Audubon Public Schools

Grade 7: Life Science

Curriculum Guide

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Course Description

Grade 7: Life Science

Life Science is a course designed to allow students to explore the basic concepts of biology. Students will be introduced to the basic unit of life, the cell. Students will explore the structures and functions of the cell and the different types of cells found in nature. Students will be introduced to the fact that traits are controlled by genes and how variation in organisms influence the organisms ability to survive and reproduce. Students will investigate how organisms reproduce and transfer their genetic information to their offspring. Students will explore the interaction of living things with each other and their environments and how human beings assert an influence on organisms ability to survive. Specific topics examined during the year include, but are not limited to, cell theory, cytology, heredity, ecology, evolution, and classification. Students will be encouraged to explore the relationship between science and everyday life with hands on activities. Students enrolled in life science need to have successfully passed 6th.

Overview / Progressions

Grade 8: Physical Science

Overview		Engineering, technology and science	Life Sciences	Physical Sciences
Unit 1	**Molecules to organisms**	MS-ETS 1-1 MS-ETS 1-2 MS-ETS 1-3 MS-ETS 1-4	MS-LS 1-1 MS-LS 1-2 MS-LS 1-3 MS-LS 1-4 MS- LS1-5 MS-LS 1-6 MS-LS 1-7 MS-LS 1-8	
Unit 2	**Interactions, energy and dynamic relationships in ecosystems.**	MS-ETS 1-1 MS-ETS 1-2 MS-ETS 1-3 MS-ETS 1-4	MS-LS 2-1 MS-LS 2-2 MS-LS 2-3 MS-LS 2-4 MS- LS2-5	
Unit 3	**Heredity, inheritance and variation of traits.**	MS-ETS 1-1 MS-ETS 1-2 MS-ETS 1-3 MS-ETS 1-4	MS-LS3-1 MS-LS3-2	
Unit 4	**Biological Evolution: Unity and Diversity**	MS-ETS 1-1 MS-ETS 1-2 MS-ETS 1-3 MS-ETS 1-4	MS-LS4-1 MS-LS4-2 MS-LS4-3 MS-LS4-4 MS-LS4-5	

			MS-LS4-6	

Life Science	Grade 7	Unit 1	Marking Period 1

From Molecules to Organisms: Structures and Processes (45 Instructional Days)	
Overarching Essential Questions	**Overarching Enduring Understandings**
• What is cell theory? • How do environmental and genetic factors affect growth and reproduction of organisms? • How do energy and matter cycle into and out of organisms?	• Living things are made of one or many cells, which are then made up of parts that contribute to their function. • Specific behaviors and structures of organisms, as well as environmental factors and genetic factors, affect the probability of successful reproduction. • Photosynthesis and chemical reactions within organisms help cycle matter and energy into and out of organisms.
Student Learning Objectives	
Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. [Clarification Statement: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living things, and understanding that living things may be made of one cell or many and varied cells.]	**MS-LS1-1**
Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.[Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.] [*Assessment Boundary: Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is*	**MS-LS1-2**

limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.]	
Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. [Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.] [*Assessment Boundary: Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.*]	**MS-LS1-3**
Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively. [Clarification Statement: Examples of behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds, and creating conditions for seed germination and growth. Examples of plant structures could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.]	MS-LS1-4
Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. [Clarification Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.] [*Assessment Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.*]	MS-LS1-5
Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. [Clarification Statement: Emphasis is on tracing movement of matter and flow of energy.] [*Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.*]	MS-LS1-6

Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. [Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.] [*Assessment Boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration.*]	MS-LS1-7
Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. [*Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.*]	MS-LS1-8
Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.	MS-ETS1-1
Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.	MS-ETS1-2
Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.	MS-ETS1-3
Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.	MS-ETS1-4

The Student Learning Objectives above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information OObtaining, evaluating, and communicating information in 6-8 builds on K-5 experiences and progresses to evaluating the merit and validity of ideas and methods. • Gather, read, and synthesize information from multiple	**LS1.A: Structure and Function** • All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (MS-LS1-1)	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS1-8) • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS1-4),(MS-LS1-5) **Scale, Proportion, and Quantity**

appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS-LS1-8) ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** • Science knowledge is based upon logical connections between evidence and explanations. (MS-LS1-6) •	• Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (MS-LS1-2) • In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (MS-LS1-3) **LS1.B: Growth and Development of Organisms** • Animals engage in characteristic behaviors that increase the odds of reproduction. (MS-LS1-4) • Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. (MS-LS1-4) • Genetic factors as well as local conditions affect the growth of the adult plant. (MS-LS1-5) **LS1.C: Organization for Matter and Energy Flow in Organisms** • Plants, algae (including phytoplankton), and many	• Phenomena that can be observed at one scale may not be observable at another scale. (MS-LS1-1) **Systems and System Models** • Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. (MS-LS1-3) **Energy and Matter** • Matter is conserved because atoms are conserved in physical and chemical processes. (MS-LS1-7) • Within a natural system, the transfer of energy drives the motion and/or cycling of matter. (MS-LS1-6) **Structure and Function** • Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS1-2) ***Connections to Engineering,Technology and Applications of Science*** **Interdependence of Science, Engineering, and Technology** • Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (MS-LS1-1)

	microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. (MS-LS1-6) • Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (MS-LS1-7) **LS1.D: Information Processing** • Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. (MS-LS1-8) **PS3.D: Energy in Chemical Processes and Everyday Life**	***Connections to Nature of Science*** **Science is a Human Endeavor** • Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas. (MS-LS1-3)

	• The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. *(secondary to MS-LS1-6)* • Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials.*(secondary to MS-LS1-7)* •	

Embedded English Language Arts/Literacy and Mathematics

ELA/Literacy-

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-3),(MS-LS1-4),(MS-LS1-5),(MS-LS1-6)

RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (MS-LS1-5),(MS-LS1-6)

RI.6.8 Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not. (MSLS1-3),(MS-LS1-4)

WHST.6-8.1 Write arguments focused on discipline content. (MS-LS1-3),(MS-LS1-4)

WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS1-5),(MS-LS1-6)

WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-LS1-1)

WHST.6-8.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-LS1-8)

WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS1-5),(MS-LS1-6)

SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS1-2),(MS-LS1-7)

Mathematics- N/A

Technology-

8.2.8.A.3 Use and/or develop a simulation that provides an environment to solve a real world problem or theory.

8.2.8.A.2 Examine a system, consider how each part relates to other parts, and discuss a part to redesign to improve the system.

Three-Dimensional Teaching and Learning

Cross-Cutting Concepts: Cause and Effect

Students will understand that cause and effect relationships can help predict behaviors and changes within a system. They can also use mathematics to show that some cause and effect relationships can only be described using probability. In any scenerio, students should be able to use sufficient evidence to support a cause and effect argument.

Science and Engineering Practices: Connections to Mathematics/Engaging in Argument from Evidence

To truly understand the likelihood of particular organisms to reproduce successfully and survive certain situations, students must have a strong understanding of probability and a basic understanding of an "if, then" logic statement. Students will build on mathematics of 5th, 6th, and 7th grade to gather and analyze empirical data to support arguments regarding the cycling of energy and matter through a system.

Prior Learning

Life Science- (4th & 5th grade)

- Plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
- Animals receive information through their senses, processes that information in their brains, and responds to that information in different ways.
- Animals get energy from food that was once energy from the sun.

Mathematics-

- Understanding of probability, ratios and rates.
- Solid foundation of fractions, decimals, and percentages.
- Analyzing tables and graphs of data and information.

- **Part A:** What are cells and how do they contribute to the function of an organism?

Concepts	Formative Assessment
• Living things are made of one or more cells.	*Students who understand the concepts are able to:*

● A cell is made up of parts that contribute to the function of the cell as a whole. ● The human body is a system of interacting subsystems composed of groups of cells (i.e., cells make up tissue, tissue make up organs, organs work together to help the body function).	• Create a representation of, identify, and summarize the role of the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall. • STEM: Build and use a model of a system to illustrate how each part of a system contributes to the function of the system as a whole. Students should be able to hypothesize how a system/cell would function differently if it were to be missing an essential part/organelle. • Develop and use models to show that the human body is made up of subsystems of cells. Students should be able to draw comparisons of this system to other systems that are made up of smaller functioning parts (e.g., parts of a bicycle, parts of a computer, parts of the water cycle, parts of a factory). • Create an argument that all of the following are subsystems within a larger system, and that each contribute to the overall function of the organism: circulatory, excretory, digestive, respiratory, muscular, and nervous systems.

Part B: How do environmental and genetic factors affect growth and reproduction of organisms?	
Concepts	**Formative Assessment**
● Certain characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants. ● Environmental factors, such as the availability of food, light, space, and water, influence the growth of organisms. ● Genetic factors, such as the size of the breed, can influence the growth of organisms.	*Students who understand the concepts are able to:* • Support an argument with empirical and anecdotal evidence that an animal or plant with a specialized behavior or structure will have a higher or lower probability of survival or reproductive success. • Lab: Conduct an experiment to reveal how environmental factors can effect the growth of a plant. Students should have a control and an experimental group to compare findings. (e.g.., Student A grows a plant with sufficient light, space, and water. Student B grows the same type of plant but varies the amount of water the plant receives. Students compare results and construct an argument based on their own observations and evidence.) • Analyze and construct and argument of how a particular species of plant or animal has been effected by a particular genetic factor or behavior.

	(e.g., Study how bright flowers attract butterflies or how herding of animals protect young.)

Part C: How do energy and matter cycle into and out of organisms?	
Concepts	**Formative Assessment**
• Photosynthesis is a process that helps cycle matter and energy into and out of organisms. • Chemical reactions help form new molecules from food to support the functioning and growth of organisms. • The brain uses sensory receptors to respond to stimuli and react to a situation by either triggering an immediate behavior or storing the information into memory.	*Students who understand the concepts are able to:* • STEM: Build and illustrate a model of how matter and energy cycle through systems. • Develop a model to show how food molecules are broken apart and put back together through chemical processes that release energy. • Use elodea and Bromthymol blue to design and construct an experiment to determine if elodea consume or release carbon dioxide during photosynthesis. Students should be able to use their observations to support the argument that carbon dioxide is consumed by plants during photosynthesis.

Modifications: *Teachers identify the modifications that they will use in the unit. The unneeded modifications can then be deleted from the list.(See NGSS Appendix D)*

- *Restructure lesson using UDL principals (*http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA*)*
- *Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.*
- *Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).*
- *Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).*
- *Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).*
- *Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.*
- *Use project-based science learning to connect science with observable phenomena.*

- *Structure the learning around explaining or solving a social or community-based issue.*
- *Provide ELL students with multiple literacy strategies.*
- *Collaborate with after-school programs or clubs to extend learning opportunities.*

Leveraging English Language Arts/Literacy and Mathematics

English Language Arts/Literacy-

- Assess the extent to which the reasoning and evidence support certain outcomes.
- Describe the cycling of energy and matter through ecosystems using sequential order, organized text structure, and transitional phrases.
- Comparing models, concepts, and ideas in several texts by different authors and determine their accuracy.
- Pose relevant, specific questions based in fact and elaborate answers by synthesizing text and data and citing textual evidence.

Mathematics-

- Use proportions and ratios to help understand the scale of cells in the body.
- Use tables and graphs of data to analyze how environmental and genetic factors can affect the growth and reproduction of an organism.
- Use empirical evidence to support the idea that an animal or plant with specialized behaviors or structures will have a higher probability of successful reproduction.

Samples of Open Education Resources for this unit:

Khan Academy is a resource for teachers and students alike to gain a deeper, intuitive understanding of science and math concepts.

NSTA Classroom Resources is a website of sample lessons aligned directly with each 7th grade space and Life Science unit.

Brainpop is a website of short mini-lesson videos.

CK-12 is a resource where you can create supplemental content in online "flexbooks" for students aligned with NGSS.

PhET Simulator is a resource of simulations of hundreds of concepts.

Differentiation

504	● preferential seating ● extended time on tests and assignments ● reduced homework or classwork ● verbal, visual, or technology aids	● modified textbooks or audio-video materials ● behavior management support ● adjusted class schedules or grading ● verbal testing
Enrichment	● Utilize collaborative media tools ● Provide differentiated feedback ● Opportunities for reflection	● Encourage student voice and input ● Model close reading ● Distinguish long term and short term goals
IEP	● Utilize “skeleton notes” where some required information is already filled in for the student ● Provide access to a variety of tools for responses ● Provide opportunities to build familiarity and to practice with multiple media tools ● Graphic organizers	● Leveled text and activities that adapt as students build skills ● Provide multiple means of action and expression ● Consider learning styles and interests ● Provide differentiated mentors
ELLs	● Pre-teach new vocabulary and meaning of symbols ● Embed glossaries or definitions ● Provide translations ● Connect new vocabulary to background knowledge	● Provide flash cards ● Incorporate as many learning senses as possible ● Portray structure, relationships, and associations through concept webs ● Graphic organizers
At-risk	● Purposeful seating ● Counselor involvement ● Parent involvement	● Contracts ● Alternate assessments ● Hands-on learning

21st Century Skills	
● Creativity ● Innovation ● Critical Thinking	● Problem Solving ● Communication ● Collaboration
Integrating Technology	
● Chromebooks ● Internet research ● Online programs	● Virtual collaboration and projects ● Presentations using presentation hardware and software

Life Science	Grade 7	Unit 2	Marking Period 2

Interactions, Energy, and Dynamics Relationships in Ecosystems (30 Instructional Days)	
Overarching Essential Questions	**Overarching Enduring Understandings**
• What effect does resource availability have on organisms in an ecosystem? • What patterns of interactions are there among organisms in ecosystems? • How does matter and energy cycle and flow through an ecosystem?	• There is a strong cause and effect relationship between resources and the growth of organisms and groups of organisms. • Patterns of interactions between organisms and abiotic components exist in all types of ecosystems, such as competitive, predatory, and mutually beneficial relationships. • Matter and energy are conserved within the boundaries of a system.
Student Learning Objectives	
Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. [Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.]	**MS-LS2-1**
Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.[Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the	**MS-LS2-2**

relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.]	
Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.[Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.] [*Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.*]	**MS-LS2-3**
Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. [Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]	MS-LS2-4
Evaluate competing design solutions for maintaining biodiversity and ecosystem services.* [Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]	MS-LS2-5
D**efine the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.**	MS- ETS1-1
Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.	MS-ETS1-2
Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.	MS-ETS1-3
Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.	MS-ETS1-4

The Student Learning Objectives above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models	**LS2.A: Interdependent Relationships in Ecosystems**	Patterns • Patterns can be used to identify cause and effect relationships. (MS-LS2-2)

Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop a model to describe phenomena. (MS-LS2-3) **Analyzing and Interpreting Data** Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Analyze and interpret data to provide evidence for phenomena. (MS-LS2-1) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena. (MS-LS2-2) **Engaging in Argument from Evidence** Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims	• Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1) • In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (MS-LS2-1) • Growth of organisms and population increases are limited by access to resources. (MS-LS2-1) • Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (MS-LS2-2)	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS2-1) **Energy and Matter** • The transfer of energy can be tracked as energy flows through a natural system. (MS-LS2-3) **Stability and Change** • Small changes in one part of a system might cause large changes in another part. (MS-LS2-4),(MS-LS2-5) ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** • The use of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (MS-LS2-5) ***Connections to Nature of Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** • Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-LS2-3)

for either explanations or solutions about the natural and designed world(s). • Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-LS2-4) • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-LS2-5) ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** • Science disciplines share common rules of obtaining and evaluating empirical evidence. (MS-LS2-4)	**LS2.B: Cycle of Matter and Energy Transfer in Ecosystems** • Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. (MS-LS2-3) **LS2.C: Ecosystem Dynamics, Functioning, and Resilience** • Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (MS-LS2-4) • Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The	**Science Addresses Questions About the Natural and Material World** • Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-LS2-5)

	completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS-LS2-5) **LS4.D: Biodiversity and Humans** • Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling.*(secondary to MS-LS2-5)* **ETS1.B: Developing Possible Solutions** • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. *(secondary to MS-LS2-5)*	

Embedded English Language Arts/Literacy and Mathematics

ELA/Literacy-

RST .6-8.1 C ite specific textual evidence to support analysis of science and technical texts. (MS-LS2-1),(MS-LS2-2),(MS-LS2-4)

RST .6-8.7 Integrate quantitative or technical information expressed in words in a text with a v ersion of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS2-1)

RST .6-8.8 Distinguish among facts, reasoned judgment based on research findings, and speculation in a text. (MS -LS2-5)

RI.8.8 Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims. (MS-LS-4),(MS-LS2-5)

WHST .6-8.1 Write arguments to support claims with clear reasons and relevant evidence. (MS-LS2-4)

WHST .6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS2-2)

WHST .6-8.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. (MS-LS2-2),(MS-LS2-4)

SL.8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly . (MS-LS2-2)

SL.8.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate ey e contact, adequate volume, and clear pronunciation.(MS-LS2-2)

SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS2-3)

Mathematics –

MP.4 Model with mathematics. (MS-LS2-5)

6.RP.A.3 Use ratio and rate reasoning to solv e real-world and mathematical problems. (MS-LS2-5)

6.EE.C.9 Use v ariables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent v ariable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent v ariables using graphs and tables, and relate these to the equation. (MS-LS2-3)

Technology--

8.2.8.D.1 Design and create a product that addresses a real world problem using a design process under specific constraints.

8.2.8.D.3 Build a prototype that meets a STEM-based design challenge using science, engineering, and math principles that validate a solution.

8.2.8.A.3 Use and/or develop a simulation that provides an environment to solve a real world problem or theory.

8.2.8.A.2 Examine a system, consider how each part relates to other parts, and discuss a part to redesign to improve the system

Three-Dimensional Teaching and Learning

Crosscutting Concept: Using Models and Analyzing Patterns

Students will practice using models of systems to help make the concepts more tangible. By comparing models and analyzing patterns within different ecosystems, students will more deeply understand how patterns can help us make logical predictions about the future of our Earth and its ecosystems. This also adds to the human-impact aspect of ecosystems and the importance of humans preserving the natural cycling of matter and energy through the environment.

Science and Engineering Practices: Connections to Engineering and Design

Standard MS-LS2-5 has a very practical STEM link in which students are asked to evaluate, and to design, solutions for maintaining biodiversity and ecosystems services, which is an exponentially growing field of study. This gives greater meaning to the designs that students analyze and create, as the task is a true issue beyond the walls of a classroom. Students can study the newest technologies and innovations currently competing to meet these needs, and discover any possible gaps in research and design.

Prior Learning

Life Science- (3rd & 5th grade)

- Species differ in their likelihood of survival and reproduction.
- Animals sometimes form groups in order to survive.

- Plants get the materials they need to grow mostly from air and water.
- Matter moves among plants, animals, decomposers, and the environment.

Mathematics-

- Understanding of probability, ratios and rates.
- Solid foundation of fractions, decimals, and percentages.
- Analyzing tables and graphs of data and information.

- **Part A:** What effect does resource availability have on organisms in an ecosystem?

Concepts	Formative Assessment
• Organisms are dependent on both the living and nonliving factors within an environment. • Ecosystems are dynamic and can change over time. Disruptions to these systems can lead to changes in populations. • Growth of organisms and population increases are limited by access to resources. •	*Students who understand the concepts are able to:* • LAB: Conduct an experiment observing the growth of duckweed in water and adjusting the resources it receives in order to construct an argument based on the data. • Analyze data to provide evidence that ecosystems can change over time. Students should be able to attribute changes to gradual change (climate, species adaptations) and rapid changes (volcanic eruptions, floods, predatory patterns). .

Part B: What patterns of interactions are there among organisms in ecosystems?

Concepts	Formative Assessment
• Patterns of interactions exist among organisms across multiple ecosystems, such as predatory, mutually-beneficial, and competitive. • Biodiversity is the variety of species in ecosystems. Biodiversity of a system can be a good indicator of the health and quality of the system.	*Students who understand the concepts are able to:* • Use a model to trace the cycling of matter and energy transfers between the parts of an ecosystem. (For example, students can trace how carbon is transferred through the carbon cycle. Vision Learning: The Carbon Cycle) • Choose an ecosystem and analyze the system's biodiversity by identifying several species within the system. Students can provide

• In addition to the availability of resources, predatory interactions may reduce the number of organisms that exist.	construct an argument of how the system would change if there were a fluctuation in its biodiversity

Part C: How does matter and energy cycle and flow through an ecosystem?

Concepts	Formative Assessment
• Food webs are models that show the flow of matter and energy through a system of three groups: producers, consumers, and decomposers. • Atoms that make up the organisms in an ecosystem are cycled between the living and nonliving parts of a system.	*Students who understand the concepts are able to:* • LAB/STEM: Create a terrarium (microcosm of an ecosystem) using a 2-liter bottle and collect empirical and anecdotal evidence of the cycling of matter an energy through the system. (Ecosystem in a Bottle or Bottle Biology) • Illustrate and explain food webs to show how matter and energy is transferred between producers, consumers, and decomposers. • STEM: Design or redesign and test a tool used for maintaining biodiversity or an ecosystem service, such as a water purification system, nutrient recycling system, or the prevention of soil erosion.

Modifications: *Teachers identify the modifications that they will use in the unit. The unneeded modifications can then be deleted from the list.(See NGSS Appendix D)*

- *Restructure lesson using UDL principals (*http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA*)*
- *Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.*
- *Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).*
- *Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).*
- *Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).*
- *Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.*

- *Use project-based science learning to connect science with observable phenomena.*
- *Structure the learning around explaining or solving a social or community-based issue.*
- *Provide ELL students with multiple literacy strategies.*
- *Collaborate with after-school programs or clubs to extend learning opportunities..*

Leveraging English Language Arts/Literacy and Mathematics

English Language Arts/Literacy-

- Assess the extent to which the reasoning and evidence support certain outcomes.
- Describe the cycling of energy and matter through ecosystems using sequential order, organized text structure, and transitional phrases.
- Comparing models, concepts, and ideas in several texts by different authors and determine their accuracy.
- Pose relevant, specific questions based in fact and elaborate answers by synthesizing text and data and citing textual evidence.

Mathematics-

- Use tables and graphs of data to analyze how availability of resources can affect organism growth and population.
- Use empirical evidence to support the idea that ecosystems are dynamic and the populations of organisms can vary over time due to a variety of factors.

Samples of Open Education Resources for this unit:

Khan Academy is a resource for teachers and students alike to gain a deeper, intuitive understanding of science and math concepts.

NSTA Classroom Resources is a website of sample lessons aligned directly with each 7th grade space and Life Science unit.

Brainpop is a website of short mini-lesson videos.

CK-12 is a resource where you can create supplemental content in online "flexbooks" for students aligned with NGSS.

PhET Simulator is a resource of simulations of hundreds of concepts.

Vision Learning: The Carbon Cycle is a resource about the Carbon Cycle and how nutrients can cycle through a system.

Ecosystem in a Bottle and Bottle Biology show examples of how to assemble terrariums out of 2-liter bottles.

Differentiation		
504	● preferential seating ● extended time on tests and assignments ● reduced homework or classwork ● verbal, visual, or technology aids	● modified textbooks or audio-video materials ● behavior management support ● adjusted class schedules or grading ● verbal testing
Enrichment	● Utilize collaborative media tools ● Provide differentiated feedback ● Opportunities for reflection	● Encourage student voice and input ● Model close reading ● Distinguish long term and short term goals
IEP	● Utilize “skeleton notes” where some required information is already filled in for the student ● Provide access to a variety of tools for responses ● Provide opportunities to build familiarity and to practice with multiple media tools ● Graphic organizers	● Leveled text and activities that adapt as students build skills ● Provide multiple means of action and expression ● Consider learning styles and interests ● Provide differentiated mentors
ELLs	● Pre-teach new vocabulary and meaning of symbols ● Embed glossaries or definitions ● Provide translations ● Connect new vocabulary to background knowledge	● Provide flash cards ● Incorporate as many learning senses as possible ● Portray structure, relationships, and associations through concept webs ● Graphic organizers

At-risk	• Purposeful seating • Counselor involvement • Parent involvement	• Contracts • Alternate assessments • Hands-on learning
21st Century Skills		
• Creativity • Innovation • Critical Thinking		• Problem Solving • Communication • Collaboration
Integrating Technology		
• Chromebooks • Internet research • Online programs		• Virtual collaboration and projects • Presentations using presentation hardware and software

Life Science	Grade 7	Unit 3	Marking Period 3

From Molecules to Organisms: Heredity: Inheritance and Variation of Traits (25 Instructional Days)	
Overarching Essential Questions	**Overarching Enduring Understandings**
● How do organisms transfer their genetic information to their offspring? ● What is the difference between asexual and sexual reproduction? ● How can mutations of chromosomes affect an organism?	● How do organisms transfer their genetic information to their offspring? ● What is the difference between asexual and sexual reproduction? ● How can mutations of chromosomes affect an organism?
Student Learning Objectives	
Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.[Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.] [*Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.*]	**MS-LS3-1**

Develop and use a model to describe why asexual reproduction resu offspring with identical genetic information and sexual reproductio offspring with genetic variation. [Clarification Statement: Emphasis is on such as Punnett squares, diagrams, and simulations to describe the cause and e relationship of gene transmission from parent(s) to offspring and resulting gen	**MS-LS3-2**
Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.	MS-ETS1-1
Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.	MS-ETS1-2
Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.	MS-ETS1-3
Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.	MS-ETS1-4

The Student Learning Objectives above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models • Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract	**LS1.B: Growth and Development of Organisms** • Organisms reproduce, either sexually or asexually, and transfer their genetic information	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS3-2) **Structure and Function** • Complex and microscopic structures and systems can be visualized, modeled, and used to describe how

phenomena and design systems. ● Develop and use a model to describe phenomena. (MS-LS3-1),(MS-LS3-2)	to their offspring. *(secondary to MS-LS3-2)* **LS3.A: Inheritance of Traits** ● Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. (MS-LS3-1) ● Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of	their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS3-1)

	chromosomes (and therefore genes) inherited. (MS-LS3-2) **LS3.B: Variation of Traits** • In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2) • In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some	

	changes are beneficial, others harmful, and some neutral to the organism. (MS-LS3-1)	

Embedded English Language Arts/Literacy and Mathematics
ELA/Literacy- *RST .6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-LS3-1),(MS-LS3-2)* *RST .6-8.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics. (MS-LS3-1),(MS-LS3-2)* *RST .6-8.7 Integrate quantitative or technical information expressed in words in a text with a v ersion of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS3-1),(MS-LS3-2)* *SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS3-1),(MS-LS3-2)* *Mathematics –* *MP.4 Model with mathematics. (MS-LS3-2)* *MP.2 - Reason abstractly and quantitatively. (MS-ESS1-3)* *MP.4 - Model with mathematics. (MS-ESS1-1), (MS-ESS1-2)* *Technology--*

8.2.8.D.1 Design and create a product that addresses a real world problem using a design process under specific constraints.

8.2.8.D.3 Build a prototype that meets a STEM-based design challenge using science, engineering, and math principles that validate a solution.

8.2.8.A.3 Use and/or develop a simulation that provides an environment to solve a real world problem or theory.

8.2.8.A.2 Examine a system, consider how each part relates to other parts, and discuss a part to redesign to improve the system

Three-Dimensional Teaching and Learning

Crosscutting Concept: Cause and Effect

Students will understand, based on patterns in nature, that cause and effect relationships may be used to predict an outcome, such as traits of an offspring. Students can study how asexual and sexual reproduction will produce very different offspring, and that sexual reproduction may be a slightly more complex outcome to predict based on the variations of inherited traits from parents.

Science and Engineering Practices: Developing and Using Models

Because this unit focuses on a microscopic level, it is important that students are able to visualize and understand these concepts on a more tangible level. This can easily be done with models, so that the students have a deeper understanding of the structure and function of each part of the system, and better analyze and predict their abstract phenomena.

Prior Learning

Life Science- (3rd grade)

- Species differ in their likelihood of survival and reproduction.
- Organisms have unique life cycles, but all have common birth, growth, reproduction, and death.

- Plants and animals have traits inherited from parents.
- Traits can be influenced by the environment.
- Variations in traits may provide advantages in reproduction, survival, and finding mates.

Mathematics-

- Understanding of probability, ratios and rates.
- Solid foundation of fractions, decimals, and percentages.
- Analyzing tables and graphs of data and information.

- **Part A:** How do organisms transfer their genetic information to their offspring?

Concepts	Formative Assessment
• Organisms transfer genetic information through either sexual or asexual reproduction. • Asexual production results in offspring with identical genetic information. • Sexual reproduction results in two alleles of each gene, one from each parent, that can be identical or different from one another.	• *Students who understand the concepts are able to:* • STEM: Create and describe a model to show how cells divide, using common craft supplies or supplies in the classroom. (Engineering Cell Division). Students should be able to use accurate vocabulary to describe the structure and function of each part of their model. • Draw and label the processes of mitosis and meiosis. Explain the difference between the two and how the offspring will differ in each circumstance. • Use Punnet Squares and diagrams to show the cause and effect relationship of gene transmission from parent to offspring. • Identify any patterns in organisms that undergo either sexual or asexual reproduction..

Part B: How do genes affect traits?

Concepts	Formative Assessment

● Mutations in genes can change traits. ● Genes are located in the chromosomes of cells and control the production of specific proteins, which affects organism traits. ● Some mutations can be beneficial, some harmful, and some neutral.	*SStudents who understand the concepts are able to:* • Create an argument based on evidence that some mutations can be beneficial, harmful, or neutral. (Students can complete the Mutations and Variations Activity to draw from personal experience to add to their argument.) Students may write a persuasive piece arguing that a particular trait is beneficial, harmful, or neutral for that particular organism. • Use simulations to show and describe how traits are transferred from parent to offspring. See also: Dragon Genetics: Understanding Inheritance • Create a model of chromosome pairs and their alleles and describe the difference between homozygous and heterozygous allele pairs. Describe how this would affect offspring

Modifications: *Teachers identify the modifications that they will use in the unit. The unneeded modifications can then be deleted from the list.(See NGSS Appendix D)*
● *Restructure lesson using UDL principals (*http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA*)* ● *Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.* ● *Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).* ● *Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).* ● *Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).* ● *Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.* ● *Use project-based science learning to connect science with observable phenomena.*

- *Structure the learning around explaining or solving a social or community-based issue.*
- *Provide ELL students with multiple literacy strategies.*
- *Collaborate with after-school programs or clubs to extend learning opportunities.*

Leveraging English Language Arts/Literacy and Mathematics

English Language Arts/Literacy-

- Assess the extent to which the reasoning and evidence support certain outcomes.
- Describe the processes of asexual and sexual reproduction using sequential order, organized text structure, and transitional phrases.
- Comparing models, concepts, and ideas in several texts by different authors and determine their accuracy.
- Pose relevant, specific questions based in fact and elaborate answers by synthesizing text and data and citing textual evidence.

Mathematics-

- Use tables and graphs of data to analyze how asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variations.
- Use empirical evidence and models to support the idea that structural changes in genes can result in positive, negative, or neutral effects to the structure and function of an organism.

Samples of Open Education Resources for this unit:

Khan Academy is a resource for teachers and students alike to gain a deeper, intuitive understanding of science and math concepts.

NSTA Classroom Resources is a website of sample lessons aligned directly with each 7th grade space and Life Science unit.

Brainpop is a website of short mini-lesson videos.

CK-12 is a resource where you can create supplemental content in online “flexbooks” for students aligned with NGSS.

PhET Simulator is a resource of simulations of hundreds of concepts.

Dragon Genetics: Understanding Inheritance is a lesson plan where students create a dragon based on inheritance of traits from parent dragons.

Fork Mutation Game is a good 5-minute game for the students to play to see how mutations can drastically affect an organism's survival.

PBS: Reproduction Video Lesson Plan is a resource for a 4-part lesson plan on comparing reproduction of different organisms.

Engineering Cell Division is a lesson plan where students create their own models to show cell division using common craft supplies.

Mutations and Variations Lab is a hands-on activity for students to understand how some mutations can be beneficial, detrimental, or neutral.

Differentiation		
504	● preferential seating ● extended time on tests and assignments ● reduced homework or classwork ● verbal, visual, or technology aids	● modified textbooks or audio-video materials ● behavior management support ● adjusted class schedules or grading ● verbal testing
Enrichment	● Utilize collaborative media tools ● Provide differentiated feedback ● Opportunities for reflection	● Encourage student voice and input ● Model close reading ● Distinguish long term and short term goals
IEP	● Utilize "skeleton notes" where some required information is already filled in for the student ● Provide access to a variety of tools for responses ● Provide opportunities to build familiarity and to practice with multiple media tools	● Leveled text and activities that adapt as students build skills ● Provide multiple means of action and expression ● Consider learning styles and interests ● Provide differentiated mentors

	• Graphic organizers	
ELLs	• Pre-teach new vocabulary and meaning of symbols • Embed glossaries or definitions • Provide translations • Connect new vocabulary to background knowledge	• Provide flash cards • Incorporate as many learning senses as possible • Portray structure, relationships, and associations through concept webs • Graphic organizers
At-risk	• Purposeful seating • Counselor involvement • Parent involvement	• Contracts • Alternate assessments • Hands-on learning
21st Century Skills		
• Creativity • Innovation • Critical Thinking		• Problem Solving • Communication • Collaboration
Integrating Technology		

• Chromebooks • Internet research • Online programs	• Virtual collaboration and projects • Presentations using presentation hardware and software

Life Science	Grade 7	Unit 4	Marking Period 4

Biological Evolution: Unity and Diversity (45 Instructional Days)	
Overarching Essential Questions	**Overarching Enduring Understandings**
• How can fossils reveal how life has evolved over the history of the Earth? • How can genetic variations affect the survival and reproduction of species? • What is the difference between natural selection and artificial selection?	• Patterns in fossils can reveal the evolution of life throughout the history of Earth. • Variations in traits can influence the probability of a species to survive and reproduce successfully. • Humans can influence the inheritance of desired traits in organisms, similar to how particular traits are naturally transferred to populations over time.
Student Learning Objectives	
Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.[Clarification Statement: Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers.] [Assessment Boundary: Assessment does not include the names of individual species or geological eras in the fossil record.]	**MS-LS4-1**

Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. [Clarification Statement: Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures.]	**MS-LS4-2**
Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy. [Clarification Statement: Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures.] [Assessment Boundary: Assessment of comparisons is limited to gross appearance of anatomical structures in embryological development.]	**MS-LS4-3**
Construct an explanation based on evidence that describes how genetic variations of traits in a population increasesome individuals' probability of surviving and reproducing in a specific environment. [Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations.]	**MS-LS4-4**
Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms. [Clarification Statement: Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and, on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.]	**MS-LS4-5**
Use mathematical representations to support explanations of how natural selection may lead to increases and decreasesof specific traits in populations over time. [Clarification Statement: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.] [*Assessment Boundary: Assessment does not include Hardy Weinberg calculations.*]	**MS-LS4-6**

Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.	MS-ETS1-1
Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.	MS-ETS1-2
Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.	MS-ETS1-3
Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.	MS-ETS1-4

The Student Learning Objectives above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
• **Analyzing and Interpreting Data** Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Analyze displays of data to identify linear and nonlinear relationships. (MS-LS4-3)	**LS4.A: Evidence of Common Ancestry and Diversity** • The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms	**Patterns** • Patterns can be used to identify cause and effect relationships. (MS-LS4-2) • Graphs, charts, and images can be used to identify patterns in data. (MS-LS4-1),(MS-LS4-3) **Cause and Effect** • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4),(MS-LS4-5),(MS-LS4-6)

• Analyze and interpret data to determine similarities and differences in findings. (MS-LS4-1) **Using Mathematics and Computational Thinking** Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. • Use mathematical representations to support scientific conclusions and design solutions. (MS-LS4-6) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-2)	throughout the history of life on Earth. (MS-LS4-1) • Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent. (MS-LS4-2) • Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy. (MS-LS4-3) **LS4.B: Natural Selection** • Natural selection leads to the predominance of certain traits in a population, and the suppression of others. (MS-LS4-4) • In *artificial* selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed on to offspring. (MS-LS4-5)	***Connections to Engineering, Technology, and Applications of Science*** **Interdependence of Science, Engineering, and Technology** • Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (MS-LS4-5) ***Connections to Nature of Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** • Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-LS4-1),(MS-LS4-2) **Science Addresses Questions About the Natural and Material World** • Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-LS4-5)

• Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena. (MS-LS4-4) **Obtaining, Evaluating, and Communicating Information** Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. • Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS-LS4-5) ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** • Science knowledge is based upon logical and conceptual connections between evidence and	**LS4.C: Adaptation** • Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (MS-LS4-6)	

explanations. (MS-LS4-1)		

Embedded English Language Arts/Literacy and Mathematics
ELA/Literacy- *RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions (MS-LS4-1),(MSLS4-2),(MS-LS4-3),(MS-LS4-4),(MS-LS4-5)* *RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS4-1),(MS-LS4-3)* *RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-LS4-3),(MS-LS4-4)* *WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS4-2),(MS-LS4-4)* *WHST.6-8.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-LS4-5)* *WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS4-2),(MS-LS4-4)* *SL.8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. (MS-LS4-2),(MS-LS4-4)* *SL.8.4 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. (MS-LS4-2),(MS-LS4-4)* *Mathematics –* *MP.4 Model with mathematics. (MS-LS4-6)* *7.RP.A.2 Recognize and represent proportional relationships between quantities. (MS-LS4-4),(MS-LS4-6*

Technology--

8.2.8.D.1 Design and create a product that addresses a real world problem using a design process under specific constraints.

8.2.8.D.3 Build a prototype that meets a STEM-based design challenge using science, engineering, and math principles that validate a solution.

8.2.8.A.3 Use and/or develop a simulation that provides an environment to solve a real world problem or theory.

8.2.8.A.2 Examine a system, consider how each part relates to other parts, and discuss a part to redesign to improve the system

Three-Dimensional Teaching and Learning

Analyzing Patterns

Much of evolution and natural selection research is based on finding patterns over long periods of time. Therefore, it is important to emphasize patterns in this unit. Students should practice looking for patterns in the fossil record, as well as look for patterns between the embryological development between several species to reveal how the theory of evolution was inferred by Darwin and other scientists in our more recent history.

Science and Engineering Practices: Using Mathematics and Computational Thinking

Students will use mathematical reasoning, models, probability, and proportional reasoning to analyze trends in populations over time, in order to analyze natural selection. In order to see the breadth of natural selection, students will need to be able to manipulate large data sets and use mathematical concepts to support explanations and arguments. This, arguably more than any unit, will emphasize mathematical thinking (which is why is also is ideal to have as the last unit so that the students can use nearly a year's worth of 7th grade mathematical concepts within their science class).

Prior Learning

Life Science- (3rd & 6th grade)

- Species differ in their likelihood of survival and reproduction.
- Organisms have unique life cycles, but all have common birth, growth, reproduction, and death.
- Plants and animals have traits inherited from parents.
- Traits can be influenced by the environment.
- Variations in traits may provide advantages in reproduction, survival, and finding mates.

Mathematics-

- Understanding of probability, ratios and rates.
- Solid foundation of fractions, decimals, and percentages.
- Analyzing tables and graphs of data and information.

- **Part A:** How can fossils reveal how life has evolved over the history of the Earth?

Concepts	Formative Assessment
• Patterns in fossils can reveal the existence, diversity, extinction, and change of life through the history of life on Earth. • Chronological order of fossils show the complexity of organisms change over time. • Speciation is the formation of a new species over the course of biological evolution. •	• *Students who understand the concepts are able to:* • Analyze fossil data and construct a argument about the increase in complexity of life forms over time. Identify any patterns within the fossils over several eras in the fossil record. Students can practice chronologically lining up different pictures of fossils based on their relative complexity (emphasis on ordering fossils by complexity and not on true age) to show the basic trend over time. • Use scientific argumentation and evidence to determine if a fossilized tooth came from a prehistoric lion or a prehistoric shark. Students should be able to make their arguments *in writing*, using appropriate claims, support/evidence, and argumentative language and phrases. Using an Argument Card Sort: Fossils

Part B: How can genetic variations affect the survival and reproduction of species?	
Concepts	**Formative Assessment**
● Natural selection is the increase in probability of a species to survive or reproduce based on a variation of traits. ● Similarities exist between embryos of different species, which may suggest a common ancestral structure. ● Homologies can show species that arose from common ancestry.	*Students who understand the concepts are able to:* • Use proportional reasoning to construct arguments and explanations of how genetic variations increase the probability of survival and reproduction. • Compare two similar species and make a claim supported with evidence that a particular variation in traits allowed it to survive and reproduce more readily than the other OR that a particular environmental change increased the likelihood of a particular trait to be passed on to offspring. • Compare the embryological development of several species to identify homologies that may not be present in the fully formed adult species, such as gills in both fish and human embryos (Evidence- Embryos). Construct an argument that there is a general relatedness between the different species suggesting similar ancestral structure.

● **Part C:** What is the difference between natural selection and artificial selection?	
Concepts	**Formative Assessment**
• Humans can influence genetic outcomes in artificial selection, such as with genetic modification, animal husbandry, and gene therapy. • Artificial selection technologies have impacted society and vice versa. • Biomimicry is the idea that humans can learn from the patterns of survival and success of other animals and imitate them in innovative ways.	*Students who understand the concepts are able to:* • Construct explanations of technologies that have greatly impacted the artificial selection field of study. Students should synthesize this information from multiple sources, being sure to assess their credibility and accuracy. • Analyze the line of events involved in a particular type of artificial selection, such as genetically modified food or the domestication of animals. Students may also analyze

•	the affect these human-controlled changes have made on the natural environment or population. • STEM: Design, redesign or analyze a design for a method of aritificial selection. • STEM: Use the idea of biomimicry to design a product for humans inspired by adaptations by nature. (Design rubric)

Modifications: *Teachers identify the modifications that they will use in the unit. The unneeded modifications can then be deleted from the list.(See NGSS Appendix D)*
● *Restructure lesson using UDL principals (*http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA*)* ● *Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.* ● *Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).* ● *Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).* ● *Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).* ● *Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.* ● *Use project-based science learning to connect science with observable phenomena.* ● *Structure the learning around explaining or solving a social or community-based issue.* ● *Provide ELL students with multiple literacy strategies.* ● *Collaborate with after-school programs or clubs to extend learning opportunities.*

Leveraging English Language Arts/Literacy and Mathematics
English Language Arts/Literacy- • Assess the extent to which the reasoning and evidence support certain outcomes. • Describe the processes of asexual and sexual reproduction using sequential order, organized text structure, and transitional phrases. • Comparing models, concepts, and ideas in several texts by different authors and determine their accuracy. • Pose relevant, specific questions based in fact and elaborate answers by synthesizing text and data and citing textual evidence. • Synthesize information about different technologies that humans can use for artificial selection. ***Mathematics-*** • Use tables and graphs of data to analyze how asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variations. • Use empirical evidence and models to support the idea that structural changes in genes can result in positive, negative, or neutral effects to the structure and function of an organism. • Use mathematical representations to support how natural selection will affect a species over time. • Analyze fossil records and data to find any patterns in organisms over time.

Samples of Open Education Resources for this unit:
PhET Simulator is a resource of simulations of hundreds of concepts. (Natural Selection simulation) NSTA Classroom Resources is a website of sample lessons aligned directly with each 6th grade space and Earth science unit. Brainpop is a website of short mini-lesson videos. CK-12 is a resource where you can create supplemental content in online “flexbooks” for students aligned with NGSS. M&M Survival Challenge is a lab that students can perform to show microevolution. Evolutionary Embryology is a resource for teachers to more deeply understand homologies and embryological structures. An Origin of Species: Pollenpeepers is a web simulation that follows the 5 million year history of a fictitious bird, the pollenpeeper.

Catch Up on Tomato History is a lesson plan for following the history of natural and artificial selection on our modern-day tomato plant.

Differentiation		
504	● preferential seating ● extended time on tests and assignments ● reduced homework or classwork ● verbal, visual, or technology aids	● modified textbooks or audio-video materials ● behavior management support ● adjusted class schedules or grading ● verbal testing
Enrichment	● Utilize collaborative media tools ● Provide differentiated feedback ● Opportunities for reflection	● Encourage student voice and input ● Model close reading ● Distinguish long term and short term goals
IEP	● Utilize “skeleton notes” where some required information is already filled in for the student ● Provide access to a variety of tools for responses ● Provide opportunities to build familiarity and to practice with multiple media tools ● Graphic organizers	● Leveled text and activities that adapt as students build skills ● Provide multiple means of action and expression ● Consider learning styles and interests ● Provide differentiated mentors

ELLs	• Pre-teach new vocabulary and meaning of symbols • Embed glossaries or definitions • Provide translations • Connect new vocabulary to background knowledge	• Provide flash cards • Incorporate as many learning senses as possible • Portray structure, relationships, and associations through concept webs • Graphic organizers
At-risk	• Purposeful seating • Counselor involvement • Parent involvement	• Contracts • Alternate assessments • Hands-on learning
21st Century Skills		
• Creativity • Innovation • Critical Thinking		• Problem Solving • Communication • Collaboration
Integrating Technology		
• Chromebooks • Internet research • Online programs		• Virtual collaboration and projects • Presentations using presentation hardware and software