Introduction

Science, Technology & Engineering, and Environmental Literacy & Sustainability (STEELS) Standards guide the study of the natural and human-made world through inquiry, problem-solving, critical thinking, and authentic exploration. This document displays a curriculum framework for Middle School Life Science. It is designed to focus curriculum and teaching, provide guidance for multiple approaches to curriculum development, encourage less reliance on textbooks as curriculum, and avoid activity-oriented teaching without focus/purpose.

Science Long Term Transfer Goals

In support of the Curriculum Framework, Long Term Transfer Goals (LTTG) provide the overarching practices that ground the foundation for a robust curriculum; thus, all curriculum should relate to one or more of the LTTGs detailed below – as they highlight the effective uses of understanding, knowledge, and skill that we seek in the long run; i.e., what we want students to be able to do when they confront new challenges – both in and outside of school.

Students will be able to engage as technological and engineering literate members of a global society, using their learning to:

1. Approach science as a reliable and tentative way of knowing and explaining the natural world and designed world.
2. Weigh evidence and use scientific approaches to ask questions, investigate, and make informed decisions.
3. Make and use observations to analyze relationships and patterns in order to explain phenomena, develop models, and make predictions.
4. Evaluate systems, in order to connect how form determines function and how any change to one component affects the entire system.
5. Explain how the natural and designed worlds are interrelated and the application of scientific knowledge and technology can have beneficial, detrimental, or unintended consequences.

Grade 6-8 Life Science

Structure and Function							
Big Idea	**Essential Question**	**Standard**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Crosscutting Concepts**	**Vocabulary**	**2007 Assessment Anchors Eligible Content**
Organisms have characteristic structures that enable functions and behaviors that allow them to grow, reproduce, and die.	How do the structures of organisms enable life's functions?	**3.1.6-8.A** **Conduct an investigation to provide evidence that living things are made of cells, either one cell or many different numbers and types of cells.**	**Planning and Carrying Out Investigations** Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation.	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).	Phenomena that can be observed at one scale may not be observable at another scale.	organism unicellular multicellular tissue organ	S8.B.1.1 S8.B1.1.2 S8.B.1.1.3 S8.B.1.1.4
Organisms have characteristic structures that enable functions and behaviors that allow them to grow, reproduce, and die.	How do the structures of organisms enable life's functions?	**3.1.6-8.B** **Develop and use a model to describe the function of a cell as a whole and the ways that parts of cells contribute to the function.**	**Developing and Using Models** Develop and use a model to describe phenomena.	Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell.	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.	osmosis diffusion cell membrane nucleus mitochondria cell wall cytoplasm Golgi ribosome endoplasmic reticulum organelle	S8.B.1.1 S8.B1.1.2 S8.B.1.1.3 S8.B.1.1.4

Organisms have characteristic structures that enable functions and behaviors that allow them to grow, reproduce, and die.	How do the structures of organisms enable life's functions?	**3.1.6-8.C** **Use arguments supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.**	**Engaging in Argument from Evidence** Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon	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.	Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.	cell tissue organ body systems types of specialized cells	S8.B.1.1 S8.B1.1.2 S8.B.1.1.3 S8.B.1.1.4
Growth and Development of Organisms							
Big Idea	**Essential Question**	**Standard**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Crosscutting Concepts**	**Vocabulary**	**2007 Assessment Anchors Eligible Content**
The characteristic structures, functions, and behaviors of organisms change in predictable ways as they progress from birth to old age. (the life cycle)	How do organisms grow and develop?	**3.1.6-8.D** **Use arguments 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.**	**Engaging in Argument from Evidence** Use an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.	Animals engage in characteristic behaviors that increase the odds of reproduction. Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction.	**Cause and Effect** Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.	asexual sexual	S8.B.2.1.1
The characteristic structures, functions, and behaviors of organisms change in	How do organisms grow and develop?	**3.1.6-8.E** **Construct a scientific explanation based on evidence for how**	**Constructing Explanations and Designing Solutions**	Genetic factors as well as local conditions affect the growth of the adult plant.	**Cause and Effect** Phenomena may have more than one cause, and some cause and	dominance recessive frequency	S8.B.2.1.2

predictable ways as they progress from birth to old age. (through the life cycle)		**environmental and genetic factors influence the growth of organisms.**	Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.		effect relationships in systems can only be described using probability	gene allele environmental factors genetic factors	
Organization for Matter and Energy Flow in Organisms							
Big Idea	**Essential Question**	**Standard**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Crosscutting Concepts**	**Vocabulary**	**2007 Assessment Anchors Eligible Content**
The structures, functions, and behaviors of organisms allow them to obtain, use, transport, and remove the matter and energy needed to live.	How do organisms obtain and use the matter and energy they need to live and grow?	**3.1.6-8.F** **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.**	**Constructing Explanations and Designing Solutions** Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	Plants, algae (including phytoplankton), and many 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. The chemical reaction by which plants produce complex food	**Energy and Matter** Within a natural system, the transfer of energy drives the motion and/or cycling of matter.	glucose energy CO2 oxygen chloroplast stomata mitochondria chemical rxn energy transformation atmosphere	S8.B.3.1.1

				molecules (sugars) requires 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)			
The structures, functions, and behaviors of organisms allow them to obtain, use, transport, and remove the matter and energy needed to live.	How do organisms obtain and use the matter and energy they need to live and grow?	**3.1.6-8.G** **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.**	**Developing and Using Models** Develop a model to describe unobservable mechanisms.	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. 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)	**Energy and Matter** Matter is conserved because atoms are conserved in physical and chemical processes.	cellular respiration mitochondria sugar chemical reaction conservation of matter cycle	S8.B.3.1.1

Information Processing							
Big Idea	**Essential Question**	**Standard**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Crosscutting Concepts**	**Vocabulary**	**2007 Assessment Anchors Eligible Content**
Animals have external and internal sensory receptors that detect different kinds of information that then gets processed by the brain.	How do organisms detect, process, and use information about the environment?	**3.1.6-8.H** **Gather and synthesize information about how sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.**	**Obtaining, Evaluating, and Communicating Information** 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.	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.	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural systems.	electromagnetic mechanical chemical neurons synapse exon dendrite receptor sites stimuli response	S8.B.3.1.1
Interdependent Relationships in Ecosystems							
Big Idea	**Essential Question**	**Standard**	**Science and Engineering Practices**	**Disciplinary Core Idea**	**Crosscutting Concepts**	**Vocabulary**	**2007 Assessment Anchors Eligible Content**
Ecosystems are complex systems that include both living (biotic) and non-living (abiotic) components that interact with each other.	How do organisms interact with the living and nonliving environments to obtain matter and energy?	**3.1.6-8.I** **Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.**	**Analyzing and Interpreting Data** Analyze and interpret data to provide evidence for phenomena.	Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. In any ecosystem, organisms and populations with	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems.	ecosystem population living non-living biotic abiotic predator	S8.B.3.1

				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. Growth of organisms and population increases are limited by access to resources.		prey limiting factors competition habitat energy diagram (food web)	
Ecosystems are complex systems that include both living (biotic) and non-living (abiotic) components that interact with each other.	How do organisms interact with the living and nonliving environments to obtain matter and energy?	**3.1.6-8.J** **Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.**	**Constructing Explanations and Designing Solutions** Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena.	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.	**Patterns** Patterns can be used to identify cause and effect relationships.	symbiotic parasitism commensalism mutualism competition predator prey abiotic factor biotic factors	S8.B.3.1

Cycles of Matter and Energy Transfer in Ecosystems							
Big Idea	**Essential Question**	**Standard**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Crosscutting Concepts**	**Vocabulary**	**2007 Assessment Anchors Eligible Content**
The cycling of matter and the flow of energy within ecosystems occur through interactions among different organisms and between organisms and the physical environment.	How do matter and energy move through an ecosystem?	**3.1.6-8.K** **Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.**	**Developing and Using Models** Develop a model to describe phenomena.	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.	**Energy and Matter** The transfer of energy can be tracked as energy flows through a natural system.	energy diagram producer consumer decomposer recycler ecosystem conservation of matter	S8.B.3.1.1

Ecosystem Dynamics, Functioning, and Resilience							
Big Idea	**Essential Question**	**Standard**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Crosscutting Concepts**	**Vocabulary**	**2007 Assessment Anchors Eligible Content**
As the environment and populations of species change, there are resulting changes in ecosystems.	How does a change in environment impact ecosystems?	**3.1.6-8.L** **Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.**	**Engaging in Argument from Evidence** 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.	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.	**Stability and Change** Small changes in one part of a system might cause large changes in another part.	resilience ecosystem population environmental disruptions	S8.B.3.2 S8.3.2.1 S8.3.2.2 S8.3.2.3
Inheritance of Traits							
Big Idea	**Essential Question**	**Standard**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Crosscutting Concepts**	**Vocabulary**	**2007 Assessment Anchors Eligible Content**
Offspring resemble, but are not identical to, their parents due to traits being passed from one generation to the next via genes.	How are the characteristics of one generation related to the previous generation?	**3.1.6-8.M** **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.**	**Developing and Using Models** Develop and use a model to describe phenomena.	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	**Structure and Function** Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems	chromosome allele dominant recessive protein synthesis offspring trait homozygous heterozygous	S8.B.3.2 S8.3.2.1 S8.3.2.2 S8.3.2.3

				proteins, which can affect the structures and functions of the organism and thereby change traits. 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.		mutation sexual repro inherited gene	
Variation of Traits							
Big Idea	**Essential Question**	**Standard**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Crosscutting Concepts**	**Vocabulary**	**2007 Assessment Anchors Eligible Content**
Variation among individuals of the same species can be explained by both genetic and environmental factors.	Why do individuals of the same species vary in how they look, function, and behave?	**3.1.6-8.N** **Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.**	**Developing and Using Models** Develop and use a model to describe phenomena.	Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. (secondary) Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural systems.	mutation gene chromosome allele genetic variation sexual reproduction trait	S8.B2.1.1 S8.B.2.1.2 S8.B.2.1.5 S8.A.3.2.1

				chromosomes (and therefore genes) inherited. 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.			
Evidence of Common Ancestry and Diversity							
Big Idea	**Essential Question**	**Standard**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Crosscutting Concepts**	**Vocabulary**	**2007 Assessment Anchors Eligible Content**
Comparisons between species provides evidence that species evolved from common ancestors which explains the similarities and differences between species.	What evidence supports that different species are related?	**3.1.6-8.O** **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**	**Analyzing and Interpreting Data** Analyze and interpret data to determine similarities and differences in findings.	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	**Patterns** Graphs, charts, and images can be used to identify patterns in data.	fossil radioactive extinct sedimentary metamorphic erosion	S8.A.1.3.2 S8.A.1.3.3 S8.A.3.3.1 S8.A.3.3.2

		natural laws operate today as in the past.		of many life forms throughout the history of life on Earth.			
Comparisons between species provides evidence that species evolved from common ancestors which explains the similarities and differences between species.	What evidence supports that different species are related?	**3.1.6-8.P** **Apply scientific ideas to construct an explanation for anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.**	**Constructing Explanations and Designing Solutions** Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events.	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.	**Patterns** Patterns can be used to identify cause and effect relationships.	fossil evolutionary relationships anatomical infer	S8.A.1.3.2 S8.A.1.3.3 S8.A.3.3.1 S8.A.3.3.2
Comparisons between species provides evidence that species evolved from common ancestors which explains the similarities and differences between species.	What evidence supports that different species are related?	**3.1.6-8.Q** **Analyze displays of pictorial data to compare patterns of similarities in anatomical structures across multiple species to identify relationships not evident in the fully formed anatomy.**	**Analyzing and Interpreting Data** Analyze displays of data to identify linear and nonlinear relationships.	Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy.	**Patterns** Graphs, charts, and images can be used to identify patterns in data.	embryo anatomy embryological development	S8.A.1.3.2 S8.A.1.3.3 S8.A.3.3.1 S8.A.3.3.2
Natural Selection							
Big Idea	**Essential Question**	**Standard**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Crosscutting Concepts**	**Vocabulary**	**2007 Assessment Anchors Eligible Content**
In any environment individuals with particular traits may be more likely than	How does genetic variation among	**3.1.6-8.R** **Gather and synthesize information about the**	**Obtaining, Evaluating, and Communicating Information**	In artificial selection, humans have the capacity to influence certain characteristics	**Cause and Effect** Phenomena may have more than one cause,	genetic engineering advantageous trait	S8.B.2.2.1 S8.B.2.2.2

others to survive and produce offspring.	organisms affect survival and reproduction?	**technologies that have changed the way humans influence the inheritance of desired traits in organisms.**	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.	of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed onto offspring.	and some cause and effect relationships in systems can only be described using probability.	disadvantageous trait	S8.B.2.1.4
In any environment individuals with particular traits may be more likely than others to survive and produce offspring	How does genetic variation among organisms affect survival and reproduction?	**3.1.6-8.S** **Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.**	**Obtaining, Evaluating, and Communicating Information** Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena.	Natural selection leads to the predominance of certain traits in a population, and the suppression of others.	**Cause and Effect** Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.	advantageous trait disadvantageous trait genetic variations sexual reproduction natural selection systems probability	S8.B.2.1.3 S8.B.2.1.4 S8.B.2.1.5
Adaptation							
Big Idea	**Essential Question**	**Standard**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Crosscutting Concepts**	**Vocabulary**	**2007 Assessment Anchors Eligible Content**
When the environment changes, some individuals in a population may have traits that provide a reproductive advantage which over many generations can	How does the environment influence populations of organisms over multiple generations?	**3.1.6-8.T** **Use mathematical representations to support explanations of how natural selection may lead to increases and**	**Using Mathematics and Computational Thinking** Use mathematical representations to support scientific	Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental	**Cause and Effect** Phenomena may have more than one cause, and some cause and effect relationships in systems can only be	camouflage mimicry adaptation natural selection	S8.B.2.1.3 S8.B.2.1.4 S8.B.2.1.5

change the make-up of a population.		**decreases of specific traits in populations over time.**	conclusions and design solutions.	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.	described using probability.		
Biodiversity and Humans							
Big Idea	**Essential Question**	**Standard**	**Science and Engineering Practices**	**Disciplinary Core Ideas**	**Crosscutting Concepts**	**Vocabulary**	**2007 Assessment Anchors Eligible Content**
Humans depend on biodiversity, the variety of species and ecosystems, for resources. Human actions can impact the diversity of species.	How do humans affect biodiversity, and how does it affect humans? Mutually impact?	**3.1.6-8.U** **Evaluate competing design solutions for maintaining biodiversity and ecosystem services.**	**Engaging in Argument from Evidence** Evaluate competing design solutions based on jointly developed and agreed upon design criteria.	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)	**Stability and Change** Small changes in one part of a system might cause large changes in another part.	biodiversity design solutions ecosystem services	S8.B.3.1.1 S8.B.3.2.1 S8.3.3.1