Introduction: The focus of this document is on one of the three dimensions of the Performance Expectations (PE); the science ideas that students should have opportunities to apply in order to explain phenomena or design solutions to real-world problems. This document should be used in conjunction with a document titled *Primer on Science Instruction*. The *Primer on Science Instruction* focusses on what teaching, learning, and assessment should look like in a three-dimensional classroom.

The life science standards blend the Disciplinary Core Ideas (DCIs) with Scientific and Engineering Practices (SEP) and Crosscutting Concepts (CCC) to support students in developing useable knowledge to explain real world phenomena in the physical, biological, and Earth and space sciences. The scientific ideas are detailed on pages 139-167 of *A Framework for K-12 Science Education* (NRC, 2012). Table 1 highlights the Core and Component Ideas in life science that must be a part of the science curriculum. Beginning on page 2, each of the component ideas are described in greater detail.

Table 1: Core and Component Ideas in the Life Sciences

Core Idea LS1: From Molecules to Organisms: Structures and Processes

- LS1.A: Structure and Function
- LS1.B: Growth and Development of Organisms
- LS1.C: Organization for Matter and Energy Flow in Organisms
- LS1.D: Information Processing

Disciplinary Core Idea

Component Ideas

Core Idea LS2: Ecosystems: Interactions, Energy, and Dynamics

- LS2.A: Interdependent Relationships in Ecosystems
- LS2.B: Cycles of Matter and Energy Transfer in Ecosystems
- LS2.C: Ecosystem Dynamics, Functioning, and Resilience
- LS2.D: Social Interactions and Group Behavior

Core Idea LS3: Heredity: Inheritance and Variation of Traits

- LS3.A: Inheritance of Traits
- LS3.B: Variation of Traits

Core Idea LS4: Biological Evolution: Unity and Diversity

- LS4.A: Evidence of Common Ancestry and Diversity
- LS4.B: Natural Selection
- LS4.C: Adaptation
- LS4.D: Biodiversity and Humans

There are multiple approaches to organizing science curriculum in the middle grades. Regardless of the approach, every student needs to receive instruction in all of the life science standards. The storylines are organized by Disciplinary Core Idea (DCI). The hyperlinked title provides quick access to the complete description of the Disciplinary Core Ideas, Component Ideas, and grade appropriate elements of the DCIs.

Some districts chose to base their revised curriculum on the NJ Model Science Curriculum (MSC). Each unit of instruction includes a guiding question, a unit overview, estimated number of instructional days necessary to complete the unit, and Student Learning Objectives. Sometimes the storylines in the model curriculum units have been modified from the original narratives in this document.

LS1: From Molecules to Organisms: Structures and Processes (pp. 143-150, NRC, 2012)

Students formulate an answer to the question, *"How can one explain the ways cells contribute to the function of living organisms?"*

Students gather information and use this information to support explanations of the structure and function relationship of cells.

They can communicate understanding of cell theory. They have a basic understanding of the role of cells in body systems and how those systems work to support the life functions of the organism.

The understanding of cells provides a context for the plant process of photosynthesis and the movement of matter and energy needed for the cell.

Students can construct an explanation for how environmental and genetic factors affect growth of organisms. They can connect this to the role of animal behaviors in reproduction of animals as well as the dependence of some plants on animal behaviors for their reproduction. Crosscutting concepts of cause and effect, structure and function, and matter and energy are called out as organizing concepts for the core ideas about processes of living organisms.

Students who demonstrate understanding can:

MS-LS1-1 **Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.**

MS-LS1-2 **Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.**

MS-LS1-3 **Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.**

MS-LS1-4 **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.**

MS-LS1-5 **Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.**

MS-LS1-6 **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.**

MS-LS1-7 **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.**

MS-LS1-8 **Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.**

LS2: Interactions, Energy, and Dynamics Relationships in Ecosystems (pp. 150-157, NRC, 2012)

Students formulate an answer to the question, *"How does a system of living and non-living things operate to meet the needs of the organisms in an ecosystem?"*

Students analyze and interpret data, develop models, and construct arguments and demonstrate a deeper understanding of resources and the cycling of matter and the flow of energy in ecosystems.

They also study patterns of the interactions among organisms within an ecosystem. They consider biotic and abiotic factors in an ecosystem and the effects these factors have on population.

They evaluate competing design solutions for maintaining biodiversity and ecosystem services.

Students who demonstrate understanding can:

MS-LS2-1 **Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.**

MS-LS2-2 **Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.**

MS-LS2-3 **Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.**

MS-LS2-4 **Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.**

MS-LS2-5 **Evaluate competing design solutions for maintaining biodiversity and ecosystem services.***

(An asterisk indicates that the PE incorporates Engineering Practices.)

LS3: Heredity: Inheritance and Variation of Traits (pp. 157-161, NRC, 2012)

Students formulate an answer to the question, *"How do living organisms pass traits from one generation to the next?"*

Students use models to describe ways gene mutations and sexual reproduction contribute to genetic variation. Crosscutting concepts of cause and effect and structure and function provide students with a deeper understanding of how gene structure determines differences in the functioning of organisms.

Students who demonstrate understanding can:

MS-LS3-1 **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.**

MS-LS3-2 **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.**

LS4: Biological Evolution: Unity and Diversity (pp. 161-167, NRC, 2012)

Students formulate an answer to the question, *"How do organisms change over time in response to changes in the environment?"*

Students construct explanations based on evidence to support fundamental understandings of natural selection and evolution.

They use ideas of genetic variation in a population to make sense of organisms surviving and reproducing, hence passing on the traits of the species.

They use fossil records and anatomical similarities of the relationships among organisms and species to support their understanding.

Crosscutting concepts of patterns and structure and function contribute to the evidence students can use to describe biological evolution.

Students who demonstrate understanding can:

MS-LS4-1 **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.**

MS-LS4-2 **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.**

MS-LS4-3 **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.**

MS-LS4-4 **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.**

MS-LS4-5 **Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.**

MS-LS4-6 **Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.**

Life Science Performance Expectations Checklist

LS1: From Molecules to Organisms: Structures and Processes

PE	Grade and Unit
MS-LS1-1	
MS-LS1-2	
MS-LS1-3	
MS-LS1-4	
MS-LS1-5	
MS-LS1-6	
MS-LS1-7	
MS-LS1-8	

LS2: Interactions, Energy, and Dynamics Relationships in Ecosystems

PE	Grade and Unit
MS-LS2-1	
MS-LS2-2	
MS-LS2-3	
MS-LS2-4	
MS-LS3-5	

LS3: Heredity: Inheritance and Variation of Traits

PE	Grade and Unit
MS-LS3-1	
MS-LS3-2	

LS4: Biological Evolution: Unity and Diversity

PE	Grade and Unit
MS-LS4-1	
MS-LS4-2	
MS-LS4-3	
MS-LS4-4	
MS-LS4-5	
MS-LS4-6	