Peardeck, Edpuzzle Assessments ● Quizzes on content ● Questions on activities and projects ● Verbal questions for comprehension ● End of unit assessment
A	- **Taking notes** from lecture, class discussions, videos and textbook readings on each topic (E2, E3)	
A, M	- **Working collaboratively** with partners or small groups to complete graphic organizers to summarize major concepts and compare the process of mitosis and meiosis (E1, E2, E3, E4)	
A, M	- **Modeling** - model the process of cell mitosis/meiosis, focusing on chromosome movement (E3)	
A, M, T	- **Collaborating on POGIL** - Steps of mitosis/meiosis, what can happen when mistakes occur (nondisjunction) (E2, E3, E4)	
A, M, T	- **Analyzing Data** - observe onion root tip cells to identify each phase of mitosis and calculate the time spent in each phase of the cell cycle (E2, E3, E4)	
A, M	- **Constructing a Karyotype** to determine chromosomal abnormalities resulting from nondisjunction (E1, E2, E3)	
A, M, T	- **Analyzing Cancer data** to relate the age and type of cell to overall cancer risk (E2, E3, E4)	
A, M, T	- **Analyzing: Case Study** - Cancer (E1, E2, E3, E4, E5)	

Unit 6: Genetics

Phenomenon: Genetic disease (could be same disease phenomenon from cells unit)
It's All Greek to Me / Lactose-Intolerance

Stage 1 Desired Results

ESTABLISHED GOALS

HS-LS1-1 Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. [Assessment Boundary: Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis.]

HS-LS1-2 Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting

Transfer

Students will be able to independently use their learning to…

- SEP1 - Ask Questions and Define Problems
- SEP 4 - Analyze and Interpret Data
- SEP 5 - Use Mathematics and Computational Thinking
- SEP 6 - Construct Explanations
- SEP 7 - Engage in Argument from Evidence
- SEP 8 - Obtain, Evaluate, and Communicate Information.

Meaning

UNDERSTANDINGS

Students will understand that…

- LS1.A: Structure and Function
  - Systems of specialized cells within organisms help them perform the essential functions of life.
  - All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the

ESSENTIAL QUESTIONS

Students will keep considering…

- What processes are responsible for life's unity and diversity?
- How do science and technology affect the quality of our lives?

system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] [Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.] HS-LS3-1 Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.] HS-LS3-2 Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. [Clarification Statement: Emphasis is on using data to support arguments for the way variation occurs.] [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.] RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as	formation of proteins, which carry out most of the work of cells. ● LS1.A: Structure and Function ○ Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. ● LS1.A: Structure and Function ○ All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. (secondary) (Note: This Disciplinary Core Idea is also addressed by HS-LS1-1.) ● LS3.A: Inheritance of Traits ○ Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. ● LS3.B: Variation of Traits ○ In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is	

they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.	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.	
	Acquisition	
	Students will know… ● Mendel's Law of Dominance ● The difference between genotype and phenotype ● The Law of Segregation and Independent Assortment ● How to predict the probability of genetic crosses (CCC: Patterns) using both monohybrid and dihybrid crosses ● Nonmendelian patterns of inheritance such as codominance, incomplete dominance and sex-linked trais ● How to use pedigrees to understand patterns of inheritance both Mendelian and non-Mendelian	*Students will be skilled at…* ● Using Punnett Squares to predict the genotypic and phenotypic probabilities of offspring of a genetic cross ● Analyzing a pedigree to determine the pattern of inheritance

Stage 2 – Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
A, M, T	Students are assessed on their understanding of core concepts of inheritance patterns and genetics as well as critical thinking skills including data analysis, data interpretation, constructing explanations from evidence and with reasoning, and communicating findings. Specific skills assessed are: the use of punnett squares to predict genotypic and phenotypic outcomes and analysis of pedigrees	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* Predicting, analyzing and communicating information about a genetic inheritance pattern. **Case Study: It's All Greek to Me** - Students read about the patient's signs and symptoms, learn about family history and diet, and analyze complete blood count (CBC). Students must then determine the inheritance pattern and determine whether the patient is suffering from the disease Cooley's anemia. Lastly, students must evaluate whether the parents should have more children.
		OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…* ● Quizzes and Tests ● Verbal Questioning / Class Discussions ● Kahoot, Peardeck, Edpuzzle Assessments ● Lab analysis questions ● Warm-ups and exit tickets ● Article readings/summaries ● Homework assignments ● Self-reflection

Stage 3 – Learning Plan		
Code	***Pre-Assessment*** ● Brainstorming at the start of the unit ● Informal assessment of prior knowledge ● Formal pre-assessments to match the post assessment (optional)	
	Summary of Key Learning Events and Instruction *Student success at transfer meaning and acquisition depends on…*	Progress Monitoring
A	- **Taking notes** from lecture, class discussions, videos and textbook readings on each topic (E2, E3)	● Warm-Up / Exit tickets ● Monitor progress for depth and accuracy ● Kahoot, Peardeck, Edpuzzle Assessments ● Quizzes on content ● Questions on activities and projects ● Verbal questions for comprehension ● End of unit assessment
A, M	- **Working collaboratively** with partners or small groups to complete graphic organizers to summarize major concepts (E1, E2, E3, E4)	
A, M	- **Predicting and analyzing** inheritance patterns (genotype and phenotype) using punnett squares and pedigrees (E1, E2, E3)	
A, M, T	- **Calculating probabilities** of multiple events occurring together as well as the odds of having certain combinations of traits (E2, E3)	
A, M	- **Collaborating on POGIL** - Pedigree analysis to determine inheritance patterns (E2, E3)	
A, M, T	- **Analyzing Data** - Lactose Intolerance Pedigree Case Study (E4, E5)	
A, M, T	- **Synthesizing: Case Study** - It's All greek to Me (E1, E2, E3, E4, E5)	

Unit 7: DNA and Protein Synthesis

Phenomenon: How do variations in traits arise?
Lactose-Intolerance / Sickle Cell Anemia

Stage 1 Desired Results

ESTABLISHED GOALS

HS-LS1-1 Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. [Assessment Boundary: Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis.]

HS-LS1-2 Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending

Transfer

Students will be able to independently use their learning to…

- SEP 2 - Develop and Use Models.
- SEP 4 - Analyze and Interpret Data
- SEP 6 - Construct Explanations
- SEP 7 - Engage in Argument from Evidence
- SEP 8 - Obtain, Evaluate, and Communicate Information.

Meaning

UNDERSTANDINGS

Students will understand that…

- LS1.A: Structure and Function
  - Systems of specialized cells within organisms help them perform the essential functions of life.
  - All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells.

ESSENTIAL QUESTIONS

Students will keep considering…

- How are organisms structured to ensure efficiency and survival? (LS1.A)
- How do science and technology affect the quality of our lives?

on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] [Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.] HS-LS3-1 Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.] HS-LS3-2 Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. [Clarification Statement: Emphasis is on using data to support arguments for the way variation occurs.] [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.] RST.9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or	○ 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. ● LS3.A: Inheritance of Traits ○ Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. ● LS3.B: Variation of Traits ○ In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. ○ Environmental factors can also cause mutations in genes, and viable mutations are inherited. Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation	

<table>
<tr><td rowspan="4">performing technical tasks, attending to special cases or exceptions defined in the text.

WHST.9-10.1 Write arguments focused on discipline-specific content.</td><td>and distribution of traits observed depends on both genetic and environmental factors.</td><td></td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● How an organism transfers the information contained in DNA to the proteins (CCC: Cause and Effect)
● That proteins determine the structure and function of all organisms (CCC: Structure and Function)
● The process of transcription and translation
● The effect of genetic mutations on protein structure (CCC: Structure and Function)
● The difference between point and frameshift mutations
● How DNA can be manipulated (engineered) to alter traits</td><td>Students will be skilled at…

● Describing the structure of DNA and RNA
● Explaining how DNA replicates itself
● Describing the general role of DNA and RNA in protein synthesis
● Outlining the steps to create a transgenic organism
● Applying the steps to create glowing bacteria
● Analyzing a DNA fingerprint
● Supporting claims using evidence</td></tr>
</table>

Stage 2 – Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
A, M, T	Students are assessed on their understanding of core concepts of DNA, genes, protein synthesis and mutation. and critical thinking skills including data analysis, data interpretation, hypothesis and reasoning, predictions and communicating findings.	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* the relationship between the genetic code and a protein's structure and function and how different types of mutations will affect the protein **GIZMO STEM CASE - Protein Synthesis STEM Case** Lucy is a baby girl whose ADA enzymes are not working properly and suffers from ADA SCID (Adenosine deaminase severe combined immunodeficiency), an autoimmune disease. Students act as a pediatrician and learn about protein synthesis to find the cause of the disease and treatment for Lucy. Students will make a claim about the type of mutation, justify with evidence and provide counterevidence to rule out alternative hypotheses.
		OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…* ● Quizzes and Tests ● Verbal Questioning / Class Discussions ● Kahoot, Peardeck, Edpuzzle Assessments ● Lab analysis questions ● Warm-ups and exit tickets ● Article readings/summaries ● Homework assignments ● Self-reflection

Stage 3 – Learning Plan

Code		
	Pre-Assessment ● Brainstorming at the start of the unit ● Informal assessment of prior knowledge ● Formal pre-assessments to match the post assessment (optional)	
	Summary of Key Learning Events and Instruction *Student success at transfer meaning and acquisition depends on…*	Progress Monitoring ● Warm-Up / Exit tickets ● Monitor progress for depth and accuracy ● Kahoot, Peardeck, Edpuzzle Assessments ● Quizzes on content ● Questions on activities and projects ● Verbal questions for comprehension ● End of unit assessment
A	- **Taking notes** from lecture, class discussions, videos and textbook readings on each topic (E2, E3)	
A	- **Working collaboratively** with partners or small groups to complete graphic organizers to summarize major concepts (E1, E2, E3, E4)	
A, M	- **Modeling** the transcription and translation steps involved in protein synthesis using **GIZMO** (E2, E3, E4)	
A, M	- **Analyzing: Protein Synthesis/Mutation** - simulate mutations during protein synthesis and analyze the impact on protein structure (E2, E3, E4)	
A, M, T	- **Simulating Protein Synthesis (GIZMO STEM Case)** (E1, E2, E3, E4, E5)	
A, M, T	- **Simulating: Paper Plasmid Lab** - simulate steps of genetic technology used to create transgenic organisms or clone a gene (E2, E3, E4)	
A, M, T	- **Providing evidence and explaining arguments** for or against the creation and use of genetically modified organisms (E2, E3, E4, E5)	
A, M, T	- **Modeling Lab**: Follow a detailed procedure to use gel electrophoresis to create a DNA Fingerprint and analyze the results to determine who committed the crime (E1, E2, E3, E4, E5)	

Unit 8: Evolution

Phenomenon: Darwin's Finches
Why do deadly diseases exist?

Stage 1 Desired Results

ESTABLISHED GOALS

HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. [Clarification Statement: Emphasis is on the use of mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits.] [

HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. [Clarification Statement: Emphasis is on a conceptual understanding of the role each line of evidence has relating to common ancestry and biological evolution. Examples of evidence could include similarities in DNA sequences, anatomical structures, and order of appearance of structures in embryological development.]

HS-LS4-2. Construct an explanation

Transfer

Students will be able to independently use their learning to…

- SEP 2 - Develop and Use Models.
- SEP 4 - Analyze and Interpret Data
- SEP 5 - Use Mathematics and Computational Thinking
- SEP 6 - Construct Explanations
- SEP 7 - Engage in Argument from Evidence
- SEP 8 - Obtain, Evaluate, and Communicate Information.

Meaning

UNDERSTANDINGS
Students will understand that…

LS3.B: Variation of Traits Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus, the variation and distribution of traits observed depends on both genetic and environmental factors.

LS4.A: Evidence of Common Ancestry and Diversity Genetic information, like the fossil record, provides evidence of evolution. DNA sequences vary among

ESSENTIAL QUESTIONS
Students will keep considering…

- What is the role of genes in the evolution of all populations?
- What evidence shows that different species are related?
- What is the driving force of evolution?
- How do humans impact biodiversity?

based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment. [Clarification Statement: Emphasis is on using evidence to explain the influence each of the four factors has on the number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Examples of evidence could include mathematical models such as simple distribution graphs and proportional reasoning.] HS-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. [Clarification Statement: Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations.] HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations. [Clarification Statement:	species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence. LS4.B: Natural Selection Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information — that is, trait variation — that leads to differences in performance among individuals. The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. LS4.C: Adaptation Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. LS4.C: Adaptation Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future	

Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other organisms) contribute to a change in gene frequency over time, leading to adaptation of populations.] HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. [Clarification Statement: Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.] RST.9-10.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.	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. LS4.C: Adaptation Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline — and sometimes the extinction — of some species. Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost. LS4.D: Biodiversity and Humans 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.	
	Acquisition	

	Students will know… ● The role genetic mutation plays in natural selection and evolution (CCC: Cause and Effect) ● Darwin's observations and inferences that support natural selection ● How evolution provides a scientific explanation for fossil records (CCC: Patterns) ● How adaptations increase chances for survival ● Evolution at the allele level (CCC: Scale, Proportion, and Quantity) ● the 5 assumptions necessary for a population to be in Hardy-Weinberg equilibrium (CCC: Stability and Change) ● how to apply the Hardy-Weinberg principle to a population (CCC: Stability and Change) ● Factors that are associated with speciation and extinction (CCC: Stability and Change) ● Evidence of evolution including fossils, homologous structures, embryology, and molecular sequences (CCC: Patterns)	*Students will be skilled at…* ● Explaining how genetic mutation and natural selection play a role in evolution ● Explaining how evolution provides a scientific explanation for fossil records ● Describing how adaptations increase chances for survival ● Explaining evolution at the allele frequency level ● Describing the factors associated with speciation ● Describing the Hardy-Weinberg principle ● Identifying homologous / analogous /vestigial structures and explaining the significance of each in relation to evolution

Stage 2 – Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
A, M, T	Constructed response rubric to assess for claim accuracy, appropriate evidence, and reasoning that connects to content accurately	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* the process of natural selection as the driving force behind life's diversity **BiteScis Case Study - From Gene to Disease: Sickle Cell Anemia** Analyze data about sickle cell anemia and the incidence of malaria. Determine the genetic causes and inheritance pattern of sickle cell anemia. Then compare the incidence of sickle cell anemia in Africa with the incidence of malaria. Interpret data to explain why natural selection has favored the prevalence of sickle cell anemia.
		OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…* ● Quizzes and Tests ● Verbal Questioning / Class Discussions ● Kahoot, Peardeck, Edpuzzle Assessments ● Lab analysis questions ● Warm-ups and exit tickets ● Article readings/summaries ● Homework assignments ● Self-reflection

Stage 3 – Learning Plan		
Code	***Pre-Assessment*** ● Brainstorming at the start of the unit ● Informal assessment of prior knowledge ● Formal pre-assessments to match the post assessment (optional)	
	Summary of Key Learning Events and Instruction *Student success at transfer meaning and acquisition depends on…*	Progress Monitoring
A	- **Taking notes** from lecture, class discussions, videos and textbook readings on each topic (E2, E3)	● Warm-up / Exit Tickets ● Monitor progress for depth and accuracy ● Kahoot, Peardeck, Edpuzzle Assessments ● Quizzes on content ● Questions on activities and projects ● Verbal questions for comprehension ● End of unit assessment
A	- **Working collaboratively** with partners or small groups to complete graphic organizers to summarize major concepts (E1, E2, E3, E4)	
A, M	- **Modeling** - simulate natural selection in a population (peppered moth, rock pocket mice, tuskless elephants) (E2, E4)	
A, M, T	- **Investigating and Applying** the principles of natural selection to the population of Galapagos finches to explain the patterns observed in beak size over several generations (bird beak lab and video) (E2, E3)	
A, M	- **Applying** the Hardy-Weinberg principle to the Rock Pocket Mouse population to determine if it is evolving at the allele level (HHMI) (E2, E3, E4, E5)	
A, M, T	- **Explaining and Summarizing** the various pieces of evidence for evolution (E2, E3)	
A, M, T	- **Analyze and Interpret Data** about sickle cell anemia and the incidence of malaria (BiteScis Case Study - From Gene to Disease: Sickle Cell Anemia) (E1, E2, E3, E4, E5)	