BIOLOGY/HONORS Curricular Documents

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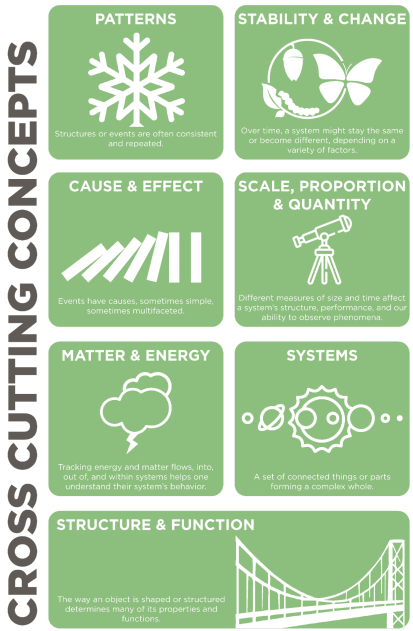
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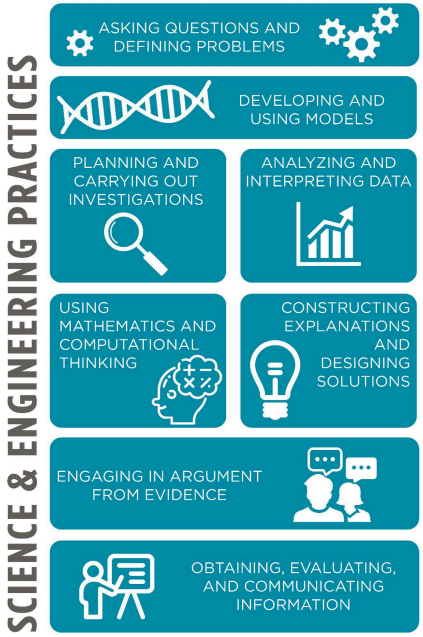
Biology Course Information	
CURRICULUM/CONTENT AREA	**COURSE LENGTH**
Science	1 semester
GRADE LEVEL	**DATE LAST REVIEWED**
9th grade	2016 Approved Curricular Docs 2023 Evaluation of Program
PREREQUISITE(s) ***if applicable***	**BOARD APPROVAL DATE**
NA	*December 2024*
PRIMARY RESOURCE ***if applicable***	
Storylines by ASC All Species Supplemental: Biology Dimensions (2018), Holt McDougal	

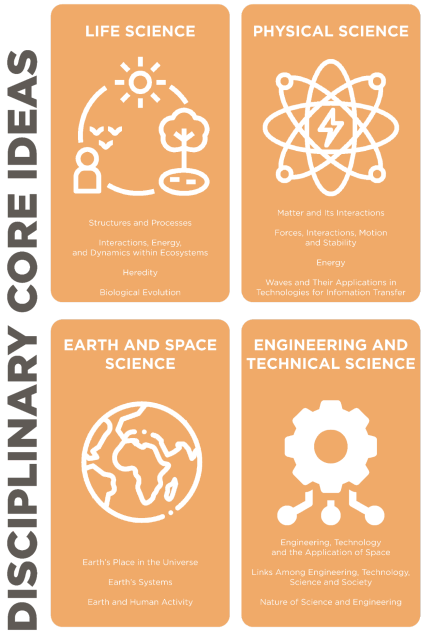
Desired Results	
COURSE DESCRIPTION	
Biology is a laboratory science course that investigates the relationship between structure and function from molecules to organisms and systems, the interdependence and interactions of biotic and abiotic components of the environment, and mechanisms that maintain continuity and lead to changes in populations over time. Students explore biological concepts through an inquiry approach grounded in real world phenomena. Honors Biology explores concepts in greater depth and at a faster pace.	
ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
Patterns: Observed patterns in nature guide organization and classification and prompt questions about relationships and	LS1: From Molecules to Organisms: Structures and Processes How do organisms live, grow, respond to their environment and reproduce? LS2: Ecosystems: Interactions, Energy, and Dynamics

causes underlying them. **Cause and Effect:** Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering. **Scale, Proportion, and Quantity:** In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change. **Systems and Models:** A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems. **Energy and Matter:** Tracking energy and matter flows, into, and out of, and within systems helps one understand their system's behavior. **Structure and Function:** The way an object is shaped or structured determines many of its properties and functions. **Stability and Change:** For both designed and natural systems, conditions that affect stability and factors that control the rates of change are critical elements to consider and understand.	How (and why} do organisms interact with their environment and what are the effects of these interactions? LS3: Heredity: Inheritance and Variation of Traits How are characteristics of one generation passed to the next? How can individuals of the same species and even siblings have different characteristics? LS4: Biological Evolution: Unity and Diversity How can there be so many similarities among organisms yet so many different kinds of plants, animals and microorganisms? *The following unit specific essential questions align to the above course essential questions.* Africa Unit: ➔ LS2.D: Why do some animals live in groups? ➔ LS1.C: How do animals obtain the energy they need? ➔ LS3.B/LS4.B How do populations change over time? ➔ LS2.A/LS4C How can species live together? ➔ LS1.B/LS1.C How do organisms grow and develop? Homeostasis Unit: ➔ LS2.A How are organisms interdependent within their environment? ➔ LD4.D How have humans impacted the ecosystem and its communities? ➔ LS2.B How does homeostasis maintain balance in ecosystems? ➔ LS1.A How does homeostasis maintain balance in organisms? ➔ LS1.A How does homeostasis maintain balance in cells? Melanin Unit: ➔ LS3.A How do traits occur in organisms? ➔ LS3.B What makes one trait different from another trait? ➔ LS1.A How are proteins used by organisms? ➔ LS4.B/LS4.C How do genotype and phenotype impact natural selection? Disease Unit: ➔ LS1B: How are cancer cells different from normal cells? ➔ LS1.A/LS1.B: How and when do normal and cancer cells divide? ➔ LS3.B: How does each cell get its own copy of DNA? ➔ LS3.A: How does a gene help regulate the cell cycle? ➔ LS3.B: How can mutations be passed to future generations? Penguin Unit: ➔ LS4.A: Does geography affect common ancestry? ➔ LS4.A: How does DNA serve as evidence for common ancestry? ➔ LS2.D/LS4.D: How do human actions affect species? ➔ LS4.D: How do human actions impact native species? ➔ LS3.B: What is the importance of genetic diversity? ➔ LS3.B: How do populations change over time? ➔ LS4.D/ETS1.B: How do humans maintain genetic diversity in managed populations? Dog Unit: ➔ LS4.A What are types of evidence to show common ancestry? ➔ LS4.B/LS4.C: How does artificial selection change phenotypes over time? ➔ LS3.A: Why is genetic variation needed for evolution?

3 Dimensional Standards







Cross Cutting Concepts BY GRADE BAND AND UNIT	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6
Standard SCI.CC1 - Patterns Students Observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale, thus requiring improved investigations and experiments. They use mathematical representations to identify and analyze patterns of performance in order to reengineer a designed system.	X	x	x	x	x	x
Standard SCI.CC2 - Cause and Effect Students understand empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.	X	x	x	x	x	x
Standard SCI.CC3 - Scale, Proportion, and Quantity Students understand the significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. They recognize patterns observable at one scale may not be observable or exist at other scales, and some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly. They use orders of magnitude to understand how a model at one scale relates to a model at another scale. They use algebraic thinking to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).	X	x	x	x	x	x
Standard SCI.CC4 - Systems and System Models Students investigate or analyze a system by defining its boundaries and initial conditions, as well as its inputs and outputs. They use models (e.g., physical, mathematical, computer models) to simulate the flow of energy, matter, and interactions within and between systems at different scales. They also use models and simulations to predict the behavior of a system and recognize that these predictions have limited precision and reliability due to the assumptions and approximations inherent in the models. They also design systems to do specific tasks.	X	x	x	x	x	x
Standard SCI.CC5 - Energy and Matter Students understand that the total amount of energy and matter in closed systems is conserved. They describe changes of energy and matter in a system in terms of energy and matter flows into, out of, and within that system. They also learn that 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. In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.	X	x	x	x	x	x
Standard SCI.CC6 - Structure and Function Students investigate systems by examining the properties of different materials, the structures of different components, and their interconnections to reveal the system's function and solve a problem. They infer the functions and properties of natural and designed objects and systems from their overall structure, the way their components are shaped and used, and the molecular substructures of their various materials.	x	x	x	x	x	x
Standard SCI.CC7 - Stability and Change Students understand much of science deals with constructing explanations of how things change and how they remain stable. They quantify and model changes in systems over very short or very long periods of time. They see some changes are irreversible, and negative feedback can stabilize a system, while positive feedback can destabilize it. They recognize systems can be designed for greater or lesser stability.	X	x	x	x	x	x

Science and Engineering Practices by GRADE BAND and UNIT	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6
standard SCI.SEP1 - **A.Asking Questions** Students ask questions to formulate, refine, and evaluate empirically testable questions. This includes the following: • Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and seek additional information. • Ask questions that arise from examining models or theories to clarify and seek additional information and relationships. • Ask questions to determine relationships, including quantitative relationships, between independent and dependent variables. • Ask questions to clarify and refine a model or an explanation • Evaluate a question to determine if it is testable and relevant. • Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory. • Ask and evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of the design. **B.Defining Problems** Students formulate, refine, and evaluate design problems using models and simulations. This includes the following: • Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and environmental considerations. • Clarify and refine an engineering problem.	x	x	x	x	x	x
Standard SCI.SEP2 - Developing and Using Models Students use, synthesize, and develop models to predict and show relationships among variables and between systems and their components in the natural and designed world. This includes the following: • Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism, or system in order to select or revise a model that best fits the evidence or design criteria. • Design a test of a model to ascertain its reliability. • Develop, revise, and use models based on evidence to illustrate and predict the relationships between systems or between components of a system. • Develop and use multiple types of models to provide mechanistic accounts and predict phenomena. Move flexibly between these model types based on merits and limitations. Develop a complex model that allows for manipulation and testing of a proposed process or system. • Develop and use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and solve problems.	x	x	x	x	x	x
Standard SCI.SEP3 - Planning and Conducting Investigations Students plan and carry out investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models: This includes the following: • Individually and collaboratively plan an investigation or test a design to produce data that can serve as evidence to build and revise models, support explanations for phenomena, and refine solutions to problems. Consider possible variables or effects and evaluate the investigation's design to ensure variables are controlled. • Individually and collaboratively plan and conduct an investigation to produce data to serve as the basis for evidence. • In the design, decide on types, how much, and accuracy of data needed to produce reliable measurements. Consider limitations on the precision of the data (e.g., number of trials, cost, risk, time) and refine the design accordingly.	x	x	x	x	x	x

• Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts. • Select appropriate tools to collect, record, analyze, and evaluate data. • Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated. • Manipulate variables and collect data about a complex model of a proposed process or system to identify failure points, or to improve performance relative to criteria for success.						
Standard SCI.SEP5 - Mathematics and Computational Thinking Students use algebraic thinking and analysis, a range of linear and nonlinear functions (including trigonometric functions, exponentials, and logarithms), and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. This includes the following: • Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success. • Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system. • Use mathematical, computational, and algorithmic representations of phenomena or design solutions to describe and support claims and explanations. • Apply techniques of algebra and functions to represent and solve scientific and engineering problems. • Use simple limit cases to test mathematical expressions, computer programs, algorithms, or simulations of a process or system to see if a model "makes sense" by comparing the outcomes with what is known about the real world. • Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, and others).	x	x	x	x	x	x
Standard SCI.SEP6 - **A.Construct Explanations** Students create explanations that are supported by multiple and independent student generated sources of evidence consistent with scientific ideas, principles, and theories. This includes the following: • Make quantitative and qualitative claims regarding the relationship between dependent and independent variables. • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources, including students' own investigations, models, theories, simulations, and peer review. • Explanations should reflect 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. • Apply scientific ideas, principles, and evidence to provide an explanation of phenomena taking into account possible, unanticipated effects. • Apply scientific reasoning, theory, and models to link evidence to the claim and to assess the extent to which the reasoning and data support the explanation. B. **Design Solutions** Students create designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. This includes the following: • Design, evaluate, and refine a solution to a complex real world problem, based on scientific knowledge, student-generated sources of evidence, and prioritized criteria. Consider tradeoffs. • Apply scientific ideas, principles, and evidence to solve design problems, taking into account possible unanticipated effects.	x	x	x	x	x	x
Standard SCI.SEP7 - Engage in Arguments Students use appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world. Arguments may also come from current scientific or historical episodes in science. This includes the following:	x	x	x	x	x	x

• Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues. • Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. • Respectfully provide and receive critiques on scientific arguments by probing reasoning and evidence, by challenging ideas and conclusions, by responding thoughtfully to diverse perspectives, and by determining what additional information is required to resolve contradictions. • Construct, use, and present oral and written arguments or counter-arguments based on data and evidence. • Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence. • Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments. Consider relevant factors (e.g. economic, societal, environmental, and ethical considerations).						
Standard SCI.SEP8 - Obtain, evaluate, and Communication Information Students evaluate the validity and reliability of claims, methods, and designs. This includes the following: • Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions, and to obtain scientific and technical information. • Summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. • Compare, integrate, and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively, or text-based) in order to address a scientific question or solve a problem. • Gather, read, and evaluate scientific and technical information from multiple authoritative sources, assessing the evidence and usefulness of each source. • Synthesize and evaluate the validity and reliability of multiple claims, methods, or designs that appear in scientific and technical texts or media reports. Verify the data when possible. • Communicate scientific and technical information in multiple formats, including orally, graphically, textually, and mathematically. Examples of information could include ideas about phenomena or the design and performance of a proposed process or system.	x	x	x	x	x	x

Disciplinary Core Ideas by GRADE BAND and UNIT						
LIFE SCIENCE						
Standard SCI.LS1						
➔ **STRUCTURE & FUNCTION:** Systems of specialized cells within organisms help perform essential functions of life. Any one system in an organism is made up of numerous parts. Feedback mechanisms maintain an organism's internal conditions within certain limits and mediate behaviors.		x	x	x		
➔ **GROWTH AND DEVELOPMENT OF ORGANISMS:** Growth and division of cells in organisms occurs by mitosis and differentiation for specific cell types.	x			x	x	
➔ **ORGANIZATION FOR MATTER AND ENERGY FLOW IN ORGANISMS:** The molecules produced through photosynthesis are used to make amino acids and other molecules that can be assembled into proteins or DNA. Through cellular respiration, matter and energy flow through different organizational levels of an organism as elements are recombined to form different products and transfer energy.	x				x	

➔ **INFORMATION PROCESSING:** Organisms can process and store a variety of information through specific chemicals and interconnected networks.				x		
Standard SCI.LS2						
➔ **INTERDEPENDENT RELATIONSHIPS IN ECOSYSTEMS:** Ecosystems have carrying capacities resulting from biotic and abiotic factors. The fundamental tension between resource availability and organism populations affects the abundance of species in any given ecosystem. The combination of the factors that affect an organism's success can be measured as a multidimensional niche.	x	x		x		
➔ **CYCLES OF MATTER AND ENERGY TRANSFER IN ECOSYSTEMS:** Photosynthesis and cellular respiration provide most of the energy for life processes. Only a fraction of matter consumed at the lower level of a food web is transferred up, resulting in fewer organisms at higher levels. At each link in an ecosystem, elements are combined in different ways, and matter and energy are conserved. Photosynthesis and cellular respiration are key components of the global carbon cycle.	x	x			x	
➔ **ECOSYSTEMS DYNAMICS, FUNCTIONING, AND RESILIENCE:** If a biological or physical disturbance to an ecosystem occurs, including one induced by human activity, the ecosystem may return to its more or less original state or become a very different ecosystem, depending on the complex set of interactions within the ecosystem.		x	x			
➔ **SOCIAL INTERACTIONS AND GROUP BEHAVIOR:** Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives.	x		x			
Standard SCI.LS3						
➔ **INHERITANCE OF TRAITS:** DNA carries instructions for forming species' characteristics. Each cell in an organism has the same genetic content, but genes expressed by cells can differ.		x	x			
➔ **VARIATION OF TRAITS:** The variation and distribution of traits in a population depend on genetic and environmental factors. Genetic variation can result from mutations caused by environmental factors or errors in DNA replication, or from chromosomes swapping sections during meiosis.	x		x	x		x
Standard SCI.LS4						
➔ **EVIDENCE OF COMMON ANCESTRY AND DIVERSITY:** The ongoing branching that produces multiple lines of descent can be inferred by comparing DNA sequences, amino acid sequences, and anatomical and embryological evidence of different organisms.	x					x
➔ **NATURAL SELECTION:** Natural selection occurs only if there is variation in the genes and traits between organisms in a population. Traits that positively affect survival can become more common in a population.	x	x	x			x
➔ **ADAPTATION:** Evolution results primarily from genetic variation of individuals in a species, competition for resources, and proliferation of organisms better able to survive and reproduce. Adaptation means that the distribution of traits in a population, as well as species expansion, emergence, or extinction, can change when conditions change.	x	x	x			x
➔ **BIODIVERSITY AND HUMANS:** Biodiversity is increased by formation of new species and reduced by extinction. Humans depend on biodiversity but also have adverse impacts on it. Sustaining biodiversity is essential to supporting life on Earth.					x	x

Africa Phenomena

In this unit, students will be focusing on key biological concepts based on locations in Africa. Students will investigate how energy flows through these ecosystems through hunting, examining the roles of organisms in transferring and transforming energy within their habitats. They explore the genetics of lions, a prominent species in many African ecosystems, to understand how genetic variations influence traits and behaviors essential for survival. They analyze the interplay between genetic inheritance and environmental factors, considering adaptations that enable lions to thrive in their habitats. Throughout the unit, students investigate the complexity of African food webs, tracing the flow of energy from producers to consumers and decomposers. They explore the interconnectedness of organisms within these webs and the consequences of disruptions on ecosystem stability considering the complexities of ecological interactions and human impacts. Students then examine the processes of photosynthesis and cellular respiration, fundamental to the cycling of energy and matter in African ecosystems. They explore how plants harness sunlight to produce energy-rich molecules and how organisms, including humans and animals, utilize these molecules to fuel cellular activities. Through hands-on investigations, students analyze data, construct models, and engage in critical thinking to deepen their understanding of ecological concepts and their applications. They apply their knowledge to real-world scenarios, exploring the implications of scientific principles on conservation efforts, biodiversity preservation, and environmental stewardship across African landscapes.

STRUCTURE AND PROCESS BUNDLE DESIRED RESULTS

ESSENTIAL QUESTION:

- ➔ LS2.D: Why do some animals live in groups?
- ➔ LS1.C: How do animals obtain the energy they need?
- ➔ LS3.B/LS4.B How do populations change over time?
- ➔ LS2.A/LS4C How can species live together?
- ➔ LS1.B/LS1.C How do organisms grow and develop?

UNIT PRIORITY STANDARDS: *Students will know and be able to…*

Cross Cutting Concepts	*Science & Engineering Practices (SEP)*	*Disciplinary Core Idea (DCI)*
➔ **Standard SCI.CC1**: Students use science and engineering practices, disciplinary core ideas, and patterns to make sense of phenomena and solve problems.	➔ **Standard SCI.SEP1**: Students ask questions and define problems, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.	➔ **SOCIAL INTERACTIONS AND GROUP BEHAVIOR:** Group behavior has evolved because membership can increase the chances of survival for individuals and their

- **Standard SCI.CC2**: Students use science and engineering practices, disciplinary core ideas, and cause and effect relationships to make sense of phenomena and solve problems.
- **Standard SCI.CC3**: Students use science and engineering practices, disciplinary core ideas, and an understanding of scale, proportion, and quantity to make sense of phenomena and solve problems.
- **Standard SCI.CC4:** Students use science and engineering practices, disciplinary core ideas, and an understanding of systems and system models to make sense of phenomena and solve problems.
- **Standard SCI.CC5**: Students use science and engineering practices, disciplinary core ideas, and an understanding of energy and matter to make sense of phenomena and solve problems.
- **Standard SCI.CC6**: Students use science and engineering practices, disciplinary core ideas, and an understanding of structure and function to make sense of phenomena and solve problems.
- **Standard SCI.CC7**: Students use science and engineering practices, disciplinary core ideas, and an understanding of stability and change to make sense of phenomena and solve problems.

- **Standard SCI.SEP2:** Students develop and use models, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.
- **Standard SCI.SEP3**: Students plan and conduct investigations, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.
- **Standard SCI.SEP4**: Students analyze and interpret data, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.
- **Standard SCI.SEP5**: Students use mathematics and computational thinking, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.
- **Standard SCI.SEP6**: Students construct explanations and design solutions, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.
- **Standard SCI.SEP7:** Students engage in argument from evidence, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.
- **Standard SCI.SEP8:** Students obtain, evaluate, and communicate information, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.

genetic relatives.

- **ORGANIZATION FOR MATTER AND ENERGY FLOW IN ORGANISMS:** The molecules produced through photosynthesis are used to make amino acids and other molecules that can be assembled into proteins or DNA. Through cellular respiration, matter and energy flow through different organizational levels of an organism as elements are recombined to form different products and transfer energy.
- **VARIATION OF TRAITS:** The variation and distribution of traits in a population depend on genetic and environmental factors. Genetic variation can result from mutations caused by environmental factors or errors in DNA replication, or from chromosomes swapping sections during meiosis.
- **NATURAL SELECTION:** Natural selection occurs only if there is variation in the genes and traits between organisms in a population. Traits that positively affect survival can become more common in a population.
- **INTERDEPENDENT RELATIONSHIPS IN ECOSYSTEMS:** Ecosystems have carrying capacities resulting from biotic and abiotic factors. The fundamental tension between resource availability and organism populations affects the abundance of species in any given ecosystem. The combination of the factors that affect an organism's success can be measured as a multidimensional niche.
- **ADAPTATION:** Evolution results primarily from genetic variation of individuals in a species, competition for resources, and proliferation of organisms better able to survive and reproduce. Adaptation means that the distribution of traits in a population, as well as species expansion, emergence, or extinction, can change when conditions

		change. ➔ **GROWTH AND DEVELOPMENT OF ORGANISMS:** Growth and division of cells in organisms occurs by mitosis and differentiation for specific cell types. ➔ **EVIDENCE OF COMMON ANCESTRY AND DIVERSITY:** The ongoing branching that produces multiple lines of descent can be inferred by comparing DNA sequences, amino acid sequences, and anatomical and embryological evidence of different organisms. ➔ **ORGANIZATION FOR MATTER AND ENERGY FLOW IN ORGANISMS:** The molecules produced through photosynthesis are used to make amino acids and other molecules that can be assembled into proteins or DNA. Through cellular respiration, matter and energy flow through different organizational levels of an organism as elements are recombined to form different products and transfer energy.

3 DIMENSIONAL LEARNING TARGETS

- ➔ HS-LS1-2. **Develop and use a model** to illustrate the hierarchical organization of **interacting systems** that provide specific functions within multicellular organisms.
- ➔ HS-LS1-5 **Use a model** to illustrate how **photosynthesis transforms light energy into stored chemical energy.**
- ➔ **HS-LS1-6 Construct and revise an explanation based on evidence** for how **carbon, hydrogen, and oxygen from sugar** molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
- ➔ HS-LS1-7 **Use a model** to illustrate that **cellular respiration is a chemical process** whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a **net transfer of energy**.
- ➔ LS2-2 **Use mathematical representations to support and revise explanations** based on evidence about factors **affecting biodiversity and populations** in ecosystems of different scales.
- ➔ LS2-3 **Construct and revise an explanation based on evidence** for the cycling of matter and flow of energy **in aerobic and anaerobic conditions.**
- ➔ LS2-4 **Use mathematical representations to support claims** for the **cycling of matter and flow of energy** among organisms in an ecosystem.
- ➔ LS2-5 **Develop a model** to illustrate the **role of photosynthesis and cellular respiration** in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
- ➔ LS2-8 **Evaluate the evidence** for the **role of group behavior** on individual and species' chances to survive and reproduce.
- ➔ LS3-3 **Apply concepts of statistics and probability** to **explain the variation and distribution of expressed traits** in a population.
- ➔ 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.

- ➔ 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.
- ➔ **LS4-4 Construct an explanation based on evidence** for how **natural selection** leads to adaptation of populations.

Extensions Learning Targets may include:

- ➔ In this unit, the central aim is to transcend basic learning targets by fostering deeper understanding, critical thinking, and creativity. We will challenge students to apply knowledge in varied contexts, analyze intricate problems, and synthesize information to generate original solutions. The overarching objective is to inspire learners to surpass expectations, equipping them with the skills and mindset crucial for lifelong learning and success.

ASSESSMENT EVIDENCE

Performance is evaluated in terms of… Students will show their learning by…

Performance Task Description(s):

- ➔ LS2.D Why do some animals live in groups?
  - ◆ HS-LS2-2 Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
  - ◆ HS-LS2-8 Evaluate evidence for the role of group behavior on individual and species' chances to survive and reproduce.
- ➔ LS1.C How do animals obtain the energy they need?
  - ◆ 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 new ecosystem.
  - ◆ HS-LS2-7 Evaluate evidence for the role of group behavior on individual and species' chances to survive and reproduce.
- ➔ LS3.B/LS4.B How do populations change over time?
  - ◆ 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-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.
- ➔ LS2.A/LS4.C How can species live together?
  - ◆ HS-LS2-2 Use mathematical representation to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
  - ◆ HS-LS4-3 Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.
- ➔ LS1.B/LS1.C How do organisms grow and develop?
  - ◆ HS-LS1-2 Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
  - ◆ HS-LS1-5 Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
  - ◆ HS-LS1-6 Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.

Success Criteria Rubrics

- ➔ Standards-aligned rubrics are used for communicating the success criteria, goal setting, reflecting during & after the unit learning, and feedback.

Key Feedback & Assessment Strategies *(What are different ways students can demonstrate their learning?)**:***

- ◆ *Conferring/Strategy Groups: Use current evidence of standards & learning targets, feedback is scaffolded based on student strengths, needs, and goals.*
- ◆ *Assessment of Unit Skills- Examples for Targeted Data Collection*
  - *Driving Question Board to gather background knowledge and activate prior knowledge*
  - *Student evidence notebooks: focus notes, CER argument writing, model & model revisions*

- *Checks for understanding (exit slips, quickwrites, etc.) aligned to unit guiding questions*
- *Lab analysis questions and write-ups*
- *Assess unit vocabulary termsAssess key unit concepts (Unit summative assessment)*
- *Evaluate student investigation tasks*
-

➔ *Extensions & College/Career Readiness may include:*

- All lessons: Remove scaffolds provided with Science and Engineering Practices as a way to give students more independent work with the elements of these practices.

The above is not an exhaustive list but shows the possible strategies & tasks that provide meaningful student evidence of learning.

Homeostasis Phenomena

In this unit, students will explore key biological concepts through the lens of homeostasis, using the phenomenon of kelp, urchins, otters, and orcas in the Pacific Northwest as a focal point. They will investigate how organisms maintain internal stability of changing external conditions, considering factors such as keystone species, abiotic vs. biotic factors, natural selection, cycling of matter, ocean acidification, and cell transport. Students will look at the role of otters as keystone species in Pacific Northwest ecosystems, examining how their presence influences the abundance and distribution of other species within their habitats. They will analyze the interplay between abiotic factors like temperature, water chemistry, and biotic factors such as prey availability and predator interactions in shaping otter populations and ecosystem dynamics. Throughout the unit, students will explore the mechanisms of natural selection and adaptation, considering how otters have evolved physiological and behavioral traits to thrive in their environment. They will investigate how genetic variation, heritability, and environmental pressures contribute to changes in otter populations over time. Furthermore, students will investigate the cycling of matter within Pacific Northwest ecosystems, focusing on nutrient cycling in aquatic environments and the impacts of ocean acidification on marine organisms. They will explore how changes in pH levels affect the availability of essential nutrients and the physiology of marine organisms, including otters. Additionally, students will examine cellular processes related to homeostasis, such as cell transport mechanisms that regulate internal balance and respond to external stimuli. They will explore how cells maintain osmotic balance, regulate ion concentrations, and transport molecules across membranes to support cellular functions and organismal homeostasis. Through hands-on investigations, data analysis, and critical thinking activities, students will deepen their understanding of these biological concepts and their interconnectedness within Pacific Northwest ecosystems. They will apply their knowledge to real-world scenarios, considering the implications of environmental changes on otter populations, ecosystem health, and conservation efforts in the region.

DESIRED RESULTS

ESSENTIAL QUESTION:

- ➔ *LS2.A How are organisms interdependent within their environment?*
- ➔ *LD4.D How have humans impacted the ecosystem and its communities?*
- ➔ *LS2.B How does homeostasis maintain balance in ecosystems?*
- ➔ *LS1.A How does homeostasis maintain balance in organisms?*
- ➔ *LS1.A How does homeostasis maintain balance in cells?*

UNIT PRIORITY STANDARDS: *Students will know and be able to…*

Cross Cutting Concepts	*Science & Engineering Practices (SEP)*	*Disciplinary Core Idea (DCI)*
➔ **Standard SCI.CC1**: Students use science and engineering practices, disciplinary	➔ **Standard SCI.SEP1**: Students ask questions and define problems, in conjunction with	➔ **STRUCTURE & FUNCTION:** Systems of specialized cells within organisms help

core ideas, and patterns to make sense of phenomena and solve problems.

- **Standard SCI.CC2**: Students use science and engineering practices, disciplinary core ideas, and cause and effect relationships to make sense of phenomena and solve problems.
- **Standard SCI.CC3**: Students use science and engineering practices, disciplinary core ideas, and an understanding of scale, proportion, and quantity to make sense of phenomena and solve problems.
- **Standard SCI.CC4:** Students use science and engineering practices, disciplinary core ideas, and an understanding of systems and system models to make sense of phenomena and solve problems.
- **Standard SCI.CC5**: Students use science and engineering practices, disciplinary core ideas, and an understanding of energy and matter to make sense of phenomena and solve problems.
- **Standard SCI.CC6**: Students use science and engineering practices, disciplinary core ideas, and an understanding of structure and function to make sense of phenomena and solve problems.
- **Standard SCI.CC7**: Students use science and engineering practices, disciplinary core ideas, and an understanding of stability and change to make sense of phenomena and solve problems.

using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.

- **Standard SCI.SEP2:** Students develop and use models, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.
- **Standard SCI.SEP3**: Students plan and conduct investigations, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.
- **Standard SCI.SEP4**: Students analyze and interpret data, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.
- **Standard SCI.SEP5**: Students use mathematics and computational thinking, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.
- **Standard SCI.SEP6**: Students construct explanations and design solutions, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.
- **Standard SCI.SEP7:** Students engage in argument from evidence, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.
- **Standard SCI.SEP8:** Students obtain, evaluate, and communicate information, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve

perform essential functions of life. Any one system in an organism is made up of numerous parts. Feedback mechanisms maintain an organism's internal conditions within certain limits and mediate behaviors.

- **INTERDEPENDENT RELATIONSHIPS IN ECOSYSTEMS:** Ecosystems have carrying capacities resulting from biotic and abiotic factors. The fundamental tension between resource availability and organism populations affects the abundance of species in any given ecosystem. The combination of the factors that affect an organism's success can be measured as a multidimensional niche.
- **CYCLES OF MATTER AND ENERGY TRANSFER IN ECOSYSTEMS**: Photosynthesis and cellular respiration provide most of the energy for life processes. Only a fraction of matter consumed at the lower level of a food web is transferred up, resulting in fewer organisms at higher levels. At each link in an ecosystem, elements are combined in different ways, and matter and energy are conserved. Photosynthesis and cellular respiration are key components of the global carbon cycle.
- **ECOSYSTEMS DYNAMICS, FUNCTIONING, AND RESILIENCE**: If a biological or physical disturbance to an ecosystem occurs, including one induced by human activity, the ecosystem may return to its more or less original state or become a very different ecosystem, depending on the complex set of interactions within the ecosystem.

	problems.	➔ **INHERITANCE OF TRAITS:** DNA carries instructions for forming species' characteristics. Each cell in an organism has the same genetic content, but genes expressed by cells can differ. ➔ **NATURAL SELECTION**: Natural selection occurs only if there is variation in the genes and traits between organisms in a population. Traits that positively affect survival can become more common in a population. ➔ **ADAPTATION**: Evolution results primarily from genetic variation of individuals in a species, competition for resources, and proliferation of organisms better able to survive and reproduce. Adaptation means that the distribution of traits in a population, as well as species expansion, emergence, or extinction, can change when conditions change.

3 DIMENSIONAL LEARNING TARGETS

- ➔ HS-LS3-1. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
- ➔ HS-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and (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.

ASSESSMENT EVIDENCE

Performance is evaluated in terms of… Students will show their learning by…

Performance Task Description(s):

- ➔ *LS2.A How are organisms interdependent within their environment?*
  - ◆ *HS-LS2-1 Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.*
  - ◆ *HS-LS2-2 Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.*
- ➔ *LS4.D How have humans impacted the ecosystem and its communities?*
  - ◆ *HS-LS2-7 Design, evaluate and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*
  - ◆ *HS-L24-6 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.

- ➔ *LS2.B How does homeostasis maintain balance in ecosystems?*
  - ◆ *HS-LS2-3 Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.*
  - ◆ *HS-LS2-4 Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.*
  - ◆ *HS-LS2-5 Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere and geosphere.*
- ➔ *LS1.A How does homeostasis maintain balance in organisms?*
  - ◆ *HS-LS1-2 Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.*
  - ◆ *HS-LS1-3 Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.*
  - ◆ *HS-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.*
- ➔ *LS1.A How does homeostasis maintain balance in cells?*
  - ◆ *HS-LS1-2 Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.*
  - ◆ *HS-LS1-3 Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.*
  - ◆ *HS-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.*

Success Criteria Rubrics

- ➔ Standards-aligned rubrics are used for communicating the success criteria, goal setting, reflecting during & after the unit learning, and feedback.

Key Feedback & Assessment Strategies *(What are different ways students can demonstrate their learning?)**:***

- ◆ *Conferring/Strategy Groups: Use current evidence of standards & learning targets, feedback is scaffolded based on student strengths, needs, and goals.*
- ◆ *Assessment of Unit Skills- Examples for Targeted Data Collection*
  - *Driving Question Board to gather background knowledge and activate prior knowledge*
  - *Student evidence notebooks: focus notes, CER argument writing, model & model revisions*
  - *Checks for understanding (exit slips, quickwrites, etc.) aligned to unit guiding questions*
  - *Lab analysis questions and write-ups*
  - *Progress tracker*
  - *Assess unit vocabulary terms*
  - *Evaluate student investigation tasks*
  - *Assess key unit concepts (Unit summative assessment)*

- ➔ *Extensions & College/Career Readiness may include:*
  - ◆ All lessons: Remove scaffolds provided with Science and Engineering Practices as a way to give students more independent work with the elements of these practices.

The above is not an exhaustive list but shows the possible strategies & tasks that provide meaningful student evidence of learning.

Melanin

In this unit, students will explore how melanin, a pigment responsible for skin, hair, and eye color, is inherited and expressed in individuals across generations, through the lens of genetics, and heredity. Students will investigate pedigrees, visual representations of genetic inheritance patterns within families, to analyze the transmission of traits related to melanin production. They will use Punnett squares to predict the outcomes of genetic crosses and explore the principles of Mendelian genetics underlying melanin inheritance. Furthermore, students will explore the central dogma of molecular biology, elucidating the processes of DNA replication, transcription, and translation involved in protein synthesis. They will investigate how genetic information encoded in DNA directs the production of melanin and other proteins essential for cellular function and organismal development. Additionally, students will examine the role of natural selection in shaping melanin-related traits in populations over time. They will explore how environmental factors, such as UV radiation and climate, influence the frequency of melanin-associated alleles and contribute to adaptation and evolutionary change. Through hands-on activities, data analysis, and inquiry-based investigations, students will deepen their understanding of melanin genetics and its implications for human variation and evolution. They will apply their knowledge to real-world scenarios, considering the social, cultural, and scientific implications of melanin-related traits in diverse populations

Melanin
DESIRED RESULTS

ESSENTIAL QUESTION:

- ➔ *LS3.A How do traits occur in organisms?*
- ➔ *LS3.B What makes one trait different from another trait?*
- ➔ *LS1.A How are proteins used by organisms?*
- ➔ *LS4.B/LS4.C How do genotype and phenotype impact natural selection?*

UNIT PRIORITY STANDARDS: *Students will know and be able to…*

Cross Cutting Concepts	*Science & Engineering Practices (SEP)*	*Disciplinary Core Idea (DCI)*
➔ **Standard SCI.CC1**: Students use science and engineering practices, disciplinary core ideas, and patterns to make sense of phenomena and solve problems. ➔ **Standard SCI.CC2**: Students use science and engineering practices, disciplinary core ideas, and cause and effect relationships to make sense of phenomena and solve problems.	➔ **Standard SCI.SEP1**: Students ask questions and define problems, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP2:** Students develop and use models, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and	➔ **STRUCTURE & FUNCTION:** Systems of specialized cells within organisms help perform essential functions of life. Any one system in an organism is made up of numerous parts. Feedback mechanisms maintain an organism's internal conditions within certain limits and mediate behaviors.

- **Standard SCI.CC3**: Students use science and engineering practices, disciplinary core ideas, and an understanding of scale, proportion, and quantity to make sense of phenomena and solve problems.
- **Standard SCI.CC4:** Students use science and engineering practices, disciplinary core ideas, and an understanding of systems and system models to make sense of phenomena and solve problems.
- **Standard SCI.CC5**: Students use science and engineering practices, disciplinary core ideas, and an understanding of energy and matter to make sense of phenomena and solve problems.
- **Standard SCI.CC6**: Students use science and engineering practices, disciplinary core ideas, and an understanding of structure and function to make sense of phenomena and solve problems.
- **Standard SCI.CC7**: Students use science and engineering practices, disciplinary core ideas, and an understanding of stability and change to make sense of phenomena and solve problems.

solve problems.

- **Standard SCI.SEP3**: Students plan and conduct investigations, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.
- **Standard SCI.SEP4**: Students analyze and interpret data, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.
- **Standard SCI.SEP5**: Students use mathematics and computational thinking, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.
- **Standard SCI.SEP6**: Students construct explanations and design solutions, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.
- **Standard SCI.SEP7:** Students engage in argument from evidence, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.
- **Standard SCI.SEP8:** Students obtain, evaluate, and communicate information, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.

- **SOCIAL INTERACTIONS AND GROUP BEHAVIOR**: Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives.
- **INHERITANCE OF TRAITS:** DNA carries instructions for forming species' characteristics. Each cell in an organism has the same genetic content, but genes expressed by cells can differ.
- **VARIATION OF TRAITS**: The variation and distribution of traits in a population depend on genetic and environmental factors. Genetic variation can result from mutations caused by environmental factors or errors in DNA replication, or from chromosomes swapping sections during meiosis.
- **ECOSYSTEMS DYNAMICS, FUNCTIONING, AND RESILIENCE**: If a biological or physical disturbance to an ecosystem occurs, including one induced by human activity, the ecosystem may return to its more or less original state or become a very different ecosystem, depending on the complex set of interactions within the ecosystem.
- **NATURAL SELECTION**: Natural selection occurs only if there is variation in the genes and traits between organisms in a population. Traits that positively affect survival can become more common in a population.
- **ADAPTATION**: Evolution results primarily from genetic variation of individuals in a species, competition for resources, and proliferation of organisms better able to survive and reproduce. Adaptation means

		that the distribution of traits in a population, as well as species expansion, emergence, or extinction, can change when conditions change.

3 DIMENSIONAL LEARNING TARGETS

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

ASSESSMENT EVIDENCE

Performance is evaluated in terms of… Students will show their learning by…

Performance Task Description(s):

- *LS3.A How do traits occur in 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.*
- *LS3.B What makes one trait different from another trait?*
  - *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.*
- *LS1.A How are proteins used by organisms?*
  - *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-LS1-3 Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.*
- *LS4.B/LS4.C How do genotype and phenotype impact natural selection?*
  - *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-LS3-3 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-LS3-4 Construct an explanation based on evidence for how natural selection leads to adaptation of populations.*

Success Criteria Rubrics

- Standards-aligned rubrics are used for communicating the success criteria, goal setting, reflecting during & after the unit learning, and

feedback.

Key Feedback & Assessment Strategies *(What are different ways students can demonstrate their learning?)**:***

- *Conferring/Strategy Groups: Use current evidence of standards & learning targets, feedback is scaffolded based on student strengths, needs, and goals.*
- *Assessment of Unit Skills- Examples for Targeted Data Collection*
  - *Driving Question Board to gather background knowledge and activate prior knowledge*
  - *Student evidence notebooks: focus notes, CER argument writing, model & model revisions*
  - *Checks for understanding (exit slips, quickwrites, etc.) aligned to unit guiding questions*
  - *Lab analysis questions and write-ups*
  - *Progress tracker*
  - *Assess unit vocabulary terms*
  - *Evaluate student investigation tasks*
  - *Assess key unit concepts (Unit summative assessment)*

➔ *Extensions & College/Career Readiness may include:*

- All lessons: Remove scaffolds provided with Science and Engineering Practices as a way to give students more independent work with the elements of these practices.

The above is not an exhaustive list but shows the possible strategies & tasks that provide meaningful student evidence of learning.

Disease storyline

In this unit, students will explore the dynamics of disease throughout life, with a focus on cancer, cell cycle regulation, mitosis, and meiosis. Students will investigate the underlying mechanisms of cancer development and progression, considering factors such as genetic mutations, abnormal cell proliferation, and tumor formation. Students will explore the cell cycle, examining the phases of interphase, mitosis, and cytokinesis. They will explore how the cell cycle is regulated to ensure accurate DNA replication and division, and how disruptions in this regulation can lead to uncontrolled cell growth characteristic of cancer. Furthermore, students will explore the process of mitosis, the division of a single cell into two genetically identical daughter cells. They will investigate the stages of mitosis, including prophase, metaphase, anaphase, and telophase, and the role of checkpoints in ensuring the fidelity of chromosome segregation. Additionally, students will examine meiosis, the specialized cell division process that produces gametes with half the chromosome number of the parent cell. They will explore the phases of meiosis, including homologous chromosome pairing, crossing over, and independent assortment, and their significance in generating genetic diversity. Through hands-on activities, data analysis, and inquiry-based investigations, students will deepen their understanding of disease mechanisms and their cellular basis. They will explore how genetic and environmental factors influence disease susceptibility, and they will analyze real-world case studies to understand the societal and ethical implications of disease research and treatment.

Disease DESIRED RESULTS

ESSENTIAL QUESTION:

- ➔ *LS1B: How are cancer cells different from normal cells?*
- ➔ *LS1.A/LS1.B: How and when do normal and cancer cells divide?*
- ➔ *LS3.B: How does each cell get its own copy of DNA?*
- ➔ *LS3.A: How does a gene help regulate the cell cycle?*
- ➔ *LS3.B: How can mutations be passed to future generations?*

UNIT PRIORITY STANDARDS: *Students will know and be able to…*

Cross Cutting Concepts	*Science & Engineering Practices (SEP)*	*Disciplinary Core Idea (DCI)*
➔ **Standard SCI.CC1**: Students use science and engineering practices, disciplinary core ideas, and patterns to make sense of phenomena and solve problems. ➔ **Standard SCI.CC2**: Students use science and engineering practices, disciplinary core ideas, and cause and effect	➔ **Standard SCI.SEP1**: Students ask questions and define problems, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP2:** Students develop and use models, in conjunction with using crosscutting concepts and disciplinary core	➔ **STRUCTURE & FUNCTION:** Systems of specialized cells within organisms help perform essential functions of life. Any one system in an organism is made up of numerous parts. Feedback mechanisms maintain an organism's internal conditions within certain limits and mediate behaviors.

relationships to make sense of phenomena and solve problems.

- **Standard SCI.CC3**: Students use science and engineering practices, disciplinary core ideas, and an understanding of scale, proportion, and quantity to make sense of phenomena and solve problems.
- **Standard SCI.CC4:** Students use science and engineering practices, disciplinary core ideas, and an understanding of systems and system models to make sense of phenomena and solve problems.
- **Standard SCI.CC5**: Students use science and engineering practices, disciplinary core ideas, and an understanding of energy and matter to make sense of phenomena and solve problems.
- **Standard SCI.CC6**: Students use science and engineering practices, disciplinary core ideas, and an understanding of structure and function to make sense of phenomena and solve problems.
- **Standard SCI.CC7**: Students use science and engineering practices, disciplinary core ideas, and an understanding of stability and change to make sense of phenomena and solve problems.

ideas, to make sense of phenomena and solve problems.

- **Standard SCI.SEP3**: Students plan and conduct investigations, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.
- **Standard SCI.SEP4**: Students analyze and interpret data, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.
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- **Standard SCI.SEP7:** Students engage in argument from evidence, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.
- **Standard SCI.SEP8:** Students obtain, evaluate, and communicate information, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.

- **GROWTH AND DEVELOPMENT OF ORGANISMS:** Growth and division of cells in organisms occurs by mitosis and differentiation for specific cell types.
- **INFORMATION PROCESSING:** Organisms can process and store a variety of information through specific chemicals and interconnected networks.
- **INHERITANCE OF TRAITS:** DNA carries instructions for forming species' characteristics. Each cell in an organism has the same genetic content, but genes expressed by cells can differ.
- **VARIATION OF TRAITS**: The variation and distribution of traits in a population depend on genetic and environmental factors. Genetic variation can result from mutations caused by environmental factors or errors in DNA replication, or from chromosomes swapping sections during meiosis.

3 DIMENSIONAL LEARNING TARGETS

- 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.

Disease ASSESSMENT EVIDENCE

Performance is evaluated in terms of… Students will show their learning by…

Performance Task Description(s):

Given an authentic scenario, students will provide evidence of learning in the following:

- ➔ *LS1B: How are cancer cells different from normal cells?*
- ➔ *LS1.A/LS1.B: How and when do normal and cancer cells divide?*
  - ◆ *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-LS1-3 Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.*
  - ◆ *HS-LS1-4 Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.*
- ➔ *LS3.B: How does each cell get its own copy of DNA?*
- ➔ *LS3.A: How does a gene help regulate the cell cycle?*
- ➔ *LS3.B: How can mutations be passed to future generations?*
  - ◆ *HS-LS3-1 Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.*
  - ◆ *HS-LS3-2 Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.*

Success Criteria Rubrics

- ➔ Standards-aligned rubrics are used for communicating the success criteria, goal setting, reflecting during & after the unit learning, and feedback. (Rubric links- TBD)

Key Feedback & Assessment Strategies *(What are different ways students can demonstrate their learning?)**:***

- ◆ *Conferring/Strategy Groups: Use current evidence of standards & learning targets, feedback is scaffolded based on student strengths, needs, and goals.*
- ◆ *Assessment of Unit Skills- Examples for Targeted Data Collection*
  - *Driving Question Board to gather background knowledge and activate prior knowledge*
  - *Student evidence notebooks: focus notes, CER argument writing, model & model revisions*
  - *Checks for understanding (exit slips, quickwrites, etc.) aligned to unit guiding questions*
  - *Lab analysis questions and write-ups*
  - *Progress tracker*
  - *Assess unit vocabulary terms*
  - *Evaluate student investigation tasks*

- *Assess key unit concepts (Unit summative assessment)*

➔ *Extensions & College/Career Readiness may include:*

- All lessons: Remove scaffolds provided with Science and Engineering Practices as a way to give students more independent work with the elements of these practices.

The above is not an exhaustive list but shows the possible strategies & tasks that provide meaningful student evidence of learning.

Penguin storyline

In this unit, students will explore the world of penguins, investigating their biology, behavior, and conservation through the lens of phylogenetics, HIPPO factors (Habitat Destruction, Invasive Species, Pollution, Population, Overharvesting), and population modeling. Students will analyze the evolutionary history of penguins using phylogenetic analyses to understand their relationships with other similar species and how they have adapted to their environments over time. Furthermore, students will examine the HIPPO framework, considering the threats facing penguin populations worldwide. They will investigate habitat destruction, invasive species, pollution, population dynamics, and overharvesting, assessing how these factors impact penguin habitats and populations. Students will design a plan to help protect the penguins from going extinct. Additionally, students will study population modeling, utilizing mathematical and computational tools to simulate and analyze changes in penguin populations over time. They will explore concepts such as population growth, carrying capacity, and demographic parameters to understand the dynamics of penguin populations and predict future trends. Through hands-on activities, data analysis, and inquiry-based investigations, students will deepen their understanding of penguin biology, ecology, and conservation. They will explore real-world case studies to assess the effectiveness of conservation strategies and develop innovative solutions to mitigate threats to penguin populations.

Penguin DESIRED RESULTS

ESSENTIAL QUESTION:

- ➔ *LS4.A: Does geography affect common ancestry?*
- ➔ *LS4.A: How does DNA serve as evidence for common ancestry?*
- ➔ *LS2.D/LS4.D: How do human actions affect species?*
- ➔ *LS4.D: How do human actions impact native species?*
- ➔ *LS3.B: What is the importance of genetic diversity?*
- ➔ *LS3.B: How do populations change over time?*
- ➔ *LS4.D/ETS1.B: How do humans maintain genetic diversity in managed populations?*

UNIT PRIORITY STANDARDS: *Students will know and be able to…*

Cross Cutting Concepts	*Science & Engineering Practices (SEP)*	*Disciplinary Core Idea (DCI)*
➔ **Standard SCI.CC1**: Students use science and engineering practices, disciplinary core ideas, and patterns to make sense of phenomena and solve problems. ➔ **Standard SCI.CC2**: Students use science and engineering practices, disciplinary	➔ **Standard SCI.SEP1**: Students ask questions and define problems, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP2:** Students develop and	➔ **GROWTH AND DEVELOPMENT OF ORGANISMS:** Growth and division of cells in organisms occurs by mitosis and differentiation for specific cell types.

core ideas, and cause and effect relationships to make sense of phenomena and solve problems. ➔ **Standard SCI.CC3**: Students use science and engineering practices, disciplinary core ideas, and an understanding of scale, proportion, and quantity to make sense of phenomena and solve problems. ➔ **Standard SCI.CC4:** Students use science and engineering practices, disciplinary core ideas, and an understanding of systems and system models to make sense of phenomena and solve problems. ➔ **Standard SCI.CC5**: Students use science and engineering practices, disciplinary core ideas, and an understanding of energy and matter to make sense of phenomena and solve problems. ➔ **Standard SCI.CC6**: Students use science and engineering practices, disciplinary core ideas, and an understanding of structure and function to make sense of phenomena and solve problems. ➔ **Standard SCI.CC7**: Students use science and engineering practices, disciplinary core ideas, and an understanding of stability and change to make sense of phenomena and solve problems.	use models, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP3**: Students plan and conduct investigations, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP4**: Students analyze and interpret data, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP5**: Students use mathematics and computational thinking, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP6**: Students construct explanations and design solutions, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP7:** Students engage in argument from evidence, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP8:** Students obtain, evaluate, and communicate information, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.	➔ **ORGANIZATION FOR MATTER AND ENERGY FLOW IN ORGANISMS**: The molecules produced through photosynthesis are used to make amino acids and other molecules that can be assembled into proteins or DNA. Through cellular respiration, matter and energy flow through different organizational levels of an organism as elements are recombined to form different products and transfer energy. ➔ **BIODIVERSITY AND HUMANS**: Biodiversity is increased by formation of new species and reduced by extinction. Humans depend on biodiversity but also have adverse impacts on it. Sustaining biodiversity is essential to supporting life on Earth. ➔ **ORGANIZATION FOR MATTER AND ENERGY FLOW IN ORGANISMS:** The molecules produced through photosynthesis are used to make amino acids and other molecules that can be assembled into proteins or DNA. Through cellular respiration, matter and energy flow through different organizational levels of an organism as elements are recombined to form different products and transfer energy.

3 DIMENSIONAL LEARNING TARGETS

- ➔ 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.

Penguin ASSESSMENT EVIDENCE

Performance is evaluated in terms of… Students will show their learning by…

Performance Task Description(s):

- ➔ *LS4.A: Does geography affect common ancestry?*
- ➔ *LS4.A: How does DNA serve as evidence for common ancestry?*
  - ◆ *HS-LS4-1 Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.*
- ➔ *LS2.D/LS4.D: How do human actions affect species?*
- ➔ *LS4.D: How do human actions impact native species?*
  - ◆ *HS-LS2-7 Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*
  - ◆ *HS-LS4-5 Evaluate the evidence supporting claims that changes in the environmental conditions may result in (1) increases in the numbers of individuals in 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.*
- ➔ *LS3.B: What is the importance of genetic diversity?*
- ➔ *LS3.B: How do populations change over time?*
  - ◆ *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.*
- ➔ *LS4.D/ETS1.B: How do humans maintain genetic diversity in managed populations?*
  - ◆ *HS-LS4-6 Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.*
  - ◆ *HS-ETS3-2 Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost benefit ratios.*
  - ◆ *HS-ETS3-4 Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*

Success Criteria Rubrics

- ➔ Standards-aligned rubrics are used for communicating the success criteria, goal setting, reflecting during & after the unit learning, and feedback.

Key Feedback & Assessment Strategies *(What are different ways students can demonstrate their learning?)**:***

- ◆ *Conferring/Strategy Groups: Use current evidence of standards & learning targets, feedback is scaffolded based on student*

strengths, needs, and goals.

- ◆ *Assessment of Unit Skills- Examples for Targeted Data Collection*
  - *Driving Question Board to gather background knowledge and activate prior knowledge*
  - *Student evidence notebooks: focus notes, CER argument writing, model & model revisions*
  - *Checks for understanding (exit slips, quickwrites, etc.) aligned to unit guiding questions*
  - *Lab analysis questions and write-ups*
  - *Progress tracker*
  - *Assess unit vocabulary terms*
  - *Evaluate student investigation tasks*
  - *Assess key unit concepts (Unit summative assessment)*

➔ *Extensions & College/Career Readiness may include:*

- ◆ All lessons: Remove scaffolds provided with Science and Engineering Practices as a way to give students more independent work with the elements of these practices.

The above is not an exhaustive list but shows the possible strategies & tasks that provide meaningful student evidence of learning.

Dog Storyline

In this unit, students will explore the world of dogs, investigating their biology, behavior, and diversity through the lens of biogeography, artificial selection, and mapping genes. Students will analyze the distribution and evolution of dog breeds using principles of biogeography, examining how geographical factors have shaped the diversity of canine populations worldwide. Furthermore, students will examine the process of artificial selection, exploring how humans have selectively bred dogs for specific traits over generations. They will investigate the genetic basis of breed characteristics, considering how genetic variation and inheritance patterns contribute to the diversity of dog breeds. Additionally, students will study the mapping of genes in dogs, using genetic techniques to identify and characterize genes associated with traits such as size, coat color, and behavior. They will explore how advances in genomics and bioinformatics have revolutionized our understanding of canine genetics and facilitated the development of genetic testing and breeding strategies. Through hands-on activities, data analysis, and inquiry-based investigations, students will deepen their understanding of dog biology, genetics, and evolution. They will explore real-world case studies to evaluate the ethical implications of artificial selection and genetic manipulation in dog breeding, considering the welfare of dogs and the conservation of genetic diversity.

Dog DESIRED RESULTS

ESSENTIAL QUESTION:

- ➔ *LS4.A What are types of evidence to show common ancestry?*
- ➔ *LS4.B/LS4.C: How does artificial selection change phenotypes over time?*
- ➔ *LS3.A: Why is genetic variation needed for evolution?*

UNIT PRIORITY STANDARDS: *Students will know and be able to…*

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core ideas, and an understanding of scale, proportion, and quantity to make sense of phenomena and solve problems.

- **Standard SCI.CC4:** Students use science and engineering practices, disciplinary core ideas, and an understanding of systems and system models to make sense of phenomena and solve problems.
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inferred by comparing DNA sequences, amino acid sequences, and anatomical and embryological evidence of different organisms.

- **NATURAL SELECTION**: Natural selection occurs only if there is variation in the genes and traits between organisms in a population. Traits that positively affect survival can become more common in a population.
- **ADAPTATION**: Evolution results primarily from genetic variation of individuals in a species, competition for resources, and proliferation of organisms better able to survive and reproduce. Adaptation means that the distribution of traits in a population, as well as species expansion, emergence, or extinction, can change when conditions change.
- **BIODIVERSITY AND HUMANS**: Biodiversity is increased by formation of new species and reduced by extinction. Humans depend on biodiversity but also have adverse impacts on it. Sustaining biodiversity is essential to supporting life on Earth.

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  - ◆ *HS-LS4-4 Construct an explanation based on evidence for how natural selection leads to adaptation of populations.*
- ➔ *LS3.A: Why is genetic variation needed for evolution?*
  - ◆ *HS-LS3-1 Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.*
  - ◆ *HS-LS1-4 Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining*
  - ◆ *complex organisms.*

Success Criteria Rubrics

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