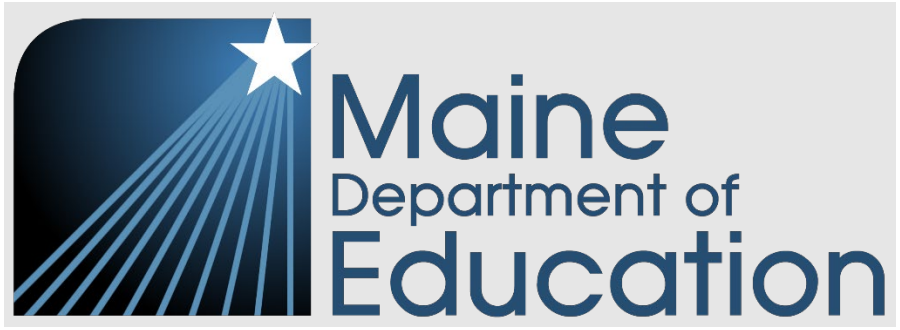
Achievement Level Descriptors (ALDs)

Grade 8

Maine Science Assessment

New Meridian Corporation

2022



Contents

What are ALDs?

- The Achievement Level Descriptors (ALDs) document is intended to be used as a guideline to describe the four levels of achievement, levels of student mastery of the Standards & Instruction - Science & Engineering, identified by the Maine DOE. This document is to support the effective teaching and assessment of Maine K–12 science and engineering instructional programs.

- The ALDs are written to align with the Next Generation Science Standards (NGSS) Topics. The NGSS topics are standards that are grouped to show the natural connections between the Disciplinary Core Ideas. To support the intent of the standards for science instruction and assessment in Maine, all Science and Engineering Practices (SEPs) and Cross-Cutting Concepts (CCCs) can be used interchangeably with any of the Disciplinary Core Ideas (DCIs), not just the ones found in the performance expectations. It is the intent that the SEP and CCC are selected to enhance the application of the DCIs to make sense of a phenomenon presented in a scenario.

General Achievement Levels for Maine

Level 1 Well Below State Expectations	Level 2 Below State Expectations	Level 3 At State Expectations	Level 4 Above State Expectations
The student's work demonstrates a minimal understanding of essential concepts in science. The student's responses demonstrate minimal ability to solve problems. Explanations are illogical, incomplete, or missing connections among central ideas. There are multiple inaccuracies.	The student's work demonstrates an incomplete understanding of essential concepts in science and inconsistent connections among central ideas. The student's responses demonstrate some ability to analyze and solve problems, but the quality of responses is inconsistent. Explanation of concepts may be incomplete or unclear.	The student's work demonstrates an adequate understanding of essential concepts in science, including the ability to make connections among central ideas. The student's responses demonstrate the ability to analyze and solve routine problems and explain central concepts with sufficient clarity and accuracy to demonstrate general understanding.	The student's work demonstrates a thorough understanding of essential concepts in science, including the ability to make multiple connections among central ideas. The student's responses demonstrate the ability to synthesize information, analyze and solve difficult problems, and explain complex concepts using evidence and proper terminology to support and communicate logical conclusions.

How to read this document and the process used by New Meridian

The NGSS topic is listed in the top left corner (and is a clickable link to the NGSS topic page). The ALD for each of the 4 levels of achievement (Well Below State Expectations; Below State Expectations; At State Expectations; Above State Expectations) runs along the top. The ALD statements are combinations of grade level DCIs (shown in orange and regular font), SEPs (shown in blue and underlined), and CCCs (shown in green and italicized). These are exemplar targets that have been constructed by New Meridian Science staff, with feedback from the ME DOE. Again, the intention is to demonstrate that any DCI can be combined with any SEP and any CCC for a particular topic and grade level. There are NOT ALDs for each individual Performance Expectation (PE).

The left column contains the exact text of the grade level DCIs included within a topic, pulled from the NGSS. For each grade, for most topics, each DCI for each topic is met at least once in at least one of the four achievement levels. The grade-level DCI, SEP, and CCC that were used are listed below each ALD. The SEPs are from the NGSS SEP matrix found here (starting on p. 17), and the CCCs are from the NGSS CCC matrix found here (p. 15–17).

The reference DCIs are located below the table and are the DCIs from either the "Above State Expectations" ALD (Grade 5 is MS, and MS is HS), or the "Well Below State Expectations" ALD (Grade 5 is Grades 2–4, MS is Grade 5, and HS is MS). These DCIs were referenced in regards of topic progression.

Example ALD table showing progression of DCIs:
The DCI alone is not what determines the achievement level, rather it is the combination of the 3 dimensions. So, for each exemplar DCI, all other achievement levels could be possible, if combined with different SEPs or CCCs. These documents just give the 4 exemplars, rather than the progression of a single dimension across all 4 achievement levels.

Topic 5.Structure and Properties of Matter	**Well Below State Expectations**	**Below State Expectations**	**At State Expectations**	**Above State Expectations**
Topic DCIs **PS1.A: Structure and Properties of Matter** • Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects. • Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.) • The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. **PS1.B: Chemical Reactions** • When two or more different substances are mixed, a new substance with different properties may be formed. • No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.)	Represent data to reveal *patterns that indicate* that materials can be identified based on their properties, and those properties are suitable for different purposes.			
		Use evidence (measurements) to support an explanation that matter is conserved when substances are mixed, even if a new substance is formed, *given that the total weight of the starting substance(s) is equal to the weight of the new substance(s).*		
			Plan an investigation to show that gases are made of particles that *are too small to be seen* but can be detected in other ways.	
				Support an argument that a new substance *has formed when* different substances are mixed.
	Grade Level DCI, SEP, and *CCC*			
	PS1.A SEP4 (Evaluate) *CCC1 (Patterns)*	PS1.A SEP3 (Investigate) *CCC3 (Scale, Proportion, and Quantity)*	PS1.A PS1.B SEP6 (Reason Scientifically) *CCC3 (Scale, Proportion, and Quantity)*	PS1.B SEP7 (Evaluate) *CCC2 (Cause and Effect)*

Grade 8
Physical Science Topics

Topic MS.Structure and Properties of Matter	**Well Below State Expectations**	**Below State Expectations**	**At State Expectations**	**Above State Expectations**
Topic DCIs **PS1.A Structure and Properties of Matter** • Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. • Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. • Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. • In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. • Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). • The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. **PS1.B: Chemical Reactions** • Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. **PS3.A: Definitions of Energy** • The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. • The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system	Ask questions that arise from observations to seek additional information that matter is made of atoms, *atoms form molecules*, and the spacing of the molecules can help define the state of matter.	Use a model to predict changes *within a system* (e.g., changes in state, temperature, kinetic energy of molecules) when thermal energy is added or removed.	Apply scientific principles to construct an explanation that the rearrangement of atoms due to a chemical reaction *can result in* the formation of a new substance.	Analyze and interpret data to provide evidence that *when a new substance is formed, the new substance has different properties* than the reactants.
	Grade Level DCI, SEP, and *CCC*			
	PS1.A SEP1 (Investigate) *CCC4 (Systems and System Models)*	PS1.A PS3.A SEP2 (Reason Scientifically) *CCC4 (Systems and System Models)*	PS1.B SEP6 (Reason Scientifically) *CCC2 (Cause and Effect)*	PS1.B SEP7 (Evaluate) *CCC2 (Cause and Effect)*

depends jointly on the temperature, the total number of atoms in the system, and the state of the material.				

Reference DCIs:

Well Below State Expectations: Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects. (5, PS1.A)

Above State Expectations: The MS DCIs do not overlap with the HS DCIs for this topic.

Topic MS.Forces and Interactions	**Well Below State Expectations**	**Below State Expectations**	**At State Expectations**	**Above State Expectations**
Topic DCIs **PS2.A: Forces and Motion** • For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law). • The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. • All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared. **PS2.B: Types of Interactions** • Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. • Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun. • Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, a magnet, or a ball, respectively).	Plan an investigation to produce data to serve as evidence about gravitational forces based on the *reference point of Earth's surface*.	Analyze and interpret data about the *relationship between* the material an object is made of and the object's magnetic force/strength.	Use mathematical representations to describe that a change in an object's motion *is proportional* to the forces acting on the object and the mass of the object.	Develop a model to describe the *effects* of changing the distance between two magnets on the magnetic fields/ force.
	Grade Level DCI, SEP, and *CCC*			
	PS2.B SEP1 (Investigate) *CCC4 (Systems and System Models)*	PS2.B SEP4 (Evaluate) *CCC1 (Patterns)*	PS2.A SEP5 (Evaluate) *CCC3 (Scale, Proportion, and Quantity)*	PS2.B SEP2 (Reason Scientifically) *CCC2 (Cause and Effect)*

Reference DCIs:
Well Below Expectations: N/A

Above State Expectations: Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS, PS2.B)

Topic MS.Chemical Reactions	**Well Below** **State Expectations**	**Below** **State Expectations**	**At State** **Expectations**	**Above** **State Expectations**
Topic DCIs **PS1.A: Structure and Properties of Matter** • Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. **PS1.B: Chemical Reactions** • Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. • The total number of each type of atom is conserved, and thus the mass does not change. • Some chemical reactions release energy, others store energy.	Ask questions to identify a pure substance by observing *patterns in several chemical or physical properties* such as color, shape, reactivity, or conductivity.	Use a model to describe that *the total number of atoms does not change* in a chemical reaction.	Plan an investigation to produce data to serve as the basis for evidence that *mass is conserved* in a chemical reaction.	Analyze and interpret data to provide evidence that a chemical reaction has *released energy or absorbed energy.*
	Grade Level DCI, SEP, and *CCC*			
	PS1.A SEP1 (Investigate) *CCC1 (Patterns)*	PS1.B SEP2 (Reason Scientifically) *CCC5 (Energy and Matter)*	PS1.B SEP3 (Investigate) *CCC5 (Energy and Matter)*	PS1.B SEP4 (Evaluate) *CCC5 (Energy and Matter)*

Reference DCIs:
Well Below Expectations: Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.) (5, PS1.A)

Above State Expectations: Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. (HS, PS1.B)

Topic MS.Energy	**Well Below** **State Expectations**	**Below** **State Expectations**	**At State** **Expectations**	**Above** **State Expectations**
Topic DCIs **PS3.A: Definitions of Energy** • Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed. • A system of objects may also contain stored (potential) energy, depending on their relative positions. • Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. **PS3.B: Conservation of Energy and Energy Transfer** • When the motion energy of an object changes, there is inevitably some other change in energy at the same time. • The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. • Energy is spontaneously transferred out of hotter regions or objects and into colder ones. **PS3.C: Relationship Between Energy and Forces** • When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object.	Interpret graphic displays to identify that *energy is transferred (and conserved)* from stored energy when the object is not moving (but at a height) to kinetic energy when the object is in motion.	Make a quantitative and/or qualitative claim regarding the relationship between the potential energy of *a system consisting of a magnet and a magnetic object* and the distance between the objects.	Apply mathematical processes to predict what will happen to an object's *kinetic energy as its mass and/or speed increases.*	Provide evidence to support the claim that a certain material *transfers thermal energy* more effectively than a different material.
	Grade Level DCI, SEP, and *CCC*			
	PS3.A PS3.B SEP4 (Evaluate) *CCC5 (Energy and Matter)*	PS3.C SEP6 (Reason Scientifically) *CCC4 (Systems and System Models)*	PS3.A SEP5 (Evaluate) *CCC3 (Scale, Proportion, and Quantity)*	PS1.B SEP7 (Evaluate) *CCC5 (Energy and Matter)*

Reference DCIs:

Well Below Expectations: Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (4, PS3.B)

Above State Expectations: Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. (HS, PS3.D)

<table>
<tr><th>Topic
MS.Waves and Electromagnetic Radiation</th><th>Well Below
State Expectations</th><th>Below
State Expectations</th><th>At State
Expectations</th><th>Above
State Expectations</th></tr>
<tr><td rowspan="3">Topic DCIs
PS4.A: Wave Properties
• A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.
• A sound wave needs a medium through which it is transmitted.
PS4.B: Electromagnetic Radiation
• When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light.
• The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends.
• A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media.
• However, because light can travel through space, it cannot be a matter wave, like sound or water waves.
PS4.C: Information Technologies and Instrumentation
• Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.</td><td>Use a model to describe repeating patterns of a wave (wavelength, frequency, amplitude).</td><td>Analyze and interpret data to determine similarities and differences between the patterns of analog and digital signals.</td><td>Use graphical displays to determine the path that light takes through or off various materials such as air, glass, and water.</td><td>Construct an explanation that includes qualitative or quantitative relationships about the patterns of light waves and sound waves passing through different media.</td></tr>
<tr><td colspan="4">Grade Level DCI, SEP, and CCC</td></tr>
<tr><td>PS4.A
SEP2 (Reason Scientifically)
CCC1 (Patterns)</td><td>PS4.C
SEP4 (Evaluate)
CCC (Patterns)</td><td>PS4.B
SEP4 (Evaluate)
CCC6 (Structure and Function)</td><td>PS4.A
PS4.B
SEP6 (Reason Scientifically)
CCC1 (Patterns)</td></tr>
</table>

Reference DCIs:
Well Below Expectations: Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (4, PS4.A)

Above State Expectations: The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. (HS, PS4.A)

Grade 8
Life Science Topics

Topic MS.Matter and Energy in Organisms and Ecosystems	**Well Below State Expectations**	**Below State Expectations**	**At State Expectations**	**Above State Expectations**
Topic DCIs **LS1.C: Organization for Matter and Energy Flow in Organisms** • 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. • 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. **LS2.A: Interdependent Relationships in Ecosystems** • 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 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. **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. **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.	Students can use qualitative or quantitative data *to show how matter and energy are transferred* between producers, consumers, and decomposers, and the growth of organisms and populations is *limited by the availability of resources* and competition for those resources.	Students can use observations or measurements as evidence that plants use energy from light to *convert carbon dioxide and water into oxygen and sugars,* which can be consumed by other organisms for energy.	Students can identify the limitations of a model that shows how *matter is transferred* among and within plants, animals, decomposers, and the environment.	Construct an argument supported by evidence that within an organism, when food molecules are broken down, they are rearranged into new molecules that either support growth or are *released as energy.*
	Grade Level DCI, SEP, and *CCC*			
	LS2.B SEP2 (Reason Scientifically) *CCC5 (Energy and Matter)*	LS1.C LS2.B SEP3 (Investigate) *CCC4 (Systems and System Models)*	LS2.A LS2.B LS2.C SEP5 (Evaluate) *Primary CCC5 (Energy and Matter)* *Secondary CCC7 (Stability and Change)*	LS1.C SEP7 (Evaluate) *CCC5 (Energy and Matter)*

Reference DCIs:
Well Below State Expectations: Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment. (5, LS2.B)

Above State Expectations: As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. (HS, LS1.C)

Topic MS.Interdependent Relationships in Ecosystems	Well Below State Expectations	Below State Expectations	At State Expectations	Above State Expectations
Topic DCIs **LS2.A: Interdependent Relationships in Ecosystems** • 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. **LS2.C: Ecosystem Dynamics, Functioning, and Resilience** • Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health.	Ask questions that arise from observations to clarify whether *interactions among organisms* are classified as competitive, predatory, or mutually beneficial.	Revise an experimental design to produce data to serve as evidence that supports the claim that *greater biodiversity indicates a healthier ecosystem.*	Construct an explanation *of the interdependent relationships of organisms* with both biotic and abiotic factors in an ecosystem.	Consider limitations of several human resource *sustainability efforts* to increase ecosystem biodiversity based on set criteria.
	Grade Level DCI, SEP, and *CCC*			
	LS2.A SEP1 (Investigate) *CCC4 (Systems and System Models)*	LS2.C SEP3 (Investigate) *CCC2 (Cause and Effect)*	LS2.A SEP6 (Reason Scientifically) *CCC5 (Energy and Matter)*	LS2.C SEP4 (Evaluate) *CCC7 (Stability and Change)*

Reference DCIs:

Well Below Expectations: When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die. (3, LS2.C)

Above State Expectations: Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. (HS, LS2.C)

Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. (HS, LS2.C)

<table>
<tr><th>Topic
MS.Natural Selection and Adaptation</th><th>Well Below
State Expectations</th><th>Below
State Expectations</th><th>At State
Expectations</th><th>Above
State Expectations</th></tr>
<tr><td rowspan="3">Topic DCIs
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 throughout the history of life on Earth.
• 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.
• Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy.
LS4.B: Natural Selection
• Natural selection leads to the predominance of certain traits in a population, and the suppression of others.
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.</td><td>Use a model to describe the relative age of fossils based on the pattern of their location in rock layers.</td><td>Interpret a data set to identify the relationship between the prevalence of variations of a particular heritable trait and the environments in which they occur.</td><td>Analyze and interpret data for patterns in anatomical similarities amongst several organisms to determine the relative position of those organisms in a cladogram.</td><td>Use mathematical representations of the proportions of each variation of phenotype, for a certain trait within a population over a period of time, to support the scientific conclusion that the population has evolved/is evolving.</td></tr>
<tr><td colspan="4">Grade Level DCI, SEP, and CCC</td></tr>
<tr><td>LS4.A
SEP2 (Reason Scientifically)
CCC1 (Patterns)</td><td>LS4.B
SEP4 (Evaluate)
CCC2 (Cause and Effect)</td><td>LS4.A
SEP4 (Evaluate)
CCC1 (Patterns)</td><td>LS4.C
SEP5 (Evaluate)
CCC7 (Stability and Change)</td></tr>
</table>

Reference DCIs:

Well Below Expectations: Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. (4, ESS1.C)

Above State Expectations: Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. (HS, LS4.C)

Topic MS.Growth, Development, and Reproduction of Organisms	**Well Below State Expectations**	**Below State Expectations**	**At State Expectations**	**Above State Expectations**
Topic DCIs **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) **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 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) **LS4.B: Natural Selection** • 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)	Ask questions that arise from observations of pollinators interacting with *structures of* plants to clarify how animals may increase a plant's reproductive success.	Analyze and interpret data to determine similarities and differences *in the resulting offspring* of plants that have modified traits due to humans.	Develop and use a model (Punnett square) to predict *the probability of phenotypes of the offspring* from a certain parental cross with known genotypes.	Apply scientific principles to construct an explanation as to how a mutation in a gene(s) may affect protein *structure and therefore protein function.*
	Grade Level DCI, SEP, and *CCC*			
	LS1.B SEP1 (Investigate) *CCC6 (Structure and Function)*	LS1.B LS4.B LS3.A SEP4 (Evaluate) *CCC2 (Cause and Effect)*	LS3.A LS3.B SEP2 (Reason Scientifically) *CCC1 (Patterns)*	LS3.B SEP6 (Reason Scientifically) *CCC6 (Structure and Function)*

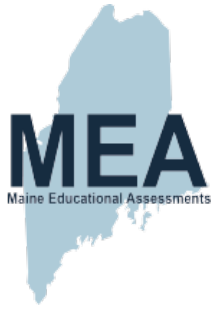
Reference DCIs:
Well Below Expectations: Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles. (3, LS1.B)

Above State Expectations: In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. (HS, LS3.B)

Topic MS.Structure, Function, and Information Processing	**Well Below** **State Expectations**	**Below** **State Expectations**	**At State** **Expectations**	**Above** **State Expectations**
Topic DCIs **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). • Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. • 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. **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.	Analyze and interpret data to identify *differences in cellular structures* that provide evidence for plant cells being able to make their own food while animal cells cannot.	Use a model to describe how the heart and blood vessels work together as the *circulatory system* to transport blood and nutrients throughout the body.	Plan an investigation, including what tools and data are needed, to identify at both *the macroscopic* (entire organisms or objects) *and microscopic* (cells or magnified part of object) *scales* whether several samples are living or nonliving.	Construct an explanation of how a given stimuli is processed by sensory receptors and the *behavior that occurs as a result.*
	Grade Level DCI, SEP, and *CCC*			
	LS1.A SEP4 (Evaluate) *CCC6 (Structure and Function)*	LS1.A SEP2 (Reason Scientifically) *CCC4 (Systems and System Models)*	LS1.A SEP1 (Investigate) *CCC3 (Scale, proportion, and quantity)*	LS1.D SEP6 (Reason Scientifically) *CCC2 (Cause and Effect)*

Reference DCIs:
Well Below Expectations: Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4, LS1.A)

Above State Expectations: Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS, LS1.A)



Grade 8
Earth and Space Science Topics

Topic MS.Weather and Climate	**Well Below State Expectations**	**Below State Expectations**	**At State Expectations**	**Above State Expectations**
Topic DCIs **ESS2.C: The Roles of Water in Earth's Surface Processes** • The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. • Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. **ESS2.D: Weather and climate** • Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. Because these patterns are so complex, weather can only be predicted probabilistically. • The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. **ESS3.D: Global Climate Change** • Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities.	Ask questions to clarify how climate describes a range of an area's typical weather conditions and the extent to which those *conditions vary* over years.	Develop a model to show how sunlight *influences* weather and climate.	Apply scientific ideas or evidence to construct an explanation that weather and climate *are influenced* by interactions involving sunlight, the oceans, landforms, and the atmosphere, as well as human activities.	Use mathematical representations to support explanations that *global climate change is a result of an increase in greenhouse* gases in the atmosphere, which has led to increasing global temperatures that impact local weather.
	Grade Level DCI, SEP, and *CCC*			
	ESS2.D SEP1 (Investigate) *CCC7 (Stability and Change)*	ESS2.D SEP2 (Reason Scientifically) *CCC2 (Cause and Effect)*	ESS3.D ESS2.C SEP6 (Reason Scientifically) *CCC2 (Cause and Effect)*	ESS3.D SEP5 (Evaluate) *CCC2 (Cause and Effect)*

Reference DCIs:

Well Below State Expectations: Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years. (3-ESS2-2) Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next. (3, ESS2.D)

Above State Expectations: Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS, ESS2.D)

Topic MS.Earth's Systems	**Well Below State Expectations**	**Below State Expectations**	**At State Expectations**	**Above State Expectations**
Topic DCIs **ESS2.A: Earth's Materials and Systems** • All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. **ESS2.C: The Roles of Water in Earth's Surface Processes** • Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. • Global movements of water and its changes in form are propelled by sunlight and gravity. **ESS3.A: Natural Resources** • Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes.	Apply scientific ideas to identify pros and cons of using either a *renewable or a nonrenewable resource* for a particular purpose.	Use graphical displays to identify *relationships between* the location of different natural resources and past geologic processes.	Develop a model to describe a *sequence of processes* that resulted in a particular rock formation.	Apply scientific principles to construct an explanation as to how the *energy from the sun,* as well as gravity, are responsible for the movement of water throughout the parts of the water cycle.
	Grade Level DCI, SEP, and *CCC*			
	ESS3.A SEP6 (Reason Scientifically) *CCC7 (Stability and Change)*	ESS3.A SEP4 (Evaluate) *CCC2 (Cause and Effect)*	ESS2.A SEP2 (Reason Scientifically) *CCC5 (Energy and Matter)*	ESS2.C SEP6 (Reason Scientifically) *CCC5 (Energy and Matter)*

Reference DCIs:

Well Below Expectations: Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (5, ESS3.C)

Above State Expectations: The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. (HS, ESS2.D)

Topic MS.Space Systems	**Well Below** **State Expectations**	**Below** **State Expectations**	**At State** **Expectations**	**Above** **State Expectations**
Topic DCIs **ESS1.A: The Universe and Its Stars** • Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. • Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. **ESS1.B: Earth and the Solar System** • The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. • This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. • The solar system appears to have formed from a disk of dust and gas, drawn together by gravity.	Ask questions to clarify *a model* of the solar system.	Use *a model* to explain the relationship between the positions of the sun, moon, and Earth in a solar eclipse.	Apply scientific evidence to construct an explanation for how the *planets of the solar system* are held in orbit.	Construct an argument based on scientific reasoning that seasons *are a result of* the tilt of Earth's axis of rotation and not a result of Earth's proximity to the Sun.
	Grade Level DCI, SEP, and *CCC*			
	ESS1.B SEP1 (Investigate) *CCC4 (Systems and System Models)*	ESS1.A ESS1.B SEP2 (Reason Scientifically) *CCC4 (Systems and System Models)*	ESS1.B SEP6 (Reason Scientifically) *CCC4 (Systems and System Models)*	ESS1.B SEP7 (Evaluate) *CCC2 (Cause and Effect)*

Reference DCIs:
Well Below Expectations: The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center. (MS, PS2.B)

Above State Expectations: N/A

Topic MS.History of Earth	**Well Below State Expectations**	**Below State Expectations**	**At State Expectations**	**Above State Expectations**
Topic DCIs **ESS1.C: The History of Planet Earth** • The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale. • Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. **ESS2.A: Earth's Materials and Systems** • The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. **ESS2.B: Plate Tectonics and Large-Scale System Interactions** • Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart. **ESS2.C: The Roles of Water in Earth's Surface Processes** • Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations.	Ask questions that arise from an observation of pictures of a landform many years apart regarding the *processes that have caused changes* to the landform throughout those years.	Use a model to determine the relative age of fossils *based on their placement* in rock strata.	Apply scientific principles to provide an explanation for the multiple geoscience processes that have occurred *over varying time scales* (such as crater formation and then erosion) that have resulted in a particular surface feature.	Analyze and interpret data on maps to provide evidence that tectonic plates have moved *throughout the history of Earth*, shifting land masses and producing geologic features.
	Grade Level DCI, SEP, and *CCC*			
	ESS2.A ESS2.C SEP1 (Investigate) *CCC7 (Stability and Change)*	ESS1.C SEP2 (Evaluate) *CCC1 (Patterns)*	ESS2.A SEP6 (Reason Scientifically) *CCC3 (Scale, Proportion, and Quantity)*	ESS2.B SEP4 (Evaluate) *CCC3 (Scale, Proportion, and Quantity)*

Reference DCIs:
Well Below Expectations: Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. (4, ESS2.A)

Above State Expectations: Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history. (HS, ESS1.C)

Topic MS.Human Impacts	**Well Below State Expectations**	**Below State Expectations**	**At State Expectations**	**Above State Expectations**
Topic DCIs **ESS3.B: Natural Hazards** • Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. **ESS3.C: Human Impacts on Earth Systems** • Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. • Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.	Ask questions to clarify evidence of the tradeoffs of growing a particular crop in the shade as opposed to growing the crop in full sun, which requires *deforestation*.	Analyze data to identify potential *environmental impacts* of fossil fuel usage by humans as either sudden or gradual.	Use maps showing historical natural hazards to explain the *correlation between* a particular abiotic factor, such as temperature, and the frequency or severity of a particular natural hazard.	Construct an argument supported by evidence that increases in human populations and per capita consumption of natural resources *have negatively impacted* Earth.
	Grade Level DCI, SEP, and *CCC*			
	ESS3.C SEP1 (Investigate) *CCC7 (Stability and Change)*	ESS3.C SEP4 (Evaluate) *CCC4 (Systems and System Models)*	ESS3.B SEP4 (Evaluate) *CCC1 (Patterns)*	ESS3.C SEP6 (Reason Scientifically) *CCC2 (Cause and Effect)*

Reference DCIs:
Well Below Expectations: Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (5, ESS3.C)

Above State Expectations: The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. (HS, ESS3.C)