HTPS Biology Curriculum Map

Unit of Study	Pacing	NGSS Performance Expectation(s)	3-Dimensional Learning Components Science and Engineering Practices: Crosscutting Concepts: Disciplinary Core Ideas (DCI):	Phenomena, Anchoring Activity/Question, Essential Questions	Enduring Understandings	Learning Targets	Assessment Formative, Summative, and Common	Interdisciplinary Connections (identify subject and standard)	21st Century Life and Career Standards
Biology in Use	2.5 weeks	**HS-LS1-2.** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.	**Science and Engineering Practices:** *Developing and Using Models* Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. **Crosscutting Concepts:** *Systems and System Models* Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. **Disciplinary Core Ideas:** *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.	**Essential Questions:** How is life defined? What makes something alive? How is life organized? How does structure determine functioning of living things? How do scientists gather and analyze data to investigate specific phenomena? **Phenomena:** Collage of pictures of different types of life leading to a discussion of how they are interconnected. Present a specific phenomenon that would drive an investigation using the scientific process.	Investigations of what makes something living or nonliving; How living things are organized from molecules to organisms; Systems of specialized cells within organisms help perform essential functions of life; Plan and carry out controlled investigations using the scientific process, collect and analyze data (both qualitative and quantitative) and construct explanations based on evidence.	PYRAMID OF LIFE MODEL AND ANALYSIS: Students analyze a model to explain the relationships between components in the model, including: The functions of at least two major body systems in terms of contributions to overall function of an organism Ways the functions of two different systems affect one another A system's function and how that relates both to the system's parts and to the overall function of the organism. IS IT ALIVE? INQUIRY ACTIVITY: Students develop checklist for characteristics that make something alive. Use checklist to evaluate several samples. Use evidence collected to make an argument if yeast or seeds are alive. Students will practice designing controlled investigations as well as collecting and analyzing data in order to construct explanations. SURVEY OF LIFE INQUIRY ACTIVITY: Students observe groups of living organisms (animal, plant, fungi, protist and bacteria). Analyze similarities among these organisms and differences from other groups. Construct explanations of ways these groups differ - including cell differences, ways of obtaining energy and reproductive strategies.	**Formative:** Group argument from Is It Alive Inquiry Activity; class discussion regarding Pyramid of Life; controlled investigations and graphing **Summative:** Unit test including a practical for HS-LS1-2. **Common:** HSCharofLifeCA	**ELA/Literacy:** SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.	9.3.ST.1 Apply engineering skills in a project that requires project management, process control and quality assurance. 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data. 9.3.ST.3 Describe and follow safety, health and environmental standards related to science, technology, engineering and mathematics (STEM) workplaces. 9.3.ST.4 Understand the nature and scope of the Science, Technology, Engineering & Mathematics Career Cluster and the role of STEM in society and the economy.

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Cell Structure and Processes	2.5 weeks	**HS-LS1-3.** Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.	**Science and Engineering Practices:** *Planning and Carrying Out Investigations* 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. *Constructing Explanations and Designing Solutions* Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. **Crosscutting Concepts:** *Stability and Change* Feedback (negative or positive) can stabilize or destabilize a system. **Disciplinary Core Ideas:** *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 Question:** How does the structure of cells determine the functioning of cells to maintain homeostasis? **Phenomena:** Topically related (ex. Impact of Energy Drinks, Caffeine on Body Systems)	Organelles have distinct functions but work together for optimal functioning of the cell. Cell transport requires mechanisms (such as active and passive transport) to maintain homeostasis to allow for survival within a given environment.	Comparison of various cell types (using microscopy) that lend to biodiversity on Earth. Modeling of cell transport (ex. egg investigation, plastic bag/dialysis tubing). Construct an explanation for how materials are transported into and out of cells.	**Formative:** Inquiry investigations, class and small group discussions, POGIL (ex. Prokaryotic and Eukaryotic Cells and Eukaryotic Cell Structure:Organelles in Animal and Plant Cells), Explanations for how cells reach homeostasis cellular transport using evidence generated from models,Red Rover molecule simulation. **Summative:** Construct an explanation using quantitative evidence for why we observed the movement of water in and out of an egg during our modeling (HS-LS1-3). Unit 2 Assessment. **Common:** HS Membrane CA	**ELA/Literacy:** WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS1-3) WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (HS-LS1-3) **Technology:** 8.2.8.B.2 Identify the desired and undesired consequences from the use of a product or system.	9.3.ST-SM.3 Analyze the impact that science and mathematics has on society. 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.

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Matter and Energy in Ecosystems	8 weeks	**HS-LS1-3.** Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. **HS-LS1-5.** Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. **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.	**Science and Engineering Practices:** *Developing and Using Models* Use a model based on evidence to illustrate the relationships between systems or between components of a system. Develop a model based on evidence to illustrate the relationships between systems or components of a system. *Mathematical and Computational Thinking* Use mathematical representations of phenomena or design solutions to support claims. *Constructing Explanations and Designing Solutions* Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. **Crosscutting Concepts:** *Systems and System Models* Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scale. *Energy and Matter* Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems. Energy drives the cycling of matter within and between systems. **Disciplinary Core Ideas:** *LS1.C: Organization for Matter and Energy Flow in Organisms* The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new	**Essential Questions:** How are all organisms dependent on each other? How do living things use food for energy and to build new parts of the body? How is matter transferred and energy transferred/transformed in living systems? How do humans impact the cycling of matter and the flow of energy in a system? **Phenomena:** Caterpillar eating video. Bread rises with yeast.	Photosynthesis converts light energy into chemical energy. Matter is assembled into other molecules needed by the cell. Matter and energy flow through levels of living systems with less energy being transferred up at each level. Cellular respiration breaks bonds to release energy to cells. Human activities have an impact on the cycling of matter and the flow of energy in Earth's systems.	Investigation of various plant structures related to optimal functioning/photosynthesis: leaves with pigments and stomata, roots and stems with capillary action. Modeling the movement of atoms during the chemical reactions of photosynthesis and cellular respiration. (Ex: Science Take-out Modeling Photosynthesis and Cellular Respiration). Planting normal green corn plants vs. albino corn plants and analyze growth rate. Construct an explanation of the role of chlorophyll in photosynthesis using numerical evidence. Analysis of various food webs and energy pyramids to explain the flow of energy and cycling of matter in an ecosystem. Investigation comparing the processes of anaerobic and aerobic respiration.	**Formative:** Inquiry investigations, class and small group discussions, interpretation of modeling and diagram class activities (ex. Science Take Out: Modeling Photosynthesis and Cellular Respiration), POGIL (ex.What's in a leaf?) **Summative:** Heart Rate Investigation with Explanation (HS-LS1-3) Unit Assessment with Modeling Question (HS-LS1-5) Analyzing Cellular Respiration Model (HS-LS1-7) Anaerobic Cellular Respiration Task/Lactic Acid Fermentation Investigation Explanations (Lab #6) (HS LS2-3) Trophic Level Calculation Assessment (HS LS2-4) **Common:** HS Photosyn CA	**ELA/Literacy:** WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS1-3) WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (HS-LS1-3) SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS-LS1-7) RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS2-3) WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (HS-LS2-3) **Mathematics:** MP.2 Reason abstractly and quantitatively. (HS-LS2-4) MP.4 Model with mathematics. (HS-LS2-4) HSN.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-LS2-4) HSN.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. (HS-LS2-4) HSN.Q.A.3 Choose a level of accuracy appropriate to limitations	9.3.ST-SM.3 Analyze the impact that science and mathematics has on society. 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data. 9.3.ST-ET.5 Apply the knowledge learned in STEM to solve problems.

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			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. *LS2.B: Cycles of Matter and Energy Transfer in Ecosystems* Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. 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. *PS3.D: Energy in Chemical Processes* The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis. *HS ESS2.D Earth's Systems: Weather and Climate* Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. *HS ESS3: Earth and Human Activity* Resource availability has guided the development of human society.					on measurement when reporting quantities. (HS-LS2-4)	

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DNA Structure and Processes	7 weeks	**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-LS1-6.** 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-LS1-4.** 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.	**Science and Engineering Practices:** *Developing and Using Models* Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. *Constructing Explanations and Designing Solutions* Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. *Asking Questions and Defining Problems* Ask questions that arise from examining models or a theory to clarify relationships. **Crosscutting Concepts:** *Structure and Function* Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. *Systems and System Models* Models (e.g., physical,mathematical, computer models) can be used to simulate systems and interactions — including energy, matter, and information flows — within and between systems at different scales. *Stability and Change* Feedback (negative or positive) can stabilize or destabilize a system. *Cause and Effect* Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. **Disciplinary Core Ideas:** *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. Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS1-3) *LS1.B: Growth and Development of Organisms*	**Essential Questions:** How do DNA and RNA participate in the process of making proteins? How is the genetic code preserved and passed on from generation to generation? How does the cell cycle regulate normal and abnormal cell growth? **Phenomena:** Why do our cuts and broken bones heal? Growth and development (show parents then zygote, baby, child, adult - how do these changes occur?) Cancer cells interrupt organism functioning. Why do some people in the US have sickle cell anemia while most do not? (use current data) How different are you from a banana?	All cells contain DNA. DNA contains regions called genes which code for proteins. Groups of specialized cells (tissues) use proteins to carry out functions that are essential to the organism. Cells have the ability to divide and differentiate and are regulated by the cell cycle. Disruption in the cell cycle can lead to abnormal cell division.	Investigations of how and why new cells are created through analysis of the cell cycle and mitosis. Various diseases will be used to compare "normal" cell division with "abnormal division. Cells from different types of organisms will be compared and contrasted to determine what makes us different from each other. Analyze the structure of DNA and how its code will affect the structure of the protein built. Analyze the effect a mutation in DNA has on the protein that it creates.	**Formative:** POGILs (ex: DNA Structure, Function, and Replication and Genetic Mutations), Inquiry investigations (ex. Investigating The Limits of Cell Growth), Class and small group discussions, modeling the structure of DNA both in 2-D and 3-D to help explain the mechanisms of DNA replication, Modeling the cell cycle to explain the the reason cells only grow to a specific point and then must divide and how this cell division leads to a multicellular organism with differentiated cells (ex. create a poster), Modeling transcription and translation to create a protein, **Summative:** Lab 4: Normal & Abnormal Cell Division: Which of These Patients Could Have Cancer? (HS LS1-4) Students can analyze a strand of DNA to determine if there is a mutation and explain using evidence how the mutation will affect the protein that is built (ex. Sickle Cell Anemia explained as a point mutation resulting in altered hemoglobin molecules) (HS-LS1-1) Unit Assessments. **Common:** HS DNA CA, HS CellCycle CA	**ELA/Literacy:** RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS1-1) WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS1-1) WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS1-1) SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS-LS1-4) RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.(HS-LS3-1) **Mathematics:** MP.4 Model with mathematics. (HS-LS1-4) HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. (HS-LS1-4) HSF-BF.A.1 Write a function that describes a relationship between two quantities. (HS-LS1-4) **Technology:** 8.2.12.D.6 Synthesize data, analyze trends and draw conclusions regarding the effect of a technology on the individual, society	9.3.ST.2 Use technology to acquire, manipulate, analyze and report data. 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society. 9.3.ST-ET.5 Apply the knowledge learned in STEM to solve problems.

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			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.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. *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.						

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Inheritance & Variation of Traits	4 weeks	**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.	**Science and Engineering Practices:** *Engaging in Argument From Evidence* Make and defend a claim based on evidence about the natural world that reflects scientific knowledge and student-generated evidence. *Analyzing and Interpreting Data* Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. *Using Mathematics and Computational Thinking* 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. **Crosscutting Concepts:** *Cause and Effect* Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. *Scale, Proportion, and Quantity* Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). **Disciplinary Core Ideas:** *LS3.B: Variation of Traits* In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors.	**Essential Questions:** What causes variations in individuals within a population? How are traits distributed within a population? How are traits passed from one generation to the next? **Phenomena:** Famous family with a distinctive trait (ex. Little People, Big World) - how does this occur?	Chromosomes contain long strands of DNA. Genes are segments of these DNA strands. DNA codes for proteins which regulate the expression of traits in an organism. Environmental factors can also affect the expression of traits. Variations in genetic material naturally result during meiosis when corresponding sections of chromosome pairs exchange places. Genetic mutations can occur through errors in DNA replication or environmental factors. Genetic material is inheritable.	Investigate patterns of inheritance that allow us to predict the outcome of genetic crosses between various individuals. Apply knowledge of gene expression and heredity to the understanding of human genetic disorders. Use the tools of genetics, including punnett squares, karyotypes and family pedigrees, to predict the likelihood of of a certain trait or disease being passed on from parent to offspring. Investigate how mutations and sexual reproduction can produce genetic variation in an organism and therefore a species.	**Formative:** Have students construct an explanation that explains the impact of the various chromosomal disorders on the individual who inherits them, Various Do Nows throughout the unit to assess student understanding of what causes genetic variation in a population (over time the do nows should assess understanding that new gene combination result from meiosis, errors occur during replication, and environmental factors play a role.(HS-LS3-2) Do Nows that assess understanding of analyzing a situation by creating and analyzing various Punnett Squares. Modeling the process of meiosis and crossing over. **Summative:** Lab 21: Models of Inheritance: Which Model of Inheritance Best Explains How a Specific Trait is Inherited in Fruit Flies? Design organisms with unique traits to model mating. Statistically analyze offspring to determine inheritance patterns. Communicate discovered inheritance pattern with class and revise model if necessary (HS-LS3-3) Unit Assessment **Common:** HS Punnet CA	**ELA/Literacy:** RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS3-2, HS-LS1-6)) WHST.9-12.1 Write arguments focused on discipline-specific content. (HS-LS3-2) WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS1-6) WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (HS-LS1-6) WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS1-6) **Mathematics:** MP.2 Reason abstractly and quantitatively. (HS-LS3-2, HS-LS3-3) **Technology:** 8.2.12.D.6 Synthesize data, analyze trends and draw conclusions regarding the effect of a technology on the individual, society.	9.3.ST-ET.5 Apply the knowledge learned in STEM to solve problems.

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Natural Selection, Evolution and Biodiversity	12 weeks	**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-LS2-7.** Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*	**Science and Engineering Practices:** *Obtaining, Evaluating, and Communicating Information* Communicate scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). *Constructing Explanations and Designing Solutions* Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. Create or revise a simulation of a phenomenon, designed device, process, or system. Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. *Using Mathematical and Computational Thinking* 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. *Engaging in Argument From Evidence* Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments. **Crosscutting Concepts:** *Patterns* Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. *Cause and Effect* Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. *Stability and Change* Much of science deals with constructing explanations of how things change and how they remain stable. **Disciplinary Core Ideas:** *HS ESS2.E Biogeology* The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it. (HS-ESS2-7) *LS4.A: Evidence of Common Ancestry and Diversity* Genetic information, like the fossil record, provides evidence of evolution. DNA	**Essential Questions:** How can we use available evidence to trace evolution over time? How do evolution and natural selection explain the diversity of species found on Earth? How does genetic variation lead to changes in a population over time and species diversity? How is human activity impacting biodiversity of ecosystems? **Phenomena:** Comparison of embryos - pictures of different embryos - which one is human? Evolution of unique organism (Koalas, Pandas, Polar Bear) Biodiversity video from Nature (see teacher resources). Racing Extinction Clip.	Evidence for evolution can be found in comparisons of DNA sequences, the fossil record, anatomical and embryological evidence. Genetic variation can lead to a variation of expressed traits in individuals in a population. Competition for limited resources causes individuals with traits that give a competitive advantage to be able to survive and reproduce at higher rates. Genes for traits with competitive advantage will be passed on in greater proportions to the next generation. Over many generations, groups with these traits can evolve into a different species. Natural selection relies on variation in genetic information and expression of traits. Natural selection causes adaptations that lead to changes in the distribution of traits within a population as conditions change. Changes in the environment, either natural or human induced, lead to changes in species such as growth, decline, emergence of new species or extinction. Humans depend on the resources and other benefits provided by biodiversity. Human activity is having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, invasive species and climate change.	Analyze evidence of evolution to show connections between related species. Investigate how variations within a species can lead to natural selection and speciation based on advantageous traits. Investigate the impact of human activities on the biodiversity of an ecosystem.	**Formative:** POGILs (ex: Evidence for Evolution) PLC Modified Investigation: Amino Acid Sequences and Evolutionary Sequences PHET Natural Simulation, analyze adaptations in a rabbit population by varying different environmental factors, Bird Beak Investigation with small group and class analysis and interpretation of quantitative data, complete revisions for explanations in journal/notebooks. Biodiversity Pre-Investigation and Investigation where students have the opportunity to investigate and area's biodiversity and then calculate the biodiversity index. The use the biodiversity index calculation to explain the health of the area. **Summative:** Construct and Analyze an evolutionary tree using different forms of evidence for evolution then construct an explanation from evidence for why the branches are drawn where they are (ex. Barbellus) (HS-LS4-1) Lab 27: Whale Evolution: How Are Whales Related to Other Mammals? The students will use an online database to examine the amino acid sequence for HBA protein found in all mammals. They will choose several mammals that they hypothesize may be closely related to whales and use the database to create a phylogenetic tree that illustrates the evolutionary history of this group of mammals based on similarities and differences in the amino acid sequence of the HBA protein. They will then need to explain (1) how whales are related to other mammals and (2) how the phylogenetic tree they created supports their claim. (HS-LS4-1) Evolutuion Common Assessment #4. Using a graph of population data in changing environmental conditions, construct an explanation using	**ELA/Literacy:** RST-11.12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS4-1, LS4-2, LS4-3, LS4-4) RST-11.12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-LS4-5) WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS4-1, LS4-2, LS4-3, LS4-4) WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS4-1, LS4-2, LS4-3, LS4-4, LS4-5) SL.11-12.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. (HS-LS4-1, LS4-2) WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (HS-LS4-6, LS2-7) WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS4-6, LS2-7) **Mathematics:** MP.2 Reason abstractly and quantitatively. (HS-LS4-1, LS4-3, LS4-4, LS4-5) **Technology:** 8.2.12.D.6 Synthesize data, analyze trends and draw conclusions regarding the effect of a technology on the individual, society	9.3.ST.2 Use technology to acquire, manipulate, analyze and report data. 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society. 9.3.ST-ET.5 Apply the knowledge learned in STEM to solve problems.

Unit of Study	Pacing	NGSS Performance Expectation(s)	3-Dimensional Learning Components Science and Engineering Practices: Crosscutting Concepts: Disciplinary Core Ideas (DCI):	Phenomena, Anchoring Activity/Question, Essential Questions	Enduring Understandings	Learning Targets	Assessment Formative, Summative, and Common	Interdisciplinary Connections (identify subject and standard)	21st Century Life and Career Standards
			sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence. *LS4.B: Natural Selection* Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information — that is, trait variation — that leads to differences in performance among individuals. The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. *LS4.C: Adaptation* Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. Adaptation also means that the distribution of traits in a population can change when conditions change. Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline — and sometimes the extinction — of some species. Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost. *LS2.C: Ecosystem Dynamics, Functioning, and Resilience* Moreover, anthropogenic changes (induced by human activity) in the environment — including habitat destruction, pollution, introduction of invasive species, overexploitation, and				quantitative evidence that explains how the population composition may change over time as organisms with favorable adaptations will survive and increase in number while others with unfavorable adaptations will decline. (HS-LS4-3) (HS-LS4-4) Evolution Common Assessment Questions #2 and #3: Students will use concepts from the bird beak investigation and apply them to scenarios that they must construct an explanation for (hummingbird specialized beak and food source is destroyed; analysis of Galápagos data on the percentage of survival of beak sizes in finches when there is a drought. (HS_LS4-5) Construct an explanation (final in journal after revisions throughout unit) using evidence from bird beak investigation that the process of evolution is based on reproductive potential, genetic variation, competition, favorable adaptations and fitness (HS-LS4-2) Students will design and implement a strategy to reduce the human impact on biodiversity in a given outside area (HS-LS2-7 and HS-LS4-6) **Common:** HS Evolution CA and HS Biodiver CA		

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			climate change — can disrupt an ecosystem and threaten the survival of some species. *LS2.D Social Interactions and Group Behavior* Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives. (HS-LS2-8). *LS4.D: Biodiversity and Humans* Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). (secondary) Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (secondary) (Note: This Disciplinary Core Idea is also addressed by HS LS4-6.) *ETS1.B: Developing Possible Solutions* When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. (secondary) Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. (secondary) *ESS3.C Human Impact on Earth Systems* The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. (HS-ESS3-3)					