DoDEA College and Career Ready Standards for Science
Integrated Science II

COLLEGE AND CAREER READY
A WORLD-CLASS EDUCATION FOR MILITARY-CONNECTED STUDENTS

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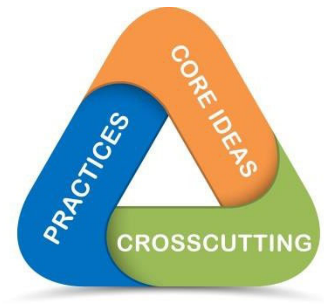
DEPARTMENT OF DEFENSE EDUCATION ACTIVITY

Three Dimensional Learning

The National Research Council's (NRC) *A Framework for K-12 Science Education* describes a vision of what it means to be proficient in science; it rests on a view of science as both a body of knowledge and an evidence-based, model and theory building enterprise that continually extends, refines, and revises knowledge. It presents the following three dimensions: practices, crosscutting concepts, and disciplinary core ideas (DCIs) that will be combined to form each standard:

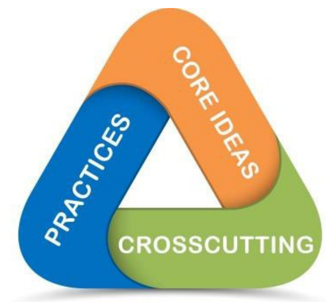


DIMENSION 1: PRACTICES	The practices describe behaviors that scientists engage in as they investigate and build models and theories about the natural world and the key set of engineering practices that engineers use as they design and build models and systems. The NRC uses the term practices instead of a term like "skills" to emphasize that engaging in scientific investigation requires not only skill but also knowledge that is specific to each practice. Part of the NRC's intent is to better explain and extend what is meant by "inquiry" in science and the range of cognitive, social, and physical practices that it requires. Although engineering design is similar to scientific inquiry, there are significant differences. For example, scientific inquiry involves the formulation of a question that can be answered through investigation, while engineering design involves the formulation of a problem that can be solved through design. Strengthening the engineering aspects of the Next Generation Science Standards will clarify for students the relevance of science, technology, engineering and mathematics (the four STEM fields) to everyday life.
DIMENSION 2: CROSSCUTTING CONCEPTS	Crosscutting concepts have application across all domains of science. As such, they are a way of linking the different domains of science. They include: Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Structure and Function; Stability and Change. The NRC Framework emphasizes that these concepts need to be made explicit for students because they provide an organizational schema for interrelating knowledge from various science fields into a coherent and scientifically-based view of the world.
DIMENSION 3: DISCIPLINARY CORE IDEAS (DCIs)	Disciplinary core ideas have the power to focus K–12 science curriculum, instruction and assessments on the most important aspects of science. To be considered core, the ideas should meet at least two of the following criteria and ideally all four: ▪ Have broad importance across multiple sciences or engineering disciplines or be a key organizing concept of a single discipline; ▪ Provide a key tool for understanding or investigating more complex ideas and solving problems; ▪ Relate to the interests and life experiences of students or be connected to societal or personal concerns that require scientific or technological knowledge; ▪ Be teachable and learnable over multiple grades at increasing levels of depth and sophistication. Disciplinary ideas are grouped in four domains: the physical sciences; the life sciences; the earth and space sciences; and engineering, technology and applications of science.

How To Read The Standards

Performance Expectation

The DoDEA College and Career Ready Standards for Science (CCRSS) are written as a set of performance expectations that are assessable statements of what students should know and be able to do. An underlying assumption of these standards is that all students should be held accountable for demonstrating their achievement of all performance expectations. A coherent and complete view of what students should be able to do comes when the performance expectations are viewed in tandem with the contents of the foundation boxes that lie just below the performance expectations. These three boxes include the practices, disciplinary core ideas, and crosscutting concepts, derived from the National Research Council's Framework for K12 Science Education that were used to construct this set of performance expectations.



Science and Engineering Practices (SEPs)	Disciplinary Core Ideas (DCIs)	Crosscutting Concepts (CCCs)
The blue box on the left includes the science and engineering practices used to construct the performance expectations in the box above. These statements are derived from and grouped by the eight categories detailed in the NRC Framework to further explain the science and engineering practices important to emphasize in each grade band. Most sets of performance expectations emphasize only a few of the practice categories; however, all practices are emphasized within a grade band.	The orange box in the middle includes statements that are taken from the NRC Framework about the most essential ideas in the major science disciplines that all students should understand during 13 years of school. Including these detailed statements was very helpful to the writing team as they analyzed and "unpacked" the disciplinary core ideas and sub-ideas to reach a level that is helpful in describing what each student should understand about each sub-idea at the end of grades 2, 5, 8, and 12. Although they appear in paragraph form in the NRC Framework, here they are bulleted to be certain that each statement is distinct.	The green box on the right includes statements derived from the NRC Framework's list of crosscutting concepts, which apply to one or more of the performance expectations in the box above. Most sets of performance expectations limit the number of crosscutting concepts so as focus on those that are readily apparent when considering the DCIs; however, all are emphasized within a grade band. Aspects of the Nature of Science relevant to the standard are also listed in this box, as are the interdependence of science and engineering, and the influence of engineering, technology, and science on society and the natural world.

CONNECTION BOXES

Three Connection Boxes are designed to support a coherent vision of the standards by showing how the performance expectations in each standard connect to other performance expectations in science, as well as to the DoDEA College and Career Ready Standards for English/Language Arts (CCRSL) and Mathematics (CCRSM).

The three boxes include:

Connections to other DCIs in this grade level or band. This box contains the names of science topics in other disciplines that have related disciplinary core ideas at the same grade level. For example, both Physical Science and Life Science performance expectations contain core ideas related to photosynthesis, and could be taught in relation to one another

Articulation of DCIs across grade levels. This box contains the names of other science topics that either:
1) provide a foundation for student understanding of the core ideas in this set of performance expectations (usually at prior grade levels) or
2) build on the foundation provided by the core ideas in this set of performance expectations (usually at subsequent grade levels).

DoDEA College and Career Ready Standards
This box contains the connections to ELA/Literacy (CCRSL) and Mathematics (CCRSM) as shown below.

ELA/Literacy (CCRSL) Connections	
SCIENCE	**ELA/LITERACY**
Performance Expectation	Standard Connection

Mathematics (CCRSM) Connections	
SCIENCE	**MATHEMATICS**
Performance Expectation	Standard Connection

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Integrated Science II Storyline:

Module I Energy & Energy Transfer

Unit 1 Energy

In Module I, Unit 1, you will begin exploring different forms of energy and the relationship between energy and matter. As you work on Unit 1, you will analyze how energy can flow in natural and designed systems. Later in the unit, you will use the engineering design process to design, build, and test a toy that demonstrates different forms and amounts of energy. In Unit 1, you will explore questions such as

- How does energy interact with and change objects?
- What are the different forms that energy can take?
- How does the flow of energy drive the cycling of matter within systems?

Unit 2 Energy Transfer

In Unit 2, you will build on the introduction to energy in Unit 1 by exploring the different forms of energy in more detail. You will investigate how energy can be transferred from one object to another and how energy can change forms, and you will consider that energy is conserved during these transfers and transformations. Later in the unit, you will investigate the relationship between temperature and thermal energy and model the flow of thermal energy through systems. You will then build on these concepts and use the engineering design process to design an insulated container to keep ice water cold. In Unit 2, you will explore questions such as

- How can energy be transferred from one object to another?
- What happens when energy changes from one form to another?
- How are temperature and heat related to thermal energy?
- How can people use knowledge of the thermal properties of materials to help design solutions to problems?

Integrated Science II Storyline:

Module L Waves & Their Applications

Unit 1 Waves

In Module L, Unit 1, you will apply your understanding of energy from Module I to investigate how waves transfer energy from one place to another. You will explore how the properties of a wave are affected by the type of matter the wave is traveling through. Later in the unit, you will analyze the unique properties of light waves and investigate how these properties contribute to the way humans perceive color and brightness. You will then use your understanding of light waves to explore the behavior of light in different phenomena. In Unit 1, you will explore questions such as

- How do waves transfer energy?
- What are some different types of waves?
- How do humans perceive light waves?
- How do light waves interact with matter?

Unit 2 Information Transfer

In Unit 2, you will apply your understanding of waves from Unit 1 to explore how technologies that we use every day send and receive information using wave energy. You will compare analog and digital information and discover how these can both be encoded in electromagnetic waves. You will then use these concepts to analyze how communication technology is developed to provide reliable methods of transmitting information. Later in Unit 2, you will investigate how these types of communication technologies can improve scientific studies. In Unit 2, you will explore questions such as

- How can a message be encoded?
- How can waves be modified to carry encoded information?
- How do designers of communication technology decide if they should use analog or digital signals?
- How have digital signals helped advance scientific discovery?

Integrated Science II Storyline:

Module F Geologic Processes & History

Unit 1 The Dynamic Earth

In Module F, Unit 1, you will apply your understanding of energy from Module I to investigate how the flow of energy drives the cycling of matter on Earth. You will begin the unit by modeling how geologic processes can change Earth's surface over time. You will then model the rock cycle to help explain how it contributes to the cycling of matter on Earth. Later in the unit, you will build on your understanding of this cycling of matter by investigating how Earth's surface has changed over time due to tectonic plate motion and other interactions between Earth's subsystems at different scales. In Unit 1, you will explore questions such as

- How do the processes of weathering, erosion, and deposition shape Earth's surface?
- How can rocks change from one type to another?
- How does the rock cycle recycle matter on Earth?
- What types of evidence can be used to explain the motion of tectonic plates and the movement of continents over time?
- How does energy from Earth's interior drive interactions that transfer matter and energy between Earth's subsystems?

Unit 2 Earth through Time

In Unit 2, you will build on your knowledge from Unit 1 about the cycling of rock in the Earth system as you investigate how scientists determine the ages of different rocks using relative and absolute dating. As you work through Unit 2, you will also explore how fossils form and how some fossils can be used to establish the ages of rock layers. Later in the unit, you will explain how rock and fossil evidence are used to organize Earth's history into the geologic time scale. In Unit 2, you will explore questions such as

- What is the difference between relative age and absolute age?
- How can the absolute age of Earth be determined?
- How can rocks and fossils be analyzed to describe Earth's past?
- How is the geologic time scale used to study events from Earth's history?

Integrated Science II Storyline:

Module B Cells & Heredity

Unit 1 Cells

In Module B, Unit 1, you will build on your understanding of systems from Modules I and F as you begin to study cells, which are the smallest living systems. As you work through the unit, you will conduct an investigation to provide evidence that living things are made of cells and that cells are a distinguishing feature of living things. Later in the unit, you will use models to describe how cell structures are responsible for particular functions. In Unit 1, you will explore questions such as

- How can cells be observed?
- How is a cell an example of a living system?
- How do the structures within a cell relate to their function?
- Why are cells so small?

Unit 2 Organisms as Systems

In Unit 2, you will build on your study of cells from Unit 1 and further apply your understanding of systems from Modules I and F as you investigate organisms as living systems. You will also continue to explore how structure relates to function at each level of organization—from cells through tissues, organs, organ systems, and organisms. Later in the unit, you will investigate plant and animal bodies as systems in more detail, including how the flow of energy drives the cycling of matter in these systems. Finally, you will gather evidence to describe how an animal's nervous system functions to process information. In Unit 2, you will explore questions such as

- How are living things organized?
- How do body systems interact to perform all life functions?
- How do plant body systems interact to respond to the environment?
- How do animal body systems interact to process information?

Unit 3 Reproduction, Heredity, and Growth

In Unit 3, you will continue your study of organisms from Units 1 and 2 as you investigate how the traits of organisms are passed down from parents to offspring. You will use models to compare the genetic results of asexual and sexual reproduction. Then you will analyze how different factors affect the growth and successful reproduction of organisms. Later in the unit, you will evaluate different reproductive strategies and relate animal behaviors to reproductive success. In Unit 3, you will explore questions such as

- How are genes related to an organism's traits?
- How are different types of reproduction related to genetic variation?
- What influences the reproductive success of flowering plants?
- How are animal behaviors related to reproductive success?
- How can genetic and environmental factors influence the growth of organisms?

MS-PS3 Energy

MS-PS3 Energy

Students who demonstrate understanding can:

MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
[Clarification Statement: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a wiffle ball versus a tennis ball.]

MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.
[Clarification Statement: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.] [Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions.]

MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.*
[Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]

MS-PS3-4. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.
[Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]

MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.
[Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.] [Assessment Boundary: Assessment does not include calculations of energy.]

The performance expectations 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 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. ▪ Develop a model to describe unobservable mechanisms. (MS-PS3-2)	**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. (MS-PS3-1) ▪ A system of objects may also contain stored (potential) energy, depending on their relative positions. (MS-PS3-2)	**Scale, Proportion, and Quantity** ▪ Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. (MS-PS3-1),(MS-PS3-4)

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Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions. ▪ Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. (MS-PS3-4) **Analyzing and Interpreting Data** Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. ▪ Construct and interpret graphical displays of data to identify linear and nonlinear relationships. (MS-PS3-1) **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. ▪ Apply scientific ideas or principles to design an object, tool, process or system. (MS-PS3-3) **Engaging in Argument from Evidence** Engaging in argument from evidence in 6–8 builds from K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.	▪ 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. (MS-PS3-3),(MS-PS3-4) **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. (MS-PS3-5) ▪ 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. (MS-PS3-4) ▪ Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (MS-PS3-3) **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. (MS-PS3-2) **ETS1.A: Defining and Delimiting an Engineering Problem** ▪ The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. (secondary to MS-PS3-3) **ETS1.B: Developing Possible Solutions** ▪ A solution needs to be tested, and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. (secondary to MS-PS3-3)	**Stability and Change** • Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems. (MS-PS3-2) **Energy and Matter** ▪ Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). (MS-PS3- 5) ▪ The transfer of energy can be tracked as energy flows through a designed or natural system. (MSPS3-3)

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
▪ Construct and present oral and written arguments 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-PS3-5) --- **Connections to Nature of Science** **Scientific Knowledge is Based on Empirical Evidence** ▪ Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS3-4),(MS-PS3-5)		

Connections

CONNECTIONS
Connections to other DCIs in this grade-band: MS.PS1.A (MS-PS3-4); MS.PS1.B (MS-PS3-3); MS.PS2.A (MS-PS3-1),(MS-PS3-4),(MS-PS3-5); MS.ESS2.A (MS-PS3-3); MS.ESS2.C (MS-PS3-3),(MS-PS3-4); MS.ESS2.D (MS-PS3-3),(MS-PS3-4); MS.ESS3.D (MS-PS3-4) Articulation across grade-bands: 4.PS3.B (MS-PS3-1),(MS-PS3-3); 4.PS3.C (MS-PS3-4)
Articulation across grade-bands: 4.PS3.B (MS-PS3-1),(MS-PS3-3); 4.PS3.C (MS-PS3-4),(MS-PS3-5); HS.PS1.B (MS-PS3-4); HS.PS2.B (MS-PS3-2); HS.PS3.A (MS-PS3-1),(MS-PS3- 4),(MS-PS3-5); HS.PS3.B (MS-PS3-1),(MS-PS3-2),(MS-PS3-3),(MS-PS3-4),(MS-PS3-5); HS.PS3.C (MS-PS3-2)

DODEA COLLEGE AND CAREER READY STANDARDS

ELA/Literacy (CCRSL) Connections	
SCIENCE	ELA/LITERACY
(MS-PS3-1) (MS-PS3-5)	**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-PS3-3) (MS-PS3-5)	**RST.6-8.3** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
(MS-PS3-1)	**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-PS3-5)	**WHST.6-8.1** Write arguments focused on discipline-specific content. ,
(MS-PS3-3) (MS-PS3-4)	**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-PS3-2)	**SL.8.5** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.

Connections

DODEA COLLEGE AND CAREER READY STANDARDS

Mathematics (CCRSM) Connections

SCIENCE	MATHEMATICS
(MS-PS3-1) (MS-PS3-4) (MS-PS3-5)	**MP.2** Reason abstractly and quantitatively.
(MS-PS3-1) (MS-PS3-5)	**6.RP.A.1** Understand the concept of ratio and use ratio language to describe a ratio relationship between two quantities.
(MS-PS3-1)	**6.RP.A.2** Understand the concept of a unit rate a/b associated with a ratio a:b with b ≠ 0, and use rate language in the context of a ratio relationship
(MS-PS3-1) (MS-PS3-5)	**7.RP.A.2** Recognize and represent proportional relationships between quantities.
(MS-PS3-1)	**8.EE.A.1** Know and apply the properties of integer exponents to generate equivalent numerical expressions.
(MS-PS3-1) (MS-PS3-5)	**8.EE.A.2** Use square root and cube root symbols to represent solutions to equations of the form x2 = p and x3 = p, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that √2 is irrational.
(MS-PS3-1) (MS-PS3-5)	**8.F.A.3** Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.
(MS-PS3-4)	**7.RP.A.2** Summarize numerical data sets in relation to their context.

MS-PS4 Waves and Their Applications in Technologies for Information Transfer

MS-PS4 Waves and Their Applications in Technologies for Information Transfer

Students who demonstrate understanding can:

MS-PS4-1. **Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.** [Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.] [Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.]

MS-PS4-2. **Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.** [Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.] [Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves.]

MS-PS4-3. **Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.** [Clarification Statement: Emphasis is on a basic understanding that waves can be used for communication purposes. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in wifi devices, and conversion of stored binary patterns to make sound or text on a computer screen.] [Assessment Boundary: Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device.]

The performance expectations 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 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. ▪ Develop and use a model to describe phenomena. (MS-PS4-2) **Using Mathematics and Computational Thinking** Mathematical and computational thinking at the 6–8 level builds on K–5 and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. ▪ Use mathematical representations to describe and/or support scientific conclusions and design solutions. (MS-PS4-1)	**PS4.A: Wave Properties** ▪ A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS-PS4-1) ▪ A sound wave needs a medium through which it is transmitted. (MS-PS4-2) **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. (MS-PS4-2)	**Patterns** ▪ Graphs and charts can be used to identify patterns in data. (MS-PS4- 1) **Structure and Function** ▪ Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (MS-PS4-2) ▪ Structures can be designed to serve particular functions. (MS-PS4-3)

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6-8 builds on K-5 and progresses to evaluating the merit and validity of ideas and methods. ▪ Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims and findings. (MS-PS4-3) --- **Connections to Nature of Science Scientific Knowledge is Based on Empirical Evidence** ▪ Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS4-1)	▪ 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. (MS-PS4-2) ▪ A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. (MS-PS4-2) ▪ However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2) **PS4.C: Information Technologies and Instrumentation** ▪ Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (MS-PS4-3)	--------------------------------------- **Connections to Engineering, Technology, and Applications of Science Influence of Science,** **Engineering, and Technology on Society and the Natural World** ▪ Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations. (MS-PS4-3) -- **Connections to Nature of Science** **Science is a Human Endeavor** ▪ Advances in technology influence the progress of science and science has influenced advances in technology. (MS-PS4-3)

Connections

CONNECTIONS
Connections to other DCIs in this grade-band: MS.LS1.D (MS-PS4-2)
Articulation across grade-bands: 4.PS3.A (MS-PS4-1); 4.PS3.B (MS-PS4-1); 4.PS4.A (MS-PS4-1); 4.PS4.B (MS-PS4-2); 4.PS4.C (MS-PS4-3); HS.PS4.A (MS-PS4-1),(MS-PS4-2),(MS-PS4-3); HS.PS4.B (MS-PS4-1),(MS-PS4-2); HS.PS4.C (MS-PS4-3); HS.ESS1.A (MS-PS4-2); HS.ESS2.A (MS-PS4-2); HS.ESS2.C (MS-PS4-2); HS.ESS2.D (MS-PS4-2)

DODEA COLLEGE AND CAREER READY STANDARDS

ELA/Literacy (CCRSL) Connections	
SCIENCE	ELA/LITERACY
(MS-PS4-3)	**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-PS4-3)	**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-PS4-3)	**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-PS4-3)	**WHST.6-8.9** Draw evidence from informational texts to support analysis, reflection, and research.
(MS-PS4-3) (MS-PS4-3)	**SL.8.5** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.

Connections

DODEA COLLEGE AND CAREER READY STANDARDS

Mathematics (CCRSM) Connections

SCIENCE	MATHEMATICS
(MS-PS4-1)	**MP.2** Reason abstractly and quantitatively.
(MS-PS4-1)	**MP.4** Model with mathematics.
(MS-PS4-1)	**6.RP.A.1** Understand the concept of ratio and use ratio language to describe a ratio relationship between two quantities.
(MS-PS4-1)	**6.RP.A.3** Use ratio and rate reasoning to solve real-world and mathematical problems.
(MS-PS4-1)	**7.RP.A.2** Recognize and represent proportional relationships between quantities.
(MS-PS4-1)	**8.F.A.3** Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.

MS-ESS1 Earth's Place in the Universe

MS-ESS1 Earth's Place in the Universe		
Students who demonstrate understanding can: **MS-ESS1-4. Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.** [Clarification Statement: Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range from being very recent (such as the last Ice Age or the earliest fossils of homo sapiens) to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains and ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions.] [Assessment Boundary: Assessment does not include recalling the names of specific periods or epochs and events within them.]		
The performance expectations 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**
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 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. (MS-ESS1-4)	**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. (MS-ESS1-4)	**Scale, Proportion, and Quantity** ▪ Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS1-4)

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea. The section entitled "Disciplinary Core Ideas" is reproduced verbatim from A Framework for K-12 Science Education: Practices, Cross-Cutting Concepts, and Core Ideas.

Connections

CONNECTIONS
Connections to other DCIs in this grade-band: MS.LS4.A (MS-ESS1-4); MS.LS4.C (MS-ESS1-4);
Articulation across grade-bands: 3.LS4.A (MS-ESS1-4); 3.LS4.C (MS-ESS1-4); 4.ESS1.C (MS-ESS1-4); HS.PS1.C (MS-ESS1-4); HS.LS4.A (MS-ESS1-4); HS.LS4.C (MS-ESS1-4); HS.ESS1.C (MS-ESS1-4); HS.ESS2.A (MS-ESS1-4)

DODEA COLLEGE AND CAREER READY STANDARDS

ELA/Literacy (CCRSL) Connections

SCIENCE	ELA/LITERACY
(MS-ESS1-4)	**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-ESS1-4)	**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.

Mathematics (CCRSM) Connections

SCIENCE	MATHEMATICS
(MS-ESS1-4)	**6.EE.B.6** Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.
(MS-ESS1-4)	**7.EE.B.6** Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

MS-ESS2 Earth's Systems

MS-ESS2 Earth's Systems

Students who demonstrate understanding can:

MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
[Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.] [Assessment Boundary: Assessment does not include the identification and naming of minerals.]

MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.
[Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.]

MS-ESS2-3. Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.
[Clarification Statement: Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches).] [Assessment Boundary: Paleomagnetic anomalies in oceanic and continental crust are not assessed.]

The performance expectations 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 phenomena and design systems. ▪ Develop and use a model to describe phenomena. (MSESS2-1) **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-ESS2-3)	**ESS1.C: The History of Planet Earth** ▪ Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. (HS.ESS1.C GBE) (secondary to MS-ESS2-3) **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. (MS-ESS2-1)	**Patterns** • Patterns in rates of change and other numerical relationships can provide information about natural systems. (MS-ESS2-3) **Scale Proportion and Quantity** ▪ Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS2-2) ▪ **Stability and Change** ▪ Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale. (MS-ESS2-1)

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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 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. (MS-ESS2-2) -- **Connections to Nature of Science** **Scientific Knowledge is Open to Revision in Light of New Evidence** ▪ Science findings are frequently revised and/or reinterpreted based on new evidence. (MS-ESS2-3)	▪ 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. (MS-ESS2-2) **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. (MS-ESS2-3) ▪ Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations. (MS-ESS2-2)	

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea. The section entitled "Disciplinary Core Ideas" is reproduced verbatim from A Framework for K-12 Science Education: Practices, Cross-Cutting Concepts, and Core Ideas.

Connections

CONNECTIONS
Connections to other DCIs in this grade-band: MS.PS1.A (MS-ESS2-1); MS.PS1.B (MS-ESS2-1), (MS-ESS2-2); MS.PS3.B (MS-ESS2-1); MS.LS2.B (MSESS2-1), (MS-ESS2-2); MS.LS2.C (MS-ESS2-1); MS.LS4.A (MS-ESS2-3); MS.ESS1.B (MS-ESS2-1); MS.ESS3.C (MS-ESS2-1)
Articulation across grade-bands: 3.LS4.A (MS-ESS2-3); 3.ESS3.B (MS-ESS2-3); 4.PS3.B (MS-ESS2- 1); 4.ESS1.C (MS-ESS2-2), (MS-ESS2-3); 4.ESS2.A (MS-ESS2-1), (MS-ESS2-2); 4.ESS2.B (MS-ESS2-3); 4.ESS2.E (MS-ESS2-2); 4.ESS3.B (MS-ESS2-3); 5.ESS2.A (MS-ESS2-1), (MS-ESS2-2); HS.PS1.B (MS-ESS2-1); HS.PS3.B (MS-ESS2- 1); HS.PS3.D (MS-ESS2-2); HS.LS1.C (MS-ESS2-1); HS.LS2.B (MS-ESS2-1), (MS-ESS2-2); HS.LS4.A (MS-ESS2-3); HS.LS4.C (MS-ESS2-3); HS.ESS1.C (MS-ESS2-2), (MS-ESS2-3); HS.ESS2.A (MS-ESS2-1),(MS-ESS2-2), (MS-ESS2-3); HS.ESS2.B (MS-ESS2-2), (MS-ESS2-3); HS.ESS2.C (MS-ESS2-1), (MS-ESS2-2); HS.ESS2.D (MS-ESS2-2); HS.ESS2.E (MS-ESS2- 1), (MS-ESS2-2); HS.ESS3.D (MS-ESS2-2)

DODEA COLLEGE AND CAREER READY STANDARDS

ELA/Literacy (CCRSL) Connections

SCIENCE	ELA/LITERACY
(MS-ESS2-2) (MS-ESS2-3)	**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-ESS2-2)	**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-ESS2-3)	**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-ESS2-1) (MS-ESS2-2)	**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-ESS2-1) (MS-ESS2-2)	**SL8.5** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.

Connections

DODEA COLLEGE AND CAREER READY STANDARDS

Mathematics (CCRSM) Connections

SCIENCE	MATHEMATICS
(MS-ESS2-2) (MS-ESS2-3)	**MP.2** Reason abstractly and quantitatively.
(MS-ESS2-5)	**6.NS.C.5** Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation
(MS-ESS2-2) (MS-ESS2-3)	**6.EE.B.6** Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.
(MS-ESS2-2) (MS-ESS2-3)	**7.EE.B.4** Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

MS-LS1 From Molecules to Organisms: Structures and Processes

MS-LS1 From Molecules to Organisms: Structures and Processes
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.** [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-LS1-2. Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.** [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 limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.] **MS-LS1-3. 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-LS1-4. 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.** [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-LS1-5. 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-LS1-8. 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.]

The performance expectations 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 phenomena and design systems. ▪ Develop and use a model to describe phenomena. (MS-LS1-2) **Planning and Carrying Out Investigations** Planning and carrying out investigations in 6-8 builds on K5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. ▪ Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. (MS-LS1-1) **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 knowledge, principles, and theories. ▪ 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. (MS-LS1-5)	**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) ▪ 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)	**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),(MSLS1-5) **Scale, Proportion, and Quantity** ▪ 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) **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)

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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 for either explanations or solutions about the natural and designed world(s). ▪ Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. (MS-LS1-3) ▪ 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. (MS-LS1-4) **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-LS1-8)	**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)	- ***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) - ***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)

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Connections

CONNECTIONS
Connections to other DCIs in this grade-band: MS.LS2.A (MS-LS1-4),(MS-LS1-5); MS.LS3.A (MS-LS1-2);
Articulation across grade-bands: 3.LS1.B (MS-LS1-4),(MS-LS1-5); 3.LS3.A (MS-LS1-5); 4.LS1.A (MS-LS1-2); 4.LS1.D (MS-LS1-8); HS.LS1.A (MS-LS1-1),(MS-LS1-2),(MS-LS1-3),(MS-LS1-8); HS.LS2.A (MS-LS1-4),(MS-LS1-5); HS.LS2.D (MS-LS1-4);

DODEA COLLEGE AND CAREER READY STANDARDS

ELA/Literacy (CCRSL) Connections

SCIENCE	ELA/LITERACY
(MS-LS1-3) (MS-LS1-4) (MS-LS1-5)	**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-LS1-5)	**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-LS1-3) (MS-LS1-4)	**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.
(MS-LS1-3) (MS-LS1-4)	**WHST.6-8.1** Write arguments focused on discipline content.
(MS-LS1-5)	**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-LS1-1)	**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-LS1-8)	**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-LS1-5)	**WHST.6-8.9** Draw evidence from informational texts to support analysis, reflection, and research.
(MS-LS1-2)	**SL8.5** Integrate_multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.

Connections

DODEA COLLEGE AND CAREER READY STANDARDS

Mathematics (CCRSM) Connections	
SCIENCE	MATHEMATICS
(MS-LS1-1) (MS-LS1-2) (MS-LS1-3)	**6.EE.C.9** Use variables 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 variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.
(MS-LS1-4) (MS-LS1-5)	**6.SP.A.2** Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.
(MS-LS1-4) (MS-LS1-5)	**6.RP.A.1** Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities

MS-LS3 Heredity: Inheritance and Variation of Traits

MS-LS3 Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can:

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.
[Clarification Statement: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.]

The performance expectations 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 dev eloping, using, and revising models to describe, test, and predict more abstract phenomena and design systems. ▪ Develop and use a model to describe phenomena. MS-LS3-2)	**LS1.B: Growth and Development of Organisms** ▪ Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. (secondary to MSLS3-2) **LS3.A: Inheritance of Traits** ▪ 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)	**Cause and Effect** ▪ Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS3- 2)

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Connections

CONNECTIONS
Connections to other DCIs in this grade-band:
Articulation across grade-bands: 3.LS3.A (MS-LS3-2); 3.LS3.B (MS-LS3-2); HS.LS1.B (MS-LS3-2); HS.LS3.A (MS-LS3-2); HS.LS3-B (MS-LS3-2)

DODEA COLLEGE AND CAREER READY STANDARDS

ELA/Literacy (CCRSL) Connections	
SCIENCE	ELA/LITERACY
(MS-LS3-2)	**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-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-LS3-2)	**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-LS3-2)	**SL8.5** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.

Mathematics (CCRSM) Connections	
SCIENCE	MATHEMATICS
(MS-LS3-2)	**MP.4** Model with mathematics.
(MS-LS3-2)	**6.SP.B.5** Summarize numerical data sets in relation to their context

MS-ETS1 Engineering Design

MS-ETS1 Engineering Design

Students who demonstrate understanding can:

MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-4. 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.

The performance expectations 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 phenomena and design systems. ▪ Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4) **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 for either explanations or solutions about the natural and designed world. ▪ Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ETS1-2)	**ETS1.B: Developing Possible Solutions** ▪ A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) ▪ Models of all kinds are important for testing solutions. (MS-ETS1-4) **ETS1.C: Optimizing the Design Solution** ▪ The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MSETS1-4)	

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Connections

CONNECTIONS

Articulation of DCIs across grade-bands: 3-5.ETS1.A (MS-ETS1-2); 3-5.ETS1.B (MS-ETS1-2),(MS-ETS1-4); 3-5.ETS1.C (MSETS1-2),(MS-ETS1-4); HS.ETS1.A (MS-ETS1-2); HS.ETS1.B (MS-ETS1-2),(MS-ETS1-4); HS.ETS1.C (MS-ETS1-4)

DODEA COLLEGE AND CAREER READY STANDARDS

ELA/Literacy (CCRSL) Connections

SCIENCE	ELA/LITERACY
(MS-ETS1-2)	**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-ETS1-2)	**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-ETS1-2)	**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-ETS1-2)	**WHST.6-8.9** Draw evidence from informational texts to support analysis, reflection, and research.
(MS-ESS1-4)	**SL8.5** Integrate_multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.

Mathematics (CCRSM) Connections

SCIENCE	MATHEMATICS
(MS-ETS1-2) (MS-ETS1-3) (MS-ETS1-4)	**MP.2** Reason abstractly and quantitatively.
(MS-ETS1-2)	**7.EE.3** Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.
(MS-ETS1-4)	**7.SP** Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.

CCRSS Appendices

	Appendices	Description
A.	Conceptual Shifts	Appendix A addresses the seven conceptual shifts that science educators and stakeholders need to make to effectively use the College and Career Ready Standards for Science.
B.	Responses to Public Drafts	Appendix B shows the results of public feedback and the responses to the standards.
C.	College and Career Readiness	Appendix C describes how the vision for K-12 science education and the content of the standards will properly prepare students for their college and careers.
D.	All Standards, All Students: Case Studies	Appendix D emphasizes that these standards require instructional shifts to enable all students to meet the requirements for college and career readiness and highlights implementation strategies.
E.	Disciplinary Core Idea Progressions	Appendix E presents the DCI learning progressions which demonstrate how each disciplinary core idea develops across the grade bands to ensure students achieve the depth of understanding expected before leaving high school.
F.	Science and Engineering Practices	Appendix F presents the eight Science and Engineering Practices. These mirror the practices of professional scientists and engineers. The SEP progressions illustrate how the SEPs are developed throughout students' K-12 science education.
G.	Crosscutting Concepts	Appendix G presents the seven Crosscutting Concepts. These crosscutting concepts give students an organizational structure to understand the world and help students make sense of and connect DCIs across disciplines and grade bands. The CCC progressions illustrate how the CCC are developed throughout students' K-12 science education.
H.	Nature of Science	Appendix H presents the eight basic understandings about the nature of science. This appendix explains the perspectives, rationale, and research supporting the importance of nature of science in the standards.
I.	Engineering Design in the NGSS	Appendix I describes engineering design and the way it allows students to engage in and aspire to solve major societal and environmental challenges they will face in the decades ahead.
J.	Science, Technology, Society, and the Environment	Appendix J describes the importance of students learning about the relationship between science, technology, society, and the environment.
K.	Model Course Mapping in Middle and High School	Appendix K supports school systems in their decision-making about how to organize science courses to address the MS and HS science standards to prepare students for post-secondary success.
L.	Connections to CCSS-Mathematics	Appendix L highlights the relationship between mathematics and science.
M.	Connections to CCSS-Literacy in Science and Technical Subjects	Appendix M highlights the relationship between literacy and science.

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