6-12 Overview

The 6th – 12th Grade Oklahoma Academic Standards for Science include the following Domains:

Physical Science (PS)

Life Science (LS) Earth & Space Science (ESS)

Each Domain has a set of Topics in science that fit within that Domain:

Physical Science (PS)

- Matter and Its Interactions (PS1)
- Motion and Stability: Forces and Interactions (PS2)
- Energy (PS3)
- Waves and Their Applications in Technologies for Information

O Life Science (LS)

Grade 6

MC DC1 /

- From Molecules to Organisms: Structure and Processes (LS1)
- Ecosystems: Interactions, Energy, and Dynamics (LS2)
- Heredity: Inheritance and Variation of Traits (LS3)
- Biological Unity and Diversity (LS4)

Earth & Space Science (ESS)

- Earth's Place in the Universe (ESS1)
- Earth's Systems (ESS2)
- Earth and Human Activity (ESS4)

The abbreviations for the Domains and Topics are utilized in the naming system of each Performance Expectation found in the Oklahoma Academic Standards for Science.

For example, the Performance Expectation MS-PS1-4 represents the following:

GRADE: Middle School DOMAIN: Physical Science TOPIC: Matter and its Interactions STANDARD: 4

Each grade level contains Performance Expectations from each Domain. The progressions are unique from other grade spans in that Performance Expectations for a particular Topic are distributed across the 6th-8th grade. Performance Expectations for Physical Science Topic 1, "Matter and its Interactions," are highlighted in green. The standards are unique to each grade and their distribution ensures students will have obtained a collection of experiences that assists them in fully understanding Topic 1 before they enter High School.

Grade 7

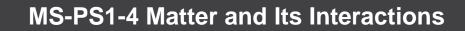
MC DC1 1

Grade 8

MC DC1 2

In 9th-12th grade, each course contains Performance Expectations that may appear in other courses and does not necessarily integrate Performance Expectations from each Domain. The Performance Expectations for Physical Science Topic 1, "Matter and its Interactions," for high school are found in Physical Science, Chemistry, and Physics, and are highlighted in green in the table below. The Performance Expectations may be duplicated considering not every student will take all three courses. In some cases, the Performance Expectations appear in multiple courses with minor differences (see HS-PS4-1 in Physical Science, Chemistry, and Physics highlighted in blue) and sometimes the Performance Expectation is duplicated exactly (see HS-PS2-2 in Physical Science and Physics, highlighted in red). In some cases, Performance Expectations may only appear in one course (see HS-PS2-6 in Chemistry).

MS-PS1-4	MS-PS1-1	MS-PS1-3	tions may only appear in one	course (see HS-PS2-6	in Chemistry).
MS-PS2-3	MS-PS1-2	MS-PS1-5	Diversional Onionen		Dharaina
MS-PS2-5	MS-PS2-4	MS-PS1-6	Physical Science	Chemistry	Physics
MS-PS3-1	MS-PS3-6	MS-PS2-1	HS-PS1-1	HS-PS1-1	HS-PS1-8
MS-PS3-2	MS-LS1-4	MS-PS2-2	HS-PS1-2	HS-PS1-2	HS-PS2-1
MS-PS3-3	MS-LS1-5	MS-PS4-1	HS-PS1-5	HS-PS1-3	HS-PS2-2
MS-PS3-4	MS-LS1-8	MS-PS4-2	HS-PS1-7	HS-PS1-4	HS-PS2-3
			HS-PS2-1	HS-PS1-5	HS-PS2-4
MS-LS1-1	MS-LS3-1	MS-PS4-3	HS-PS2-2	HS-PS1-6	HS-PS2-5
MS-LS1-2	MS-LS3-2	MS-LS1-7	HS-PS2-3	HS-PS1-7	HS-PS3-1
MS-LS1-3	MS-LS4-3	MS-LS4-1	HS-PS2-5	HS-PS1-8	HS-PS3-2
MS-LS1-6	MS-LS4-4	MS-LS4-2	HS-PS3-1	HS-PS2-6	HS-PS3-3
MS-LS2-1	MS-LS4-5	MS-ESS1-4	HS-PS3-2	HS-PS3-3	HS-PS3-4
MS-LS2-2	MS-LS4-6	MS-ESS2-1	HS-PS3-3	HS-PS3-4	HS-PS3-5
MS-LS2-3	MS-ESS1-1	MS-ESS2-2	HS-PS3-4	HS-PS4-1	HS-PS4-1
MS-LS2-4	MS-ESS1-2	MS-ESS2-3	HS-PS4-1	HS-PS4-3	HS-PS4-2
MS-LS2-5	MS-ESS1-3	MS-ESS3-1	HS-PS4-2		HS-PS4-3
MS-ESS2-4	MS-ESS2-5	MS-ESS3-2	HS-PS4-4		HS-PS4-4
MS-ESS3-3	MS-ESS2-6	MS-ESS3-4			HS-PS4-5



Science & Engineering Practices

- Asking questions (for science) and
- defining problems (for engineering) 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 predict and/or describe phenomena.
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations (for science) and designing solutions (for engineering)
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

Disciplinary Core Ideas

- Structure and Properties of Matter:
- 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.
- The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter.

Definitions of Energy:

- (secondary to MS-PS1-4)
- 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 depends jointly on the temperature, the total number of atoms in the system, and the state of the material.

Performance Expectations

MS-PS1-4

Students who demonstrate understanding can:

Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

Clarification Statement:

Emphasis is on qualitative molecularlevel models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.

Assessment Boundary:

The use of mathematical formulas is not intended.

Crosscutting Concepts: Cause and Effect

• Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
WHST.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).	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-PS2-3 Motion and Stability: Forces and Interactions

Disciplinary Core Ideas

Performance Expectations

motor.

Assessment Boundary:

Assessment about questions that

algebraic thinking. Assessment of

Coulomb's Law is not intended.

require quantitative answers is limited to proportional reasoning and

_		
Types	of Inter	actions:

- Asking guestions (for science) and **MS-PS2-3** defining problems (for engineering) • Electric and magnetic (electromagnetic) Students who demonstrate forces can be attractive or repulsive, Asking guestions and defining understanding can: problems in grades 6–8 builds from and their sizes depend on the magnitudes of the charges, currents, grades K-5 experiences and Ask questions about data or magnetic strengths involved and progresses to specifying relationships to determine the factors that on the distances between the between variables, and clarifying affect the strength of electric interacting objects. arguments and models. and magnetic forces. Ask guestions that can be investigated within the scope of **Clarification Statement:** the classroom, outdoor environment, Examples of devices that use electric and museums and other public and magnetic forces could include facilities with available resources electromagnets, electric motors, or and, when appropriate, frame a hypothesis based on observations generators. Examples of data could include the effect of the number of and scientific principles. turns of wire on the strength of an 2 Developing and using models electromagnet, or the effect of increasing the number or strength of investigations Analyzing and interpreting data magnets on the speed of an electric
- **S** Using mathematics and computational thinking
- Constructing explanations (for science) and designing solutions (for engineering)
- Engaging in argument from evidence

Crosscutting Concepts: Cause and Effect

Obtaining, evaluating, and communicating information

Planning and carrying out

Oklahoma Academic Standards Connections

• Cause and effect relationships may be used to predict phenomena in natural or designed systems.

ELA/Literacy	Mathematics
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.	MP.2 Reason abstractly and quantitatively.

MS-PS2-5 Motion and Stability: Forces and Interactions

Science & Engineering Practices

defining problems (for engineering)

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

explanations or design solutions. • Conduct an investigation and

evaluate the experimental design

to produce data to serve as the

the goals of the investigation.

G Using mathematics and computational

• Constructing explanations (for science) and designing solutions (for

Engaging in argument from evidence

Obtaining, evaluating, and

communicating information

Analyzing and interpreting data

thinking

engineering)

basis for evidence that can meet

provide evidence to support

Asking questions (for science) and

2 Developing and using models

Planning and carrying out

Planning and carrying

out investigations

Disciplinary Core Ideas

Performance Expectations

Types of Interactions:

• 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, or a ball, respectively).

understanding can: Conduct an investigation and

Students who demonstrate

MS-PS2-5

evaluate the experimental design to provide evidence that fi exist between objects exerting forces on each other even though the objects are not in contact.

Clarification Statement:

Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, and electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations.

Assessment Boundary:

Assessment is limited to electric and magnetic fields, and limited to qualitative evidence for the existence of fields.

Crosscutting Concepts: Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Okianoma Academic Standards Connections		
ELA/Literacy	Mathematics	
 RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. WHST.6-8.7 Conduct short research projects to answer a question (incuding a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. 	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. MP.5 Use appropriate tools strategically. 6.EE.A.2 Write, read, and evaluate expressions in which lestand for numbers. 6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables c f equivalent ratios, tape diagrams, double number line diagrams, or equations. 	

Oklahoma Academic Standards Connections

MS-PS3-1 Energy			
Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations	
 Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations 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. Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering) Engaging in argument from evidence Obtaining, evaluating, and communicating information 	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 Students who demonstrate understanding can: 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. Assessment Boundary: Does not include mathematical calculations of kinetic energy. 	

• 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.

Oklahoma	Academic	Standards	Connections
Uniterrounie	/ todalonni		

ELA/Literacy	Mathematics
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. 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).	 MP.2 Reason abstractly and quantitatively. 6.RP.A.1 Understand the concept of ratio and use ratio language to describe a ratio relationship between two quantities. 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. 7.RP.A.2 Recognize and represent proportional relationships between quantities. 8.EE.A.1 Know and apply the properties of integer exponents to generate equivalent numerical expressions. 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. 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.

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

6-0 0-00

	Disciplinary Core Ideas	Performance Expectations
 Asking questions (for science) and defining problems (for engineering) 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 predict and/or describe phenomena. Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering) Engaging in argument from evidence Obtaining, evaluating, and communicating information 	Definitions of Energy: • A system of objects may also contain stored (potential) energy, depending on their relative positions. 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 Students who demonstrate understanding can: 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 vary- ing 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 is limited to two objects and electric, magnetic, and gravitational interactions.

 Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
SL.8.5 II tegrate multimedia and visual displays into present i tions to clarify information, strengthen claims and evidence, and add interest.	 6.NS.C.7a Interpret statements of inequality as statements about the relative position of two numbers on a number I diagram. 6.NS.C7b Write, interpret, and explain statements of ord er for rational numbers in real-world contexts.

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

88

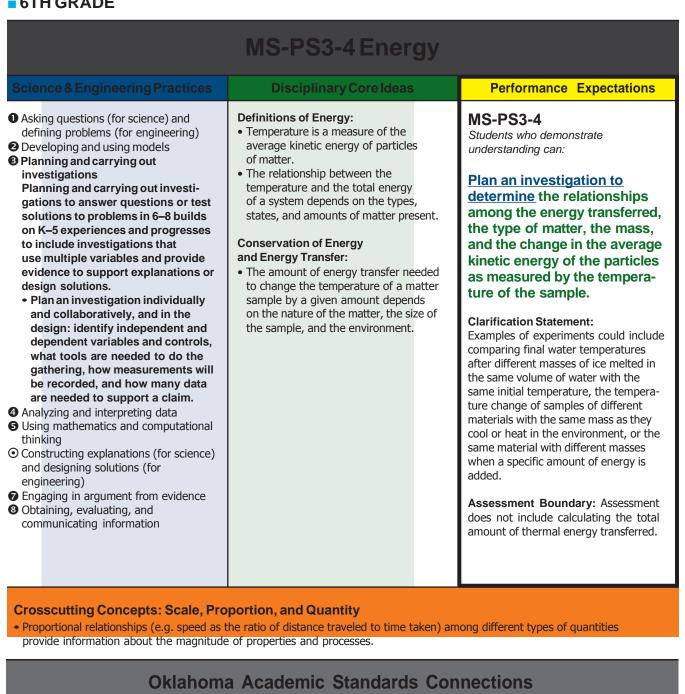
0-00 9-00

MS-PS3-3 Energy			
Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations	
 Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) 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, construct, and test a design of an object, tool, process or system. Engaging in argument from evidence Obtaining, evaluating, and communicating information 	 Definitions of Energy: 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. Conservation of Energy and Energy Transfer: Energy is spontaneously transferred out of hotter regions or objects and into colder ones. Defining and Delimiting an Engineering Problem: (secondary to MS-PS3-3) 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 scientific principles and other relevant knowledge that is likely to limit possible solutions. Developing Possible Solutions: (secondary to MS-PS3-3) 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. 	 MS-PS3-3 Students who demonstrate understanding can: 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. Care should be taken with devices that concentrate significant amounts of energy, e.g. conduction, convection, and/or radiation. Assessment does not include calculating the total amount of thermal energy transferred. 	

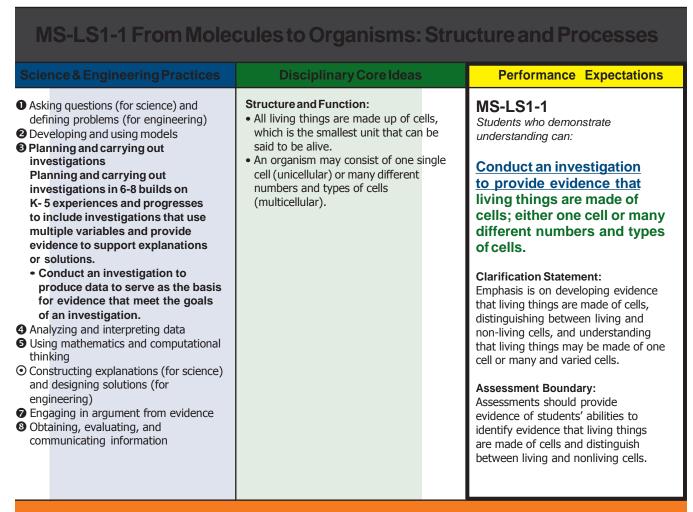
Crosscutting Concepts: Energy and Matter

• The transfer of energy can be tracked as energy flows through a designed or natural system.

Oklahoma Academic Standards Connections		
ELA/Literacy Mathematics		
 RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. 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. 	 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. 6.G.G Understand congruence and similarity using physical models, transparencies, or geometry software. 	



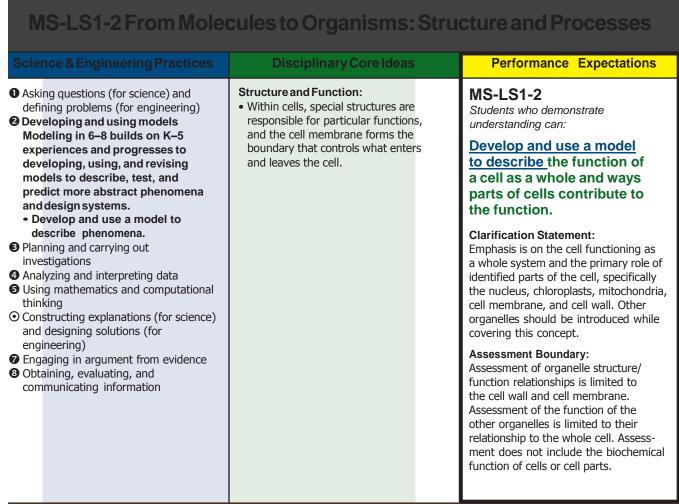
ELA/Literacy	Mathematics
RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing echnical tasks.	MP.2 Reason abstractly and quantitatively.6.SP.B.5 Summarize numerical data sets in relation to their context.
WHST.6-8.7 Conduct short research 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.	



Crosscutting Concepts: Scale, Proportion, and Quantity

• Phenomena that can be observed at one scale may not be observable at another scale.

ELA/Literacy	Mathematics
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.	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.

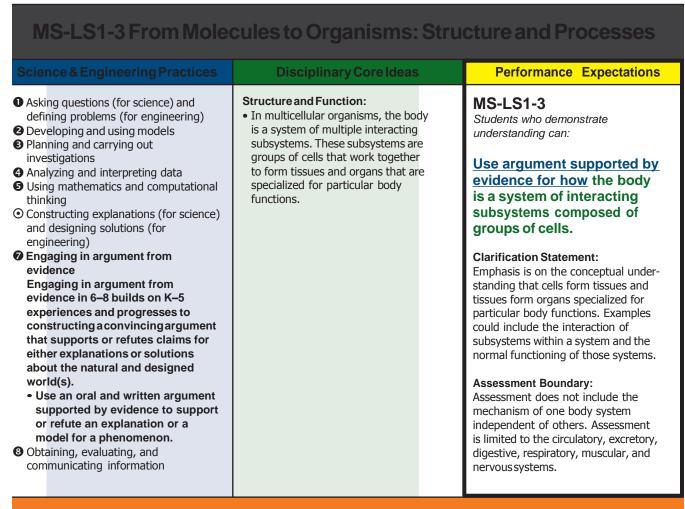


Crosscutting Concepts: Structure and Function

• 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.

Oklahoma Academic Standards Connections

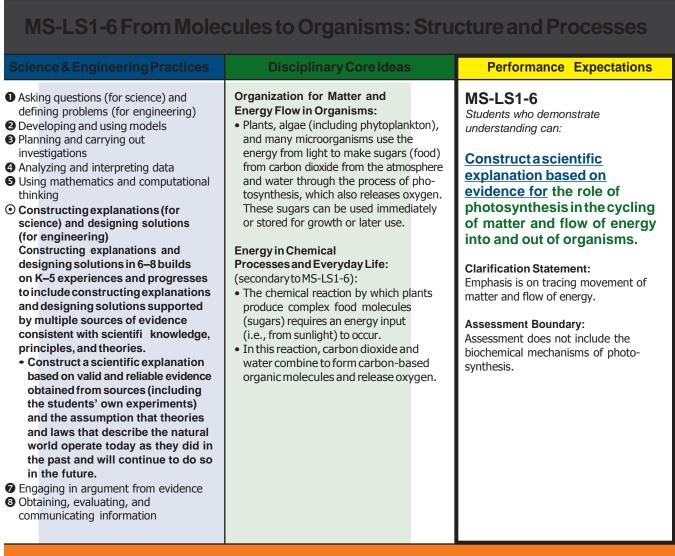
ELA/Literacy	Mathematics
SL.8.5 II tegrate multimedia and visual displays into presenta- tions to clarify information, strengthen claims and evidence, and addinterest.	6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one an other; write an equation 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 bet ween the dependent and independent variables using graphs and tables, and relate these to the equation.



Crosscutting Concepts: Systems and System Models

• Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.

Oklahoma Academic Standards Connections	
ELA/Literacy	Mathematics
 RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. RI.6.8 T and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidenc e from claims that are not. WHST.6-8.1 Write arguments focused on discipline content. 	6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one an other; 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 bet ween the dependent and independent variables using graphs and tables, and relate these to the equation.

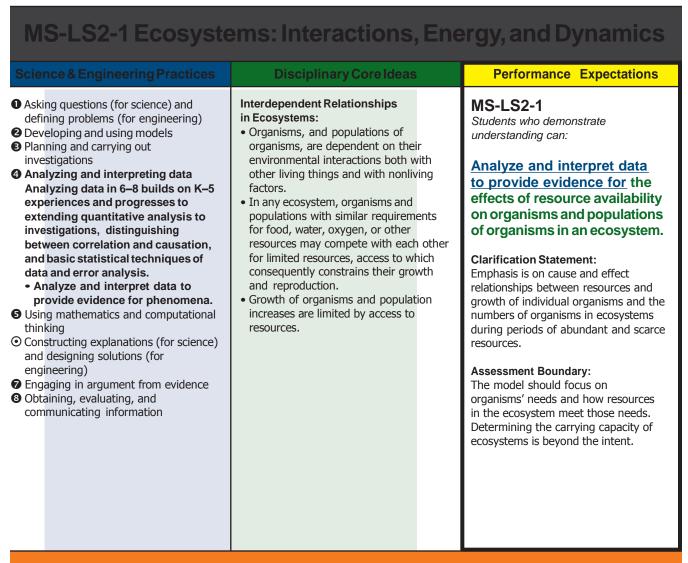


Crosscutting Concepts: Energy and Matter

• Within a natural system, the transfer of energy drives the motion and/or cycling of matter.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
 RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. 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. 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. WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. 	6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one an other; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, though tof as the independent variable. Analyze the relationship bet ween the dependent and independent variables using graphs and tables, and relate these to the equation.

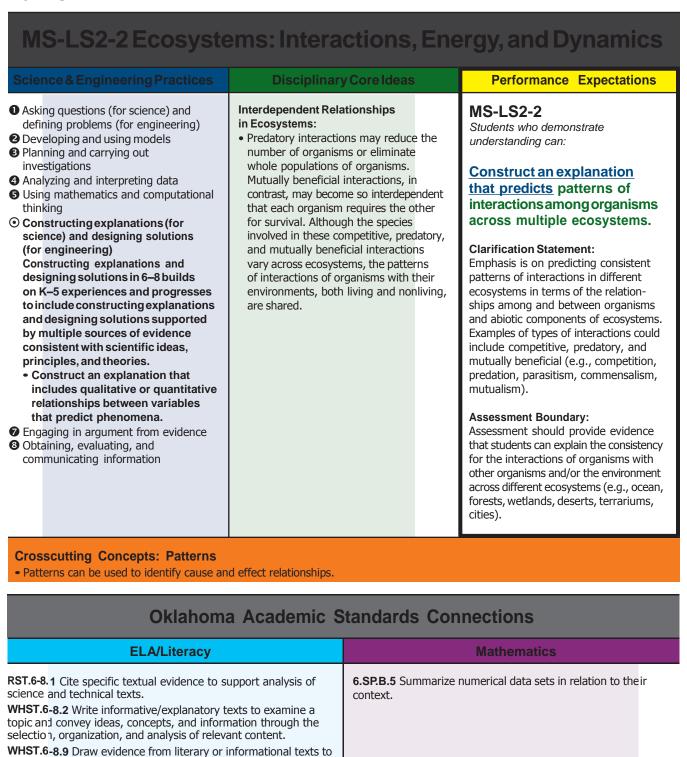


Crosscutting Concepts: Cause and Effect

• Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
 RST.6- 1 Cite specific textual evidence to support analysis of and technical texts. science 7 Integrate quantitative or technical information RST.6- (d in words in a text with a version of that information (d visually (e.g., in a flowchart, diagram, model, graph, express). express or table) 	MP.2 Reason abstractly and quantitatively.MP.4 Model with mathematics.6.SP Develop understanding of statistical variability.



*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

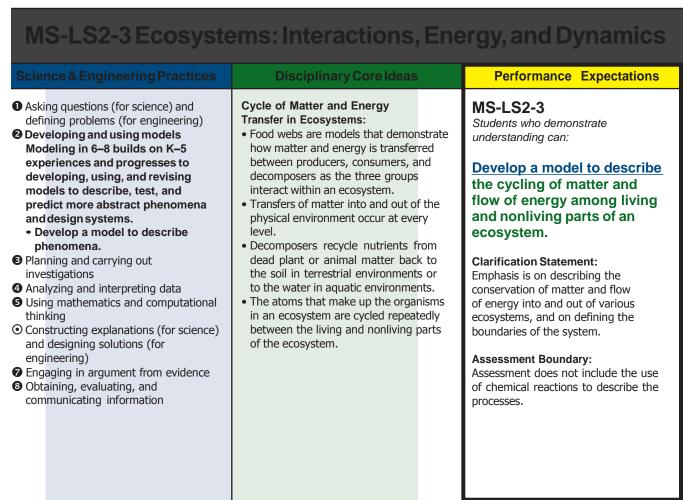
support analysis, reflection, and research.

adequate volume, and clear pronunciation.

expressing their own clearly.

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

SL.8.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact,

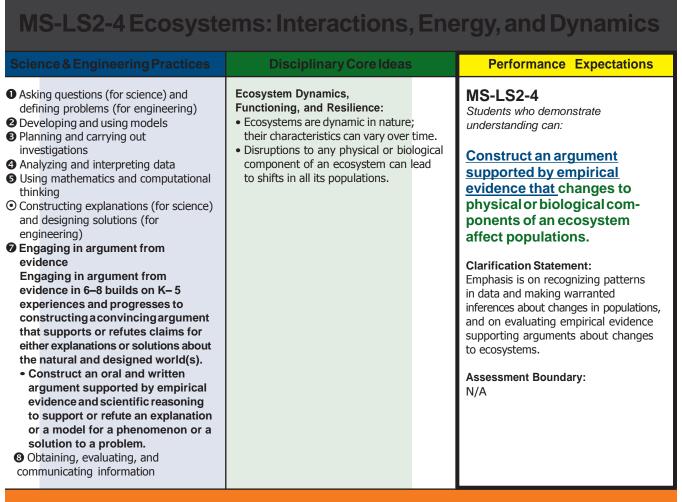


Crosscutting Concepts: Energy and Matter

• The transfer of energy can be tracked as energy flows through a natural system.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
SL.8.5 II clude multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.	6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one an other; 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 bet ween the dependent and independent variables using graphs and tables, and relate these to the equation.

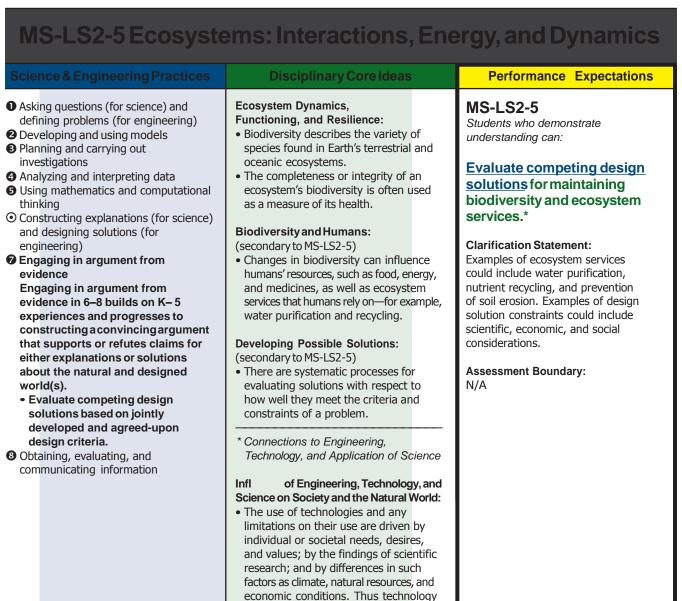


Crosscutting Concepts: Stability and Change

• Small changes in one part of a system might cause large changes in another part.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
 RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. RI.8.8 T and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims. WHST.6-8.1 Write arguments to support claims with clear reasons an 1 relevant evidence. WHST.6-8.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. 	 MP.2 Reason abstractly and quantitatively. MP.3 Construct viable arguments and critique the reason ing of others. 6.SP Develop understanding of statistical variability.



Crosscutting Concepts: Stability and Change

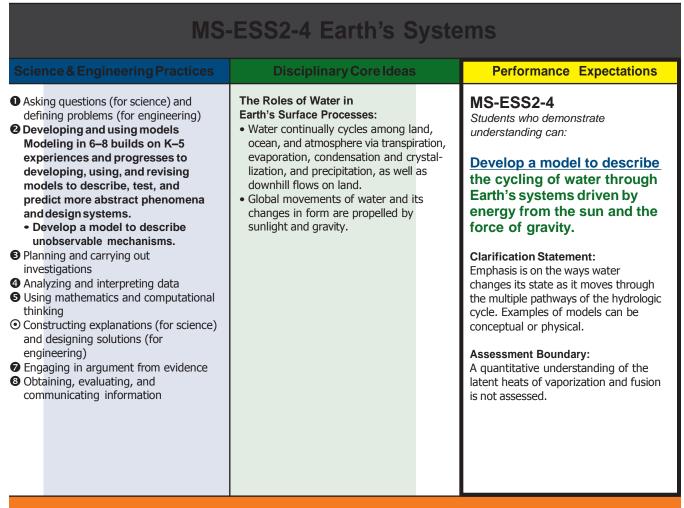
• Small changes in one part of a system might cause large changes in another part.

over time.

Oklahoma Academic Standards Connections

use varies from region to region and

ELA/Literacy	Mathematics
RST.6-8.8 Distinguish among facts, reasoned judgment based on research findings, and speculation in a text. RI.8.8 T and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims.	MP.4 Model with Mathematics.6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems.

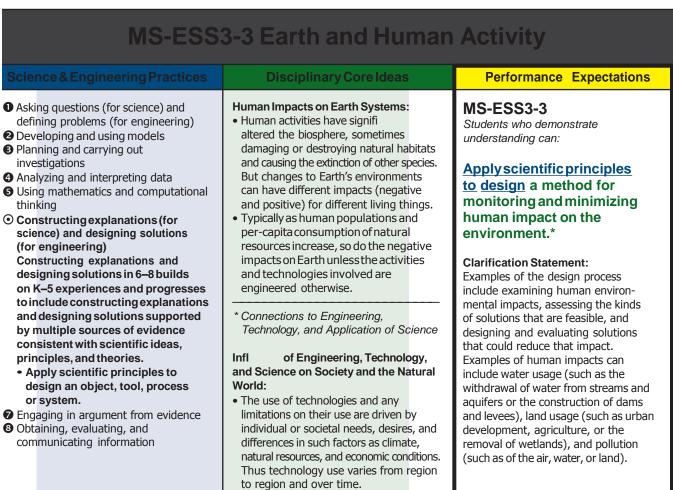


Crosscutting Concepts: Energy and Matter

• Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter.

Oklahoma Academic Standards Connections

	ELA/Literacy	Mathematics	
N	/A	N/A	



Crosscutting Concepts: Cause and Effect

• Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.

Oklahoma Academic Standards Connections	
ELA/Literacy	Mathematics
 WHST. 6-8.8 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. WHST. 6-8.8 Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. WHST. 6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (MS-ESS3-1), (MS-ESS3-4) 	 6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. 7.RP.A.2 Recognize and represent proportional relationships between quantities. 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. 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.

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

MS-PS1-1 Matter and Its Interactions		
Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations
 Asking questions (for science) and defining problems (for engineering) 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 predict and/or describe phenomena. Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering) Engaging in argument from evidence Obtaining, evaluating, and communicating information 	 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. Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). 	 MS-PS1-1 Students who demonstrate understanding can: Develop models to describe the atomic composition of simple molecules and extended structures. Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms. Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete depiction of all individual atoms in a complex molecule or extended structure.

Crosscutting Concepts: 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.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
RST.6- 7 Integrate quantitative or technical information 8. (d in words in a text with a version of that information express d visually (e.g., in a flowchart, diagram, model, graph, express . or table)	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. 6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems. 8.EE.A.3 Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other.

MS-PS1-2 Matter and Its Interactions		
Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations
 Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations 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. Analyze and interpret data to determine similarities and differences in findings. Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for science) Bengaging in argument from evidence Obtaining, evaluating, and communicating information 	 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. 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. 	 MS-PS1-2 Students who demonstrate understanding can: Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. Clarification Statement: Analyze characteristic chemical and physical properties of pure substances. Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with HCl. Assessment Boundary: Assessment is limited to analysis of the following properties: color change, formation of a gas, temperature change, density, melting point, boiling point, solubility, flammability, and odor.

Crosscutting Concepts: Patterns

• Macroscopic patterns are related to the nature of microscopic and atomic-level structure.

Oklahoma Academic Standards Connections		
ELA/Literacy	Mathematics	
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. 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).	 MP.2 Reason abstractly and quantitatively. 6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems. 8.SP.B.4 Display numerical data in plots on a number line, including dot plots, histograms, and box plots. 8.SP.B.5 Summarize numerical data sets in relation to their context. 	

MS-PS2-4 Motion and Stability: Forces and Interactions

Science & Engineering Practices	Disciplinary Core leas	Performance Expectations
 Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering) 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. Construct and present oral and written arguments supported by empirical evidence and scientific 	 Types of Interactions: Gravitational forces are alwa's	NS-PS2-4 Students who demonstrate understanding can: Construct and present arguments using evid ence to support the claim that gravitational interact ons are attractive and depend on the masses of interacting objects. Clarification Statement: Examples of evidence for a guments could include data generated from simulations or digital tools; and charts displaying mass, strength of interaction, distance from the Sun, and orbital periods of objects within the solar system.
reasoning to support or refute an explanation or a model for a		Assessment Boundary:
 phenomenon or a solution to a problem. Obtaining, evaluating, and containing, information 		Assessment does not include Newton's Law of Gravitation or Kepler's Laws.

communicating information

Crosscutting Concepts: Systems and System Models

• Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems.

ELA/Literacy	Mathematics
WHST.6-8.1 Write arguments focused on discipline-specific content.	MP.2 Reason abstractly and quantitatively.

Oklahoma Academic Standards Connections

MS-PS3-6 Energy		
Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations
 Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering) 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 worlds. Construct, use, and present oral and written arguments supported by empirical evidence and scientifi reasoning to support or refute an explanation or a model for a phenomenon. Obtaining, evaluating, and communicating information 	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-PS3-6 Students who demonstrate understanding can: 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.

Crosscutting Concepts: Energy and Matter

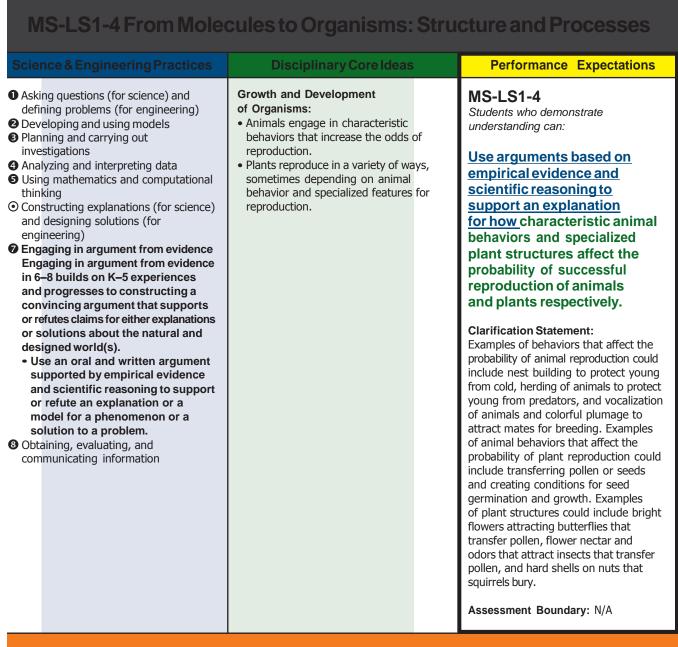
• Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion).

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
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. (5) WHST.6-8.1 Write arguments focused on discipline-specific content.	 MP.2 Reason abstractly and quantitatively. 6.RP.A.1 Understand the concept of ratio and use ratio language to describe a ratio relationship between two quantities. 7.RP.A.2 Recognize and represent proportional relationships between quantities. 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.

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

6-0 0-0

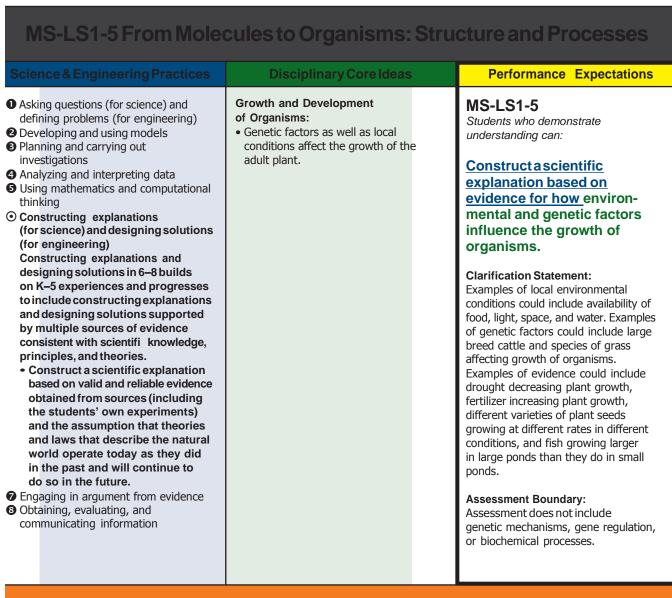


Crosscutting Concepts: Cause and Effect

Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
 RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. RI.6.8 T and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not. WHST.6-8.1 Write arguments focused on discipline content. 	 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. 6.SP.B.4 Summarize numerical data sets in relation to their context.

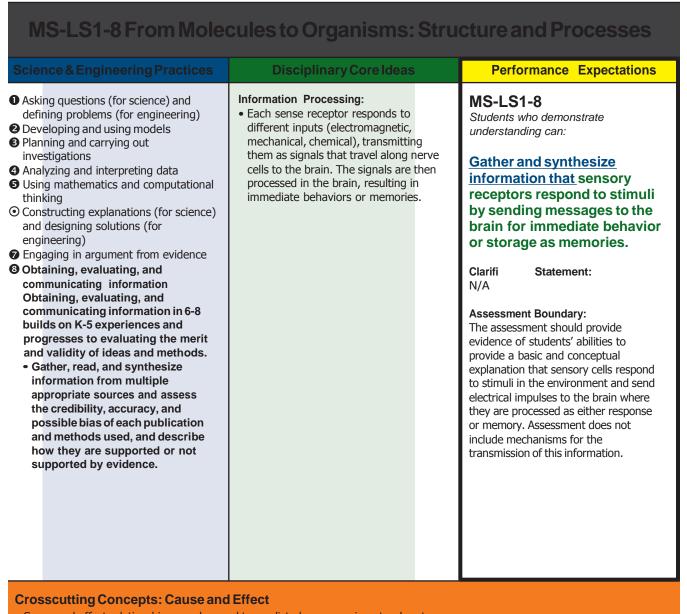


Crosscutting Concepts: Cause and Effect

• Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

Oklahoma Academic Standards Connections		
ELA/Literacy	Mathematics	
 RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. 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. 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. WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. 	 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. 6.SP.B.4 Summarize numerical data sets in relation to their context. 	

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

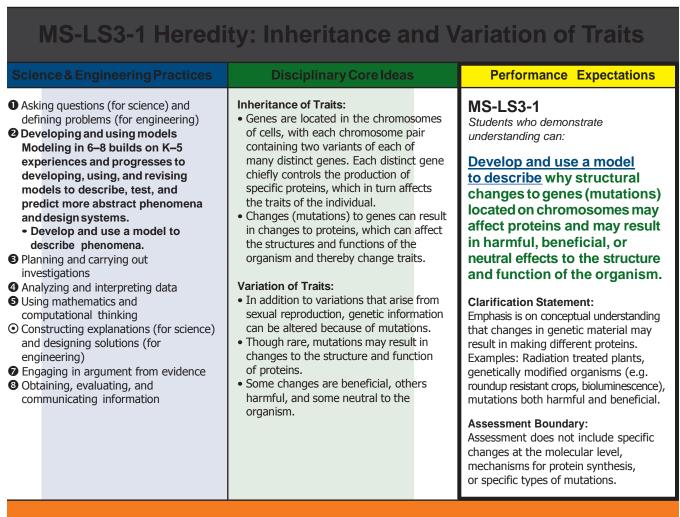


6-0

• Cause and effect relationships may be used to predict phenomena in natural systems.

ELA/Literacy	Mathematics	
WHST.6-8.8 Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoidin ; plagiarism and providing basic bibliographic information for sources.	N/A	

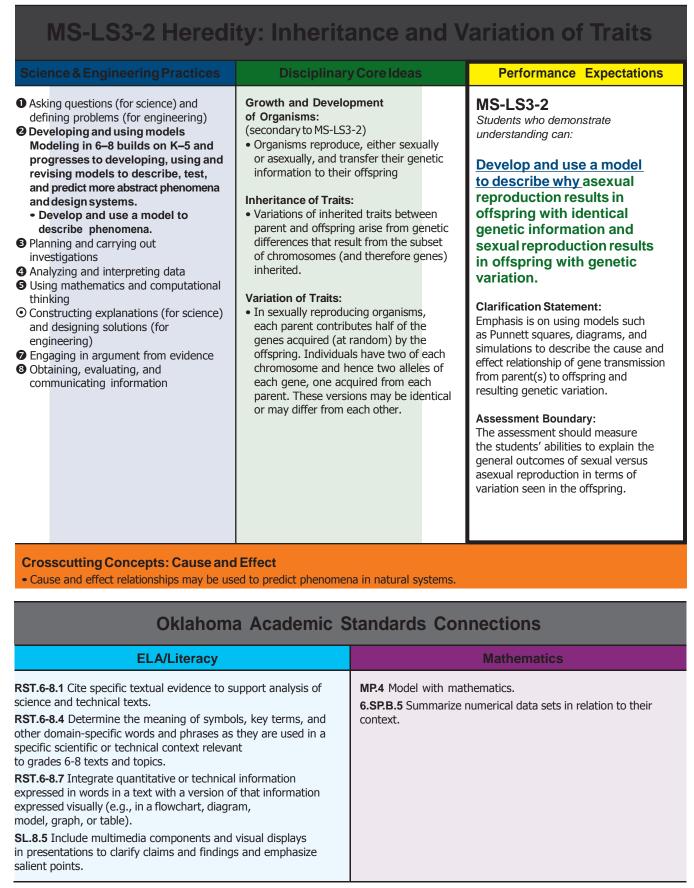
Oklahoma Academic Standards Connecti



Crosscutting Concepts: Structure and Function

• Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function.

Oklahoma Academic Standards Connections		
ELA/Literacy	Mathematics	
 RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. 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. 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). SL.8.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. 	N/A	



Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations
 Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze displays of data to identify linear and nonlinear relationships. Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering) Engaging in argument from evidence Obtaining, evaluating, and communicating information 	Evidence of Common Ancestry and Diversity: • Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy.	 MS-LS4-3 Students who demonstrate understanding can: Analyze displays of pictorial data to compare patterns of similarities in the embryo- logical development across multiple species to identify relationships not evident in the fully formed anatomy. Clarification Statement: Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures. Assessment Boundary: Assessment of comparisons is limited to gross appearance of anatomical structures in embryological development.

Crosscutting Concepts: Patterns

• Graphs, charts, and images can be used to identify patterns in data.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
 RST.6- 1 Cite specific textual evidence to support analysis of and technical texts, attending to the precise details of science tions or descriptions. explana 7 Integrate quantitative or technical information RST.6- (d in words in a text with a version of that information (d visually (e.g., in a flowchart, diagram, model, graph, express). express 9 Compare and contrast the information gained from or table) ents, simulations, video, or multimedia sources with that RST.6- rom reading a text on the same topic. 8. expremining a for the same topic. 	N/A

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

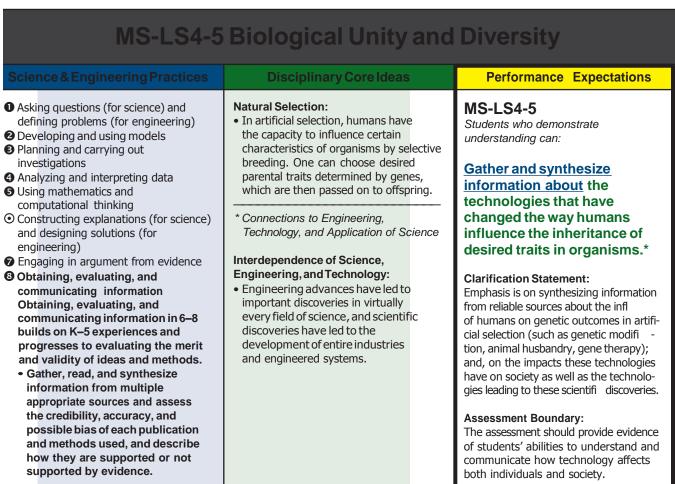
6-0 0

MS-LS4-4 Biological Unity and Diversity		
Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations
 Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering) Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena. Engaging in argument from evidence Obtaining, evaluating, and communicating information 	Natural Selection: • Natural selection leads to the predominance of certain traits in a population, and the suppression of others.	 MS-LS4-4 Students who demonstrate understanding can: Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations. Assessment Boundary: The assessment should provide evidence of students' abilities to explain why some traits are suppressed and other traits become more prevalent for those individuals better at finding food, shelter, or avoiding predators.

Crosscutting Concepts: Cause and Effect

• Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

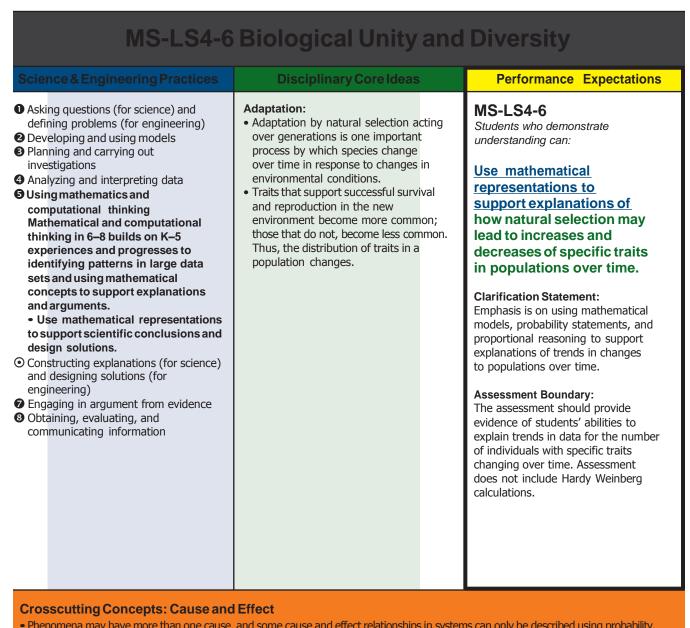
ELA/Literacy	Mathematics
 RST.6- Cite specific textual evidence to support analysis of and technical texts, attending to the precise details of science tions or descriptions. explana 9 Compare and contrast the information gained from RST.6-8.ents, simulations, video, or multimedia sources with that experimrom reading a text on the same topic. gained f-8.2 Write informative/explanatory texts to examine a WHST.6 convey ideas, concepts, and information through the topic am, organization, and analysis of relevant content. selectio -8.9 Draw evidence from informational texts to support WHST.6 reflectively in a range of collaborative discussions one, in groups, teacher-led) with diverse partners on topics, texts, and issues, building on others' ideas and ng their own clearly. (one-on-resent claims and findings, emphasizing salient points in grade 6 d, coherent manner with relevant evidence, sound valid expressig, and well-chosen details; use appropriate eye contact, SL.8.4 Pe volume, and clear pronunciation.	 6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quan tities 6.SP.B.5 Summarize numerical data sets in relation to their context. 7.RP.A.2 Recognize and represent proportional relationships between quantities.



Crosscutting Concepts: Cause and Effect

• Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

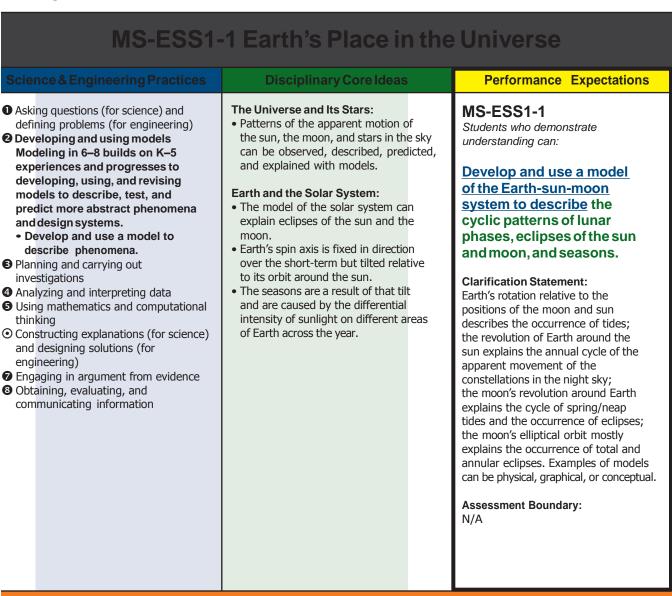
Oklahoma Academic Standards Connections		
ELA/Literacy	Mathematics	
RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explana tions or descriptions. (5) WHST.6-8.8 Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoidin j plagiarism and providing basic bibliographic information for sources.	N/A	



Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

Oklahoma Academic Stand	ards Connections
-------------------------	------------------

	ELA/Literacy	Mathematics
N/A		 MP.4 Model with mathematics. 6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. 6.SP.B.5 Summarize numerical data sets in relation to their context. 7.RP.A.2 Recognize and represent proportional relationships between quantities.



Crosscutting Concepts: Patterns

• Patterns can be used to identify cause- and-effect relationships.

Oklahoma Academic Standards Connections			
ELA/Literacy	Mathematics		
SL.8.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.	 MP.4 Model with mathematics. 6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. 7.RP.A.2 Recognize and represent relationships between quantities. 		



defining problems (for engineering)

• Asking questions (for science) and

Modeling in 6-8 builds on K-5

experiences and progresses to

developing, using, and revising

predict more abstract phenomena

• Constructing explanations (for science) and designing solutions (for

• Engaging in argument from evidence

models to describe, test, and

• Develop and use a model to

describe phenomena.

Analyzing and interpreting data **G** Using mathematics and computational

and design systems.

B Planning and carrying out

³Obtaining, evaluating, and

communicating information

investigations

thinking

engineering)

2 Developing and using models

Disciplinary Core Ideas

Performance Expectations

The Universe and Its Stars:

• Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe.

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.
- The solar system appears to have formed from a disk of dust and gas, drawn together by gravity.

MS-ESS1-2 Students who demonstrate understanding can:

Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.

Clarification Statement:

Emphasis for the model is on gravity as the force that holds together the solar system and Milky Way galaxy and controls orbital motions within them. Examples of models can be physical (such as the analogy of distance along a football field or computer visualizations of elliptical orbits) or conceptual (such as mathematical proportions relative to the size of familiar objects such as their school or state).

Assessment Boundary:

Assessment does not include Kepler's Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth.

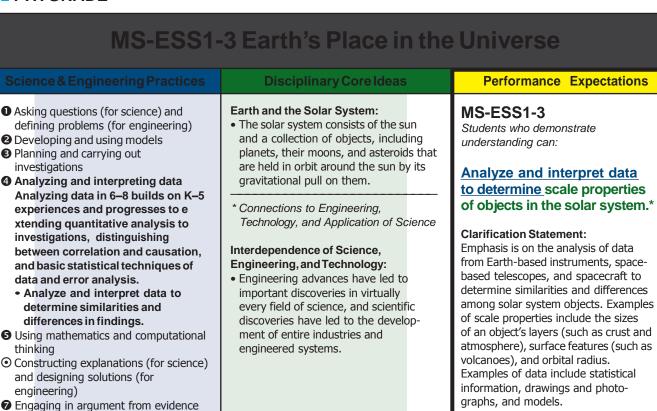
Crosscutting Concepts: Systems and System Models Models can be used to represent systems and their interactions.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
SL.8.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.	 MP.4 Model with mathematics. 6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. 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 specific set. 7.RP.A.2 Recognize and represent relationships between quantities. 7.EE.B.4 Use variables to represent guantities in a real-world
	or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

³ Obtaining, evaluating, and

communicating information



Assessment Boundary:

Assessment does not include recalling facts about properties of the planets and other solar system bodies.

Crosscutting Concepts: 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.

ELA/Literacy	Mathematics	
RST.6- 1 Cite specific textual evidence to support analysis of and technical texts. Science 7 Integrate quantitative or technical information RST.6- (d in words in a text with a version of that information 8. (d visually (e.g., in a flowchart, diagram, model, graph, express or table)	 MP.2 Reason abstractly and quantitatively. 6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. 7.RP.A.2 Recognize and represent proportional relations hips between quantities. 	

Oklahoma Academic Standards Connections

MS-ESS2-5 Earth's Systems		
Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations
 Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering) Engaging in argument from evidence Obtaining, evaluating, and communicating information 	Weather and Climate: • Because these patterns are so complex, weather can only be predicted probabilistically.	<section-header><section-header><section-header><section-header><section-header><text><text></text></text></section-header></section-header></section-header></section-header></section-header>

Crosscutting Concepts: Cause and Effect

• Cause and effect relationships may be used to predict phenomena in natural or designed systems.

ELA/Literacy	Mathematics
 RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. 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). WHST.6-8.8 Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. 	 MP.2 Reason abstractly and quantitatively. 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.

Oklahoma Academic Standards Connections



Science & Engineering Practices

defining problems (for engineering)

Asking questions (for science) and

Modeling in 6-8 builds on K-5

experiences and progresses to

developing, using, and revising

predict more abstract phenomena

G Using mathematics and computational

Constructing explanations (for science)

• Engaging in argument from evidence

models to describe, test, and

· Develop and use a model to

describe phenomena.

Analyzing and interpreting data

and designing solutions (for

communicating information

³Obtaining, evaluating, and

and design systems.

B Planning and carrying out

investigations

thinking

engineering)

2 Developing and using models

Disciplinary Core Ideas

The Roles of Water in

Earth's Surface Processes:

• Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents.

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.
- 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.

Performance Expectations

MS-ESS2-6

Students who demonstrate understanding can:

Develop and use a model to describe how unequal heating and rotation of the Earth causes patterns of atmospheric and oceanic circulation that determine regional climates.

Clarification Statement:

Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation (e.g. el niño/la niña) is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models can be diagrams, maps and globes, or digital representations.

Assessment Boundary:

Assessment does not include the dynamics of the Coriolis effect.

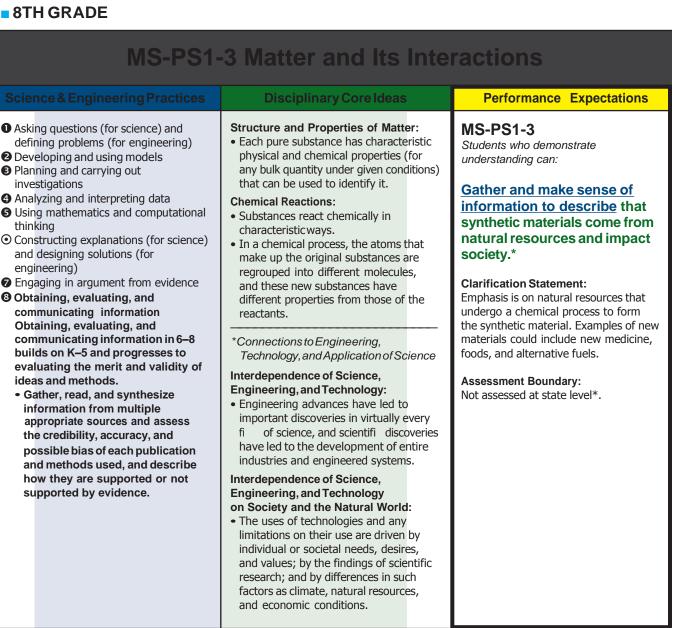
Crosscutting Concepts: Systems and System Models

• Models can be used to represent systems and their interactions—such as inputs, processes and outputs— and energy, matter, and information flows within systems.

Oklahoma Academic Standards Connections

 ELA/Literacy
 Mathematics

 SL.8.5 II clude multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.
 N/A

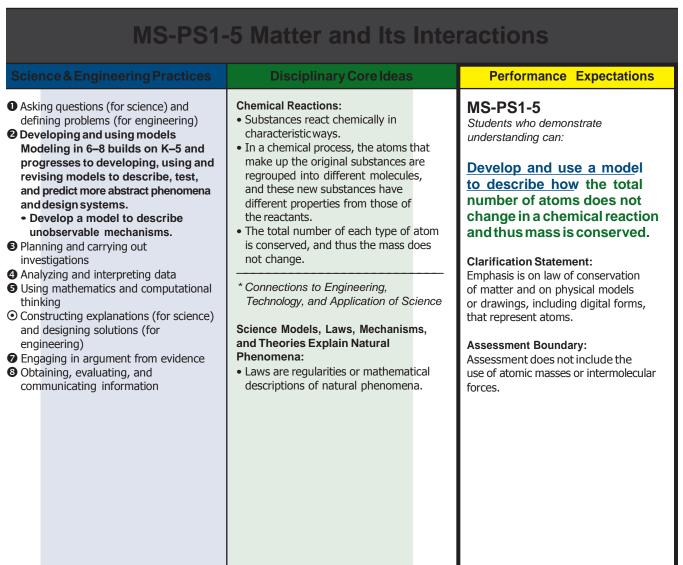


Crosscutting Concepts: Structure and Function

 Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.

Oklahoma Academic Standards Connections

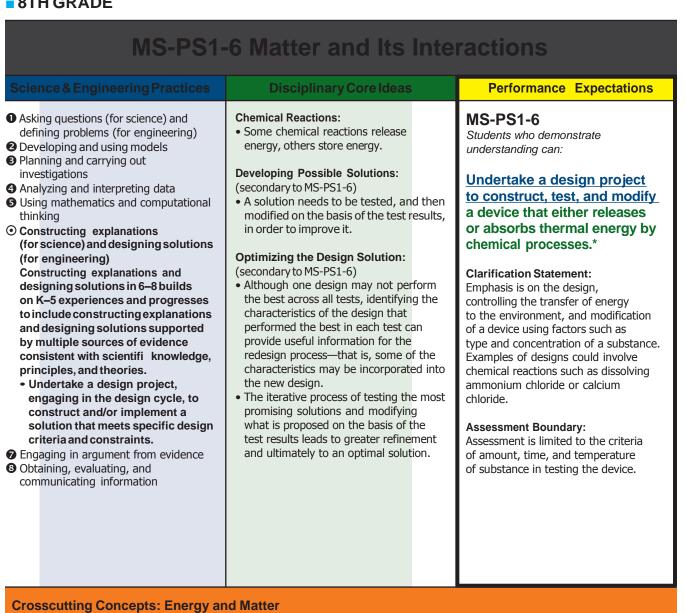
ELA/Literacy	Mathematics
 RST.6- 1 Cite specific textual evidence to support analysis of and technical texts, attending to the precise details of science tions or descriptions. explana -8.8 Gather relevant information from multiple print WHST. tal sources, using search terms effectively; assess the ty and accuracy of each source; and quote or paraphrase and digi and conclusions of others while avoiding plagiarism credibilik wing a standard format for citation. 	N/A



Crosscutting Concepts: Energy and Matter

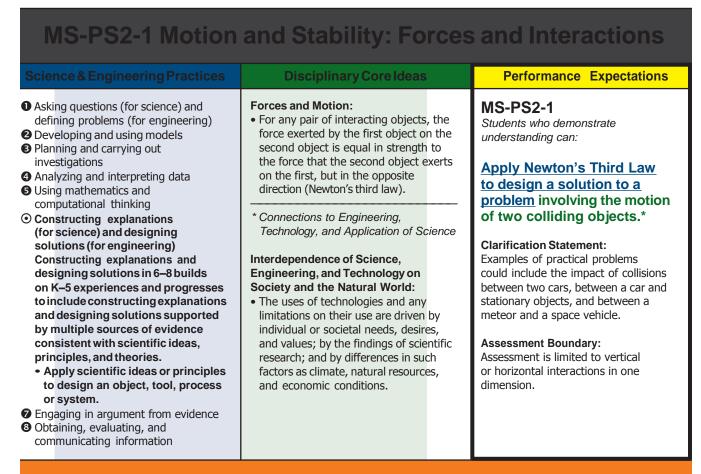
• Matter is conserved because atoms are conserved in physical and chemical processes.

Oklahoma Academic Standards Connections			
ELA/Literacy		Mathematics	
WHST8.7 Integrate quantitative or technica 6 (d in words in a text with a version of t express (d visually (e.g., in a flowchart, diagrar express) or table)	hat information	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. 6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems. 	



• The transfer of energy can be tracked as energy flows through a designed or natural system.

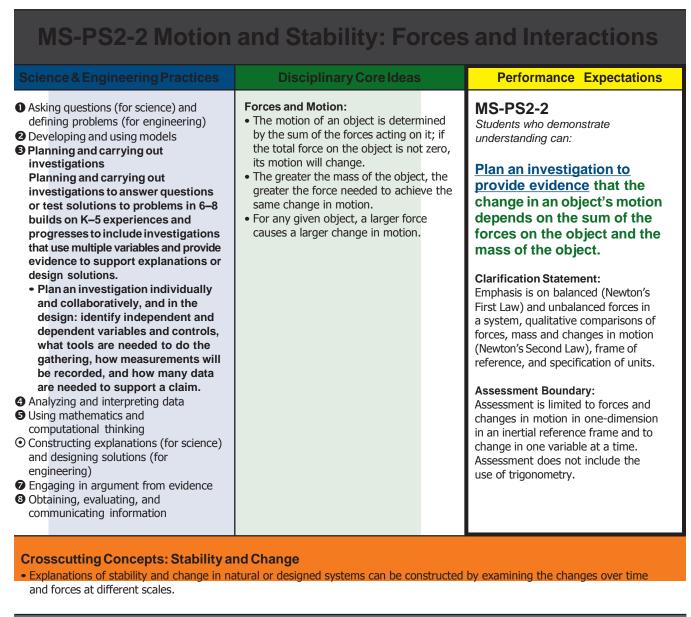
Oklahoma Academic S	tandards Connections
ELA/Literacy	Mathematics
 RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. 	8.SP Investigate patterns of association in bivariate data.



Crosscutting Concepts: Systems and System Models

• Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems.

Oklahoma Academic S	tandards Connections
ELA/Literacy	Mathematics
 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. RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. 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. 	 MP.2 Reason abstractly and quantitatively. 6.NS.C.5 Understand that positive and negative numbers are used together to describe quantities having opposite directions or values; use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. 6.EE.A.2 Write, read, and evaluate expressions in which letters stand for numbers. 7.EE.B.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, 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. 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.



Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. 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.	 MP.2 Reason abstractly and quantitatively. 6.EE.A.2 Write, read, and evaluate expressions in which letters stand for numbers. 7.EE.B.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, 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. 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.

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

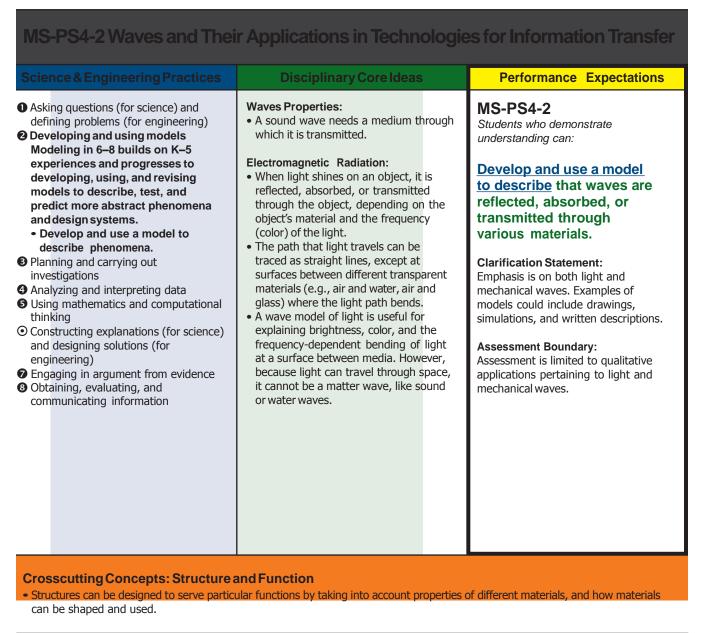
124

Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations
 Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data 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. Constructing explanations (for science) and designing solutions (for engineering) Engaging in argument from evidence Obtaining, evaluating, and communicating information 	Waves Properties: • A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.	 MS-PS4-1 Students who demonstrate understanding can: 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.

Crosscutting Concepts: Patterns

• Graphs and charts can be used to identify patterns in data.

Oklahoma Academic S	tandards Connections
ELA/Literacy	Mathematics
SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. 6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. 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.



Oklahoma Academic Standards Connections

SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.	ELA/Literacy	Mathematics
	presentations to clarify information, strengthen claims	N/A

Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations
 Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering) Engaging in argument from evidence 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. 	Information Technologies and Instrumentation: • Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.	

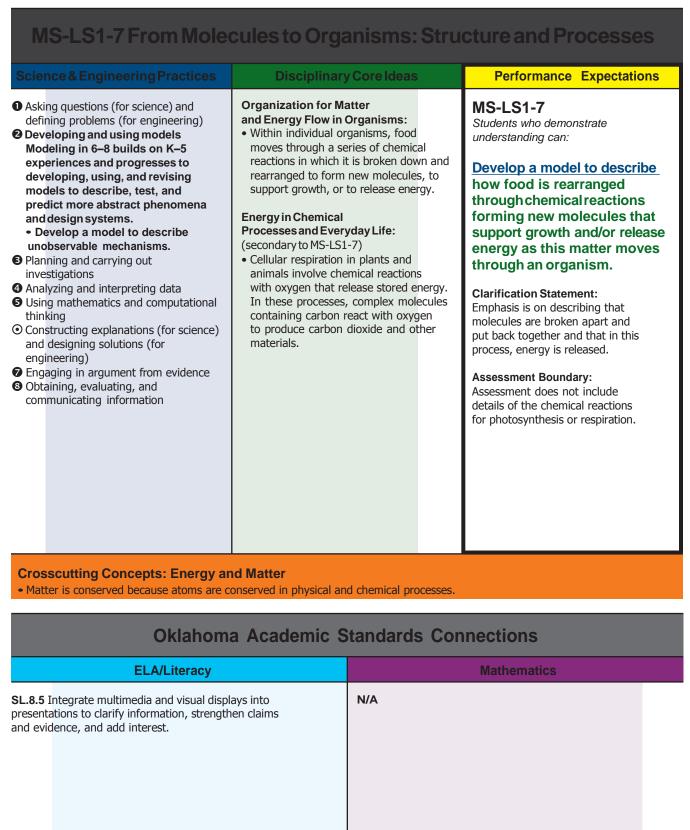
Crosscutting Concepts: Structure and Function

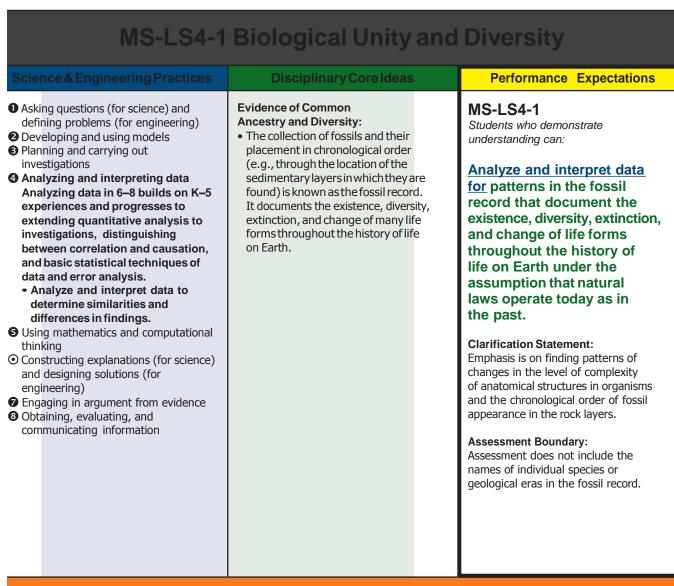
• Structures can be designed to serve particular functions.

Oklahoma Academic S	Standards Connections
ELA/Literacy	Mathematics
 RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. 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. 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. WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. 	N/A

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

6-0 0-00

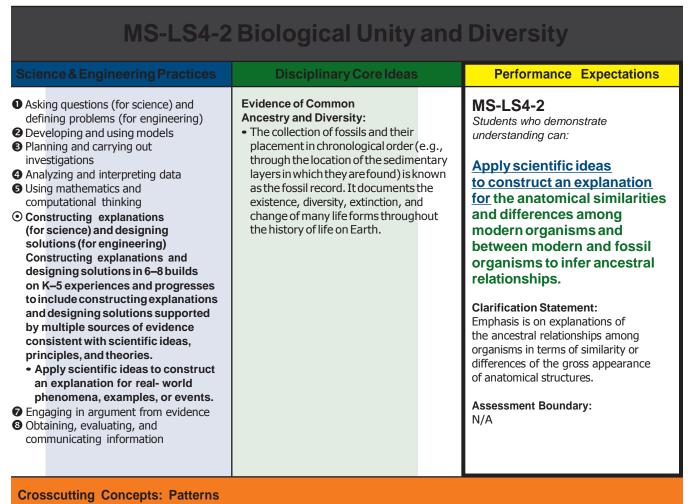




Crosscutting Concepts: Patterns

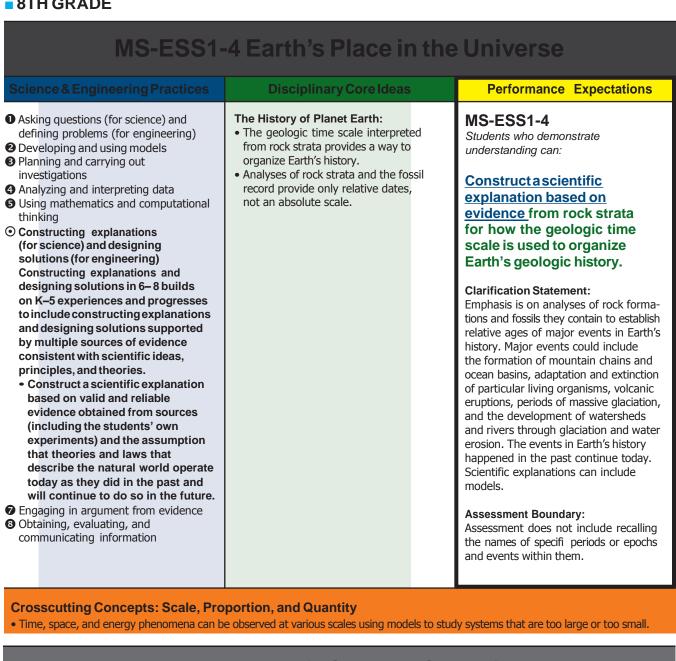
• Graphs, charts, and images can be used to identify patterns in data.

Oklahoma Academic S	tandards Connections
ELA/Literacy	Mathematics
 RST.6- 1 Cite specific textual evidence to support analysis of and technical texts, attending to the precise details of science tions or descriptions explana 7 Integrate quantitative or technical information RST.6- (d in words in a text with a version of that information 6. (d visually (e.g., in a flowchart, diagram, model, express rtable). express graph, c 	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.



• Patterns can be used to identify cause and effect relationships.

ELA/Literacy	Mathematics
 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. 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. WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. SL.8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. SL.8.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. 	6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical pr oblem understand that a variable can represent an unknown nu mber, or, depending on the purpose at hand, any number in a specified set.

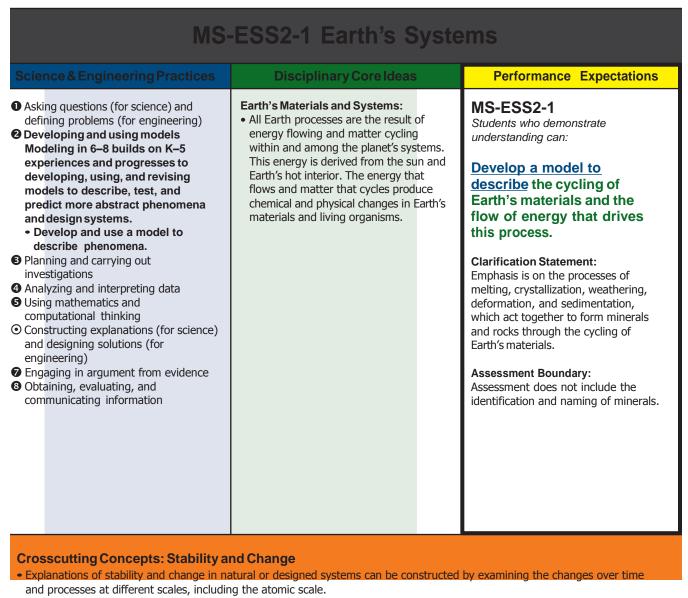


Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics	
RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. 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.	N/A	

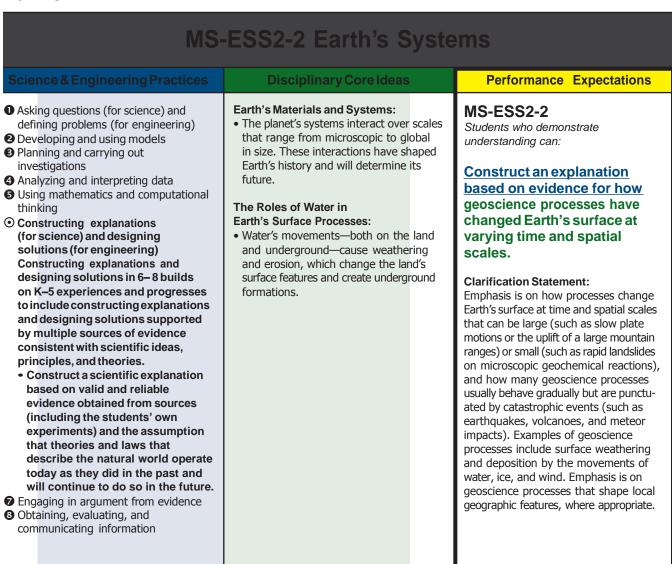
*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

131



Oklahoma Academic Standards Connections

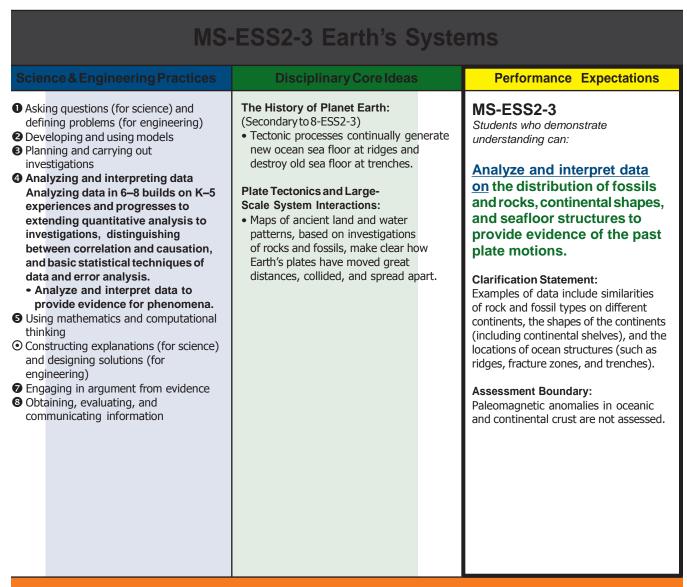
ELA/Literacy	Mathematics	
clude multimedia components and visual displays ntations to clarify claims and findings and emphasize pints.	N/A	



Crosscutting Concepts: 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.

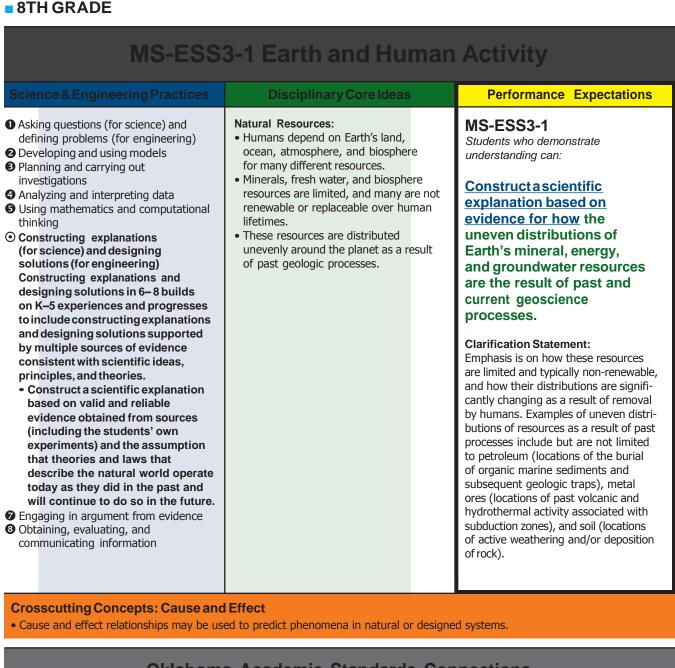
Oklahoma Academic Standards Connections		
ELA/Literacy	Mathematics	
 RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. WHST. 6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. SL.8.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. 	 MP.2 Reason abstractly and quantitatively. 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. 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. 	



Crosscutting Concepts: Patterns

• Patterns in rates of change and other numerical relationships can provide information about natural systems.

Oklanoma Academic Standards Connections		
ELA/Literacy	Mathematics	
RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. 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).	 MP.2 Reason abstractly and quantitatively. 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. 	
RST.6-8.7 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.	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.	



ELA/Literacy Mathematics RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.

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.

WHST. 6-8.9 Draw evidence from informational texts to support analysis, reflection, and research.

Oklahoma Academic Standards Connections

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.

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.

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

135

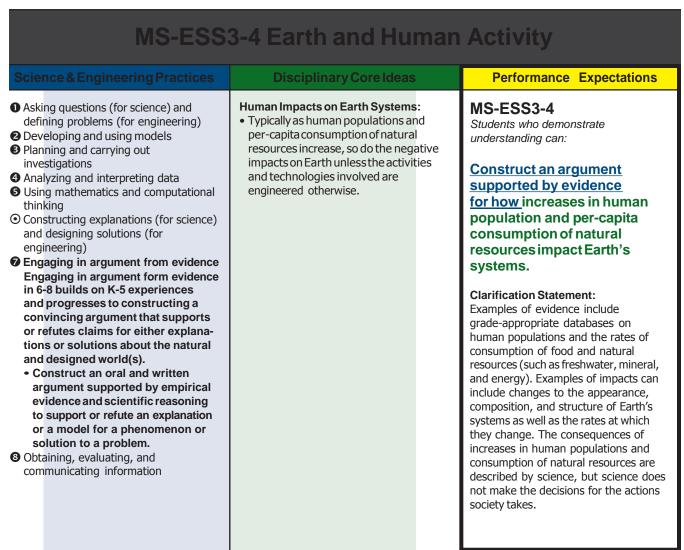
Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations
 Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Analyzing data in 6–8 builds on K–5 experiences 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. Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering) Engaging in argument from evidence Obtaining, evaluating, and communicating information 	Natural Hazards: • Mapping the history of natural hazards in a region, combined with an understanding of related geolo forces can help forecast the locatio and likelihoods of future events.	ogic

Crosscutting Concepts: Patterns

• Graphs, charts, and images can be used to identify patterns in data.

Oklahoma Academic Standards Connections

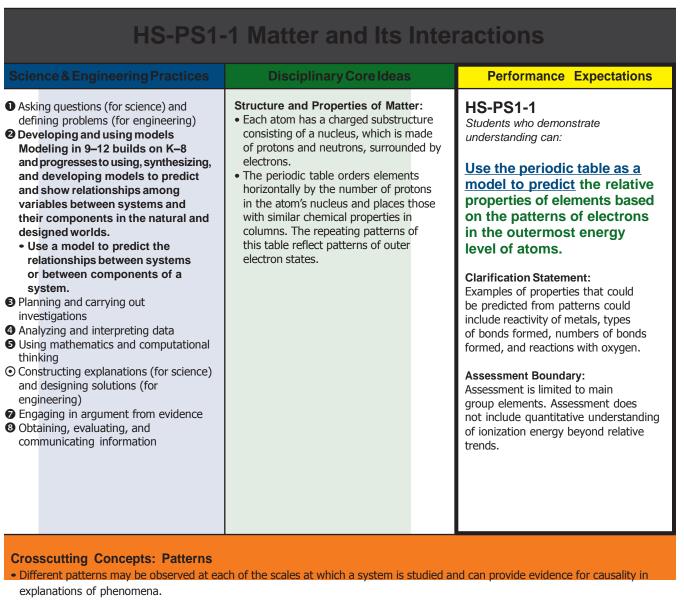
ELA/Literacy	Mathematics
RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. RST. 6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).	 MP.2 Reason abstractly and quantitatively. 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. 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.



Crosscutting Concepts: Cause and Effect

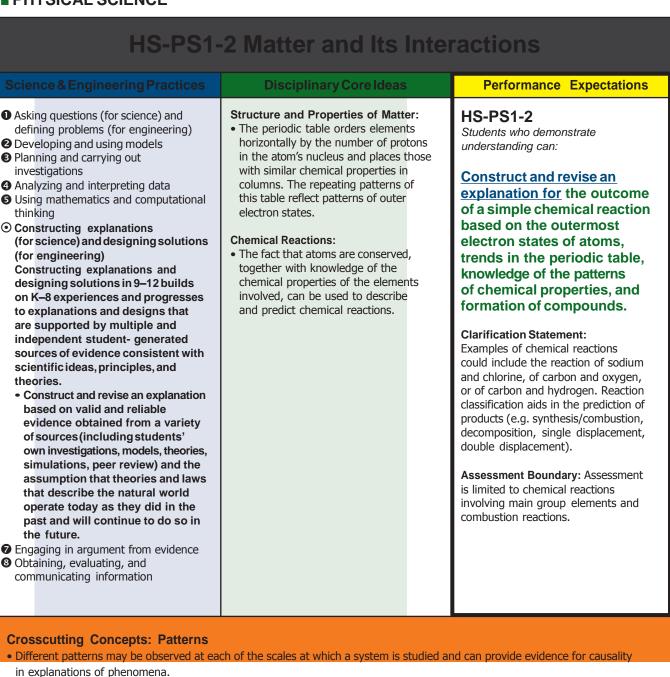
Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Oklahoma Academic Standards Connections		
ELA/Literacy	Mathematics	
RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. WHST.6-8.1 Write arguments focused on discipline content. WHST. 6-8.9 Draw evidence from informational texts to support analysis, reflection, and research.	 6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. 7.RP.A.2 Recognize and represent proportional relationships between quantities. 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. 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. 	

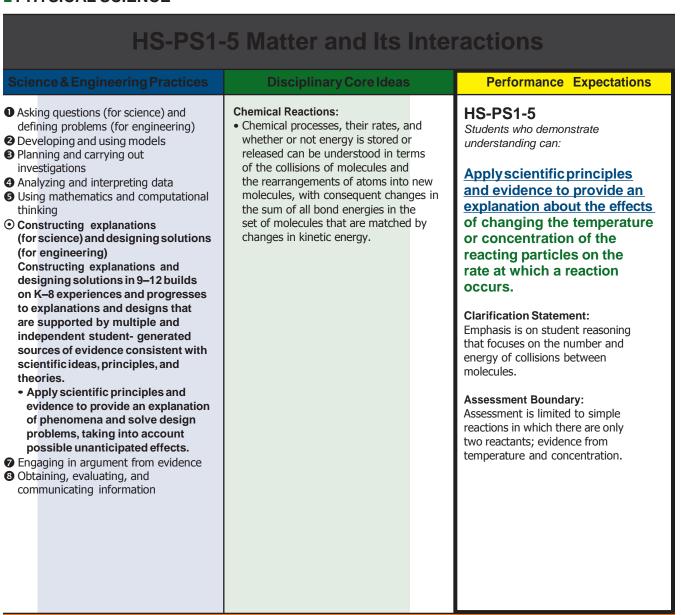


Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) ad translate information expressed visually or mathematically (e.g., in an equation) into words.	N/A



Oklahoma Academic Standards Connections ELA/Literacy Mathematics WHST.9-12.2 Write informative/explanatory texts, including the HSN-Q.A.1 Use units as a way to understand problems and to narration of historical events, scientific procedures/ experiments, guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and or technical processes. the origin in graphs and data displays. WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, HSN-Q.A.3 Choose a level of accuracy appropriate to limitations focusing on addressing what is most significant for a specific on measurement when reporting quantities. purpose and audience.



Crosscutting Concepts: Patterns

• Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

Oklahoma Academic Standards Connections		
ELA/Literacy	Mathematics	
 RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. 	 MP.2 Reason abstractly and quantitatively. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. 	

HS-PS1-7 Matter and Its Interactions			
Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations	
 Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Mathematical and computational thinking Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical representations of phenomena to support claims. Constructing explanations (for science) and designing solutions (for engineering) Engaging in argument from evidence Obtaining, evaluating, and communicating information 	Chemical Reactions: • The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.	<section-header><section-header><section-header><section-header></section-header></section-header></section-header></section-header>	

• The total amount of energy and matter in closed systems is conserved.

	Oklahoma Academic Standards Connections		
ELA/Literacy Mathematics		Mathematics	
N/A		 MP.2 Reason abstractly and quantitatively. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.2 Choose a level of accuracy appropriate to li nitations on measurement when reporting quantities. 	

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

SCIENCE STANDARDS • OKLAHOMA STATE DEPARTMENT OF EDUCATION

	Disciplinary Core Ideas	Performance Expectations
 Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Analyzing data in 9–12 builds on K-8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientifi claims or determine an optimal design solution. Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering) Engaging in argument from evidence Obtaining, evaluating, and communicating information 	Forces and Motion: • Newton's second law accurately predicts changes in the motion of macroscopic objects.	 HS-PS2-1 Students who demonstrate understanding can: Analyze data and use it to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. Clarification Statement: Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object rolling down a ramp, or a moving object being pulled by a constant force. Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds.

Crosscutting Concepts: Cause and Effect

• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Oklahoma Academic Standards Connections		
ELA/Literacy	Mathematics (continued)	
RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanation and descriptions. RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.	 HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context. HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. HSA-CED.A.1 Create equations and inequalities in one variable and use them to solve problems. 	
Mathematics	HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations	
 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. 	 on coordinate axes with labels and scales. HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by in hand in simple cases and using technology for more complicated cases. HSS-ID.A.1 Represent data with plots on the real number line (dot plots, histograms, and box plots). 	

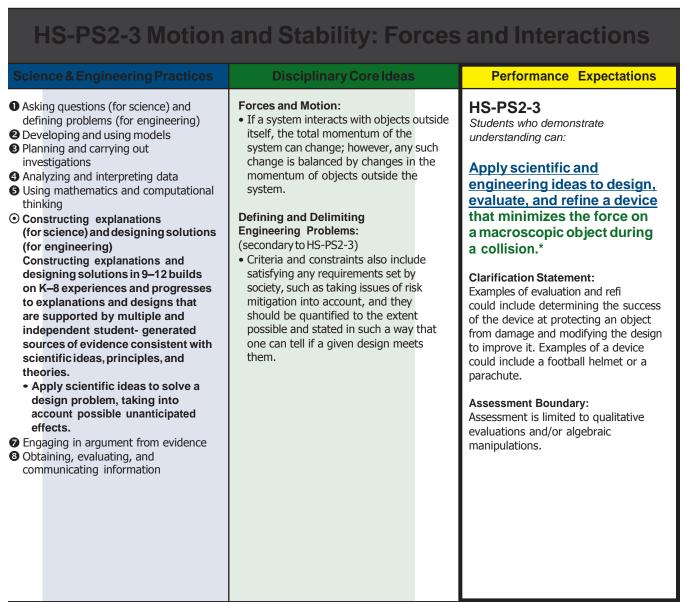
HS-PS2-2 Motion and Stability: Forces and Interactions			
 Science & Engineering Practices Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Mathematical and computational thinking Mathematical and computational thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical representations of phenomena to describe explanations. Use mathematical representations (for science) and designing solutions (for engineering) Engaging in argument from evidence Obtaining, evaluating, and communicating information 	 Disciplinary Core Ideas Forces and Motion: Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. 	Performance ExpectationsHS-PS2-2Students who demonstrate understanding can:Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.Clarification Statement: Emphasis is on the qualitative conservation of momentum in interactions and the qualitative meaning of this principle.Assessment Boundary: Assessment is limited to systems of two macroscopic bodies moving in one dimension.	

Crosscutting Concepts: Systems and System Models

• When investigating or describing a system, the boundaries and initial conditions of the system need to be defined.

	ELA/Literacy	Mathematics
I/A	ELAVLITERACY	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and irterpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A3 Choose a level of accuracy appropriate to limitation on measurement when reporting quantities. HSA-CED.A.1 Create equations and inequalities in one variable and use them to solve problems. HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations or coordinate axes with labels and scales.

Oklahoma Academic Standards Connections

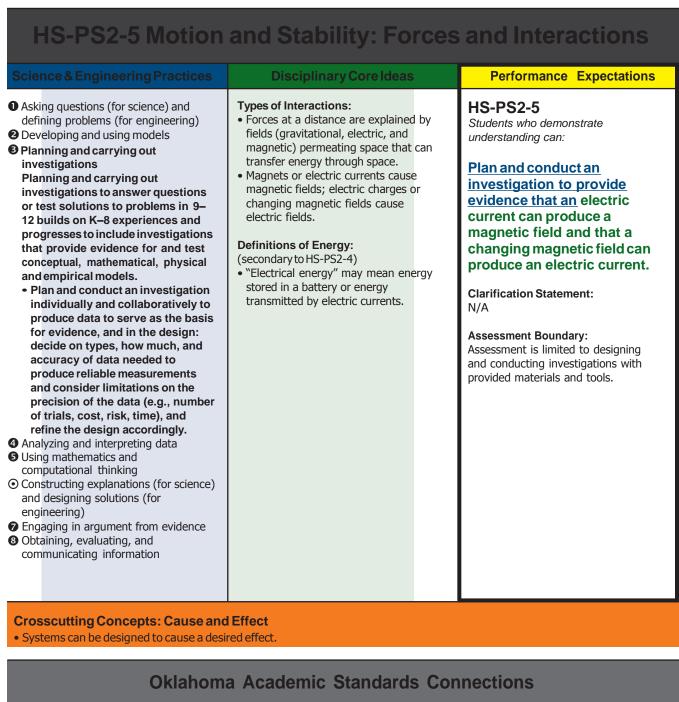


Crosscutting Concepts: Cause and Effect

• Systems can be designed to cause a desired effect.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathe	matics
WHST12.7 Conduct short as well as ma 9 projects to answer a question (incresearched question) or solve a problem; r generat iry when appropriate; synthesize r the inqubject, demonstrating understand on the svestigation. under in	uding a self- nrow or broaden ultiple sources	egically.



*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

ELA/Literacy

WHST.9-12.7 Conduct short as well as more sustained

research projects to answer a question (including a self-

under investigation.

analysis, reflection, and research.

generated question) or solve a problem; narrow or broaden

on the subject, demonstrating understanding of the subject

WHST.9-12.9 Draw evidence from informational texts to support

the inquiry when appropriate; synthesize multiple sources

Mathematics

HSN-Q.A.1 Use units as a way to understand problems and to

guide the solution of multi-step problems; choose and interpret

units consistently in formulas; choose and interpret the scale and

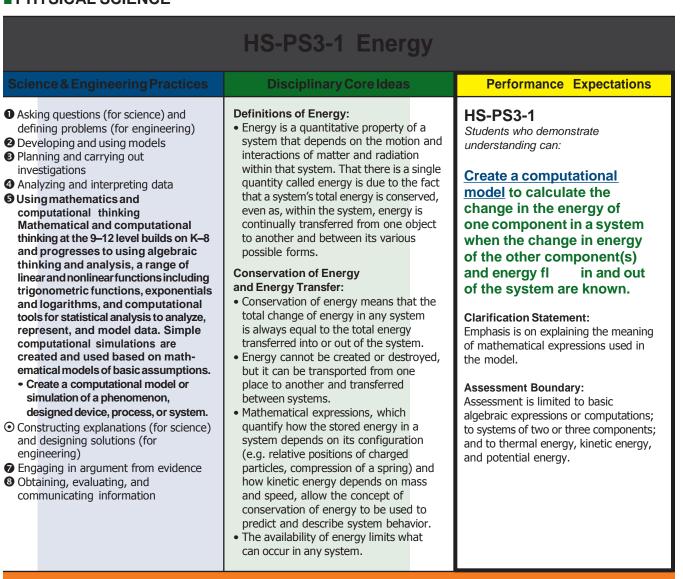
HSN-Q.A.3 Choose a level of accuracy appropriate to limitations

HSN-Q.A.2 Define appropriate quantities for the purpose of

the origin in graphs and data displays.

on measurement when reporting quantities.

descriptive modeling.

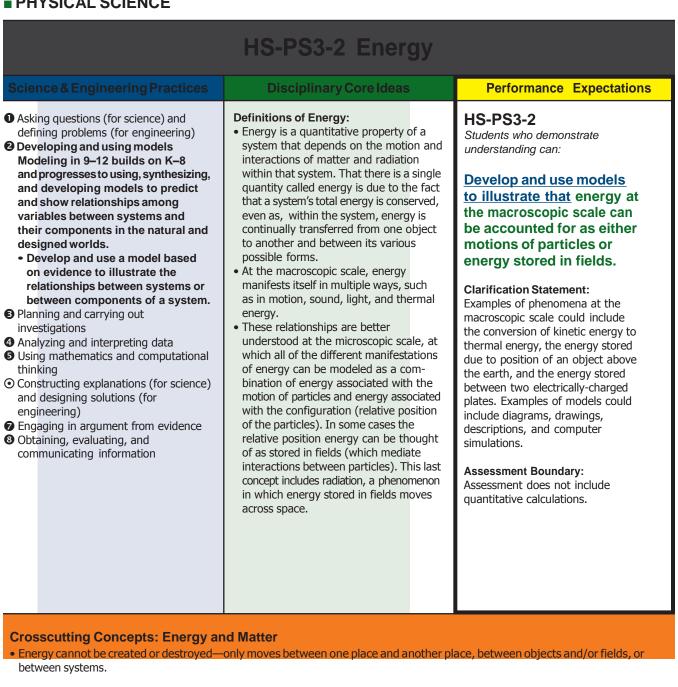


Crosscutting Concepts: Systems and System Models

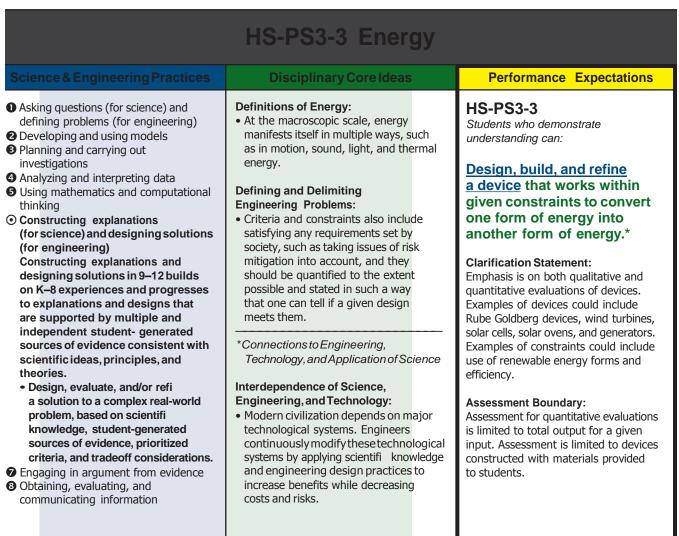
• Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
SL.9-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSN-Q.A.1 Use units as away to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale ar the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to limitatio on measurement when reporting quantities.



Oklahoma Academic Standards Connections			
ELA/Literacy	Mathematics		
SL.9-12.5 Make strategic use of digital media (e.g., te: tual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.	MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics.		



Crosscutting Concepts: Energy and Matter

• Changes of energy and matter in a system can be described in terms of energy and matter fl into, out of, and within that system.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
WH ST .9 -12.7 Conduct short as w ell as more sustained re- search projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSN-Q.A.1 Use units as away to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to limitation on measurement when reporting quantities.

HS-PS3-4 Energy			
Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations	
 Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Planning and carrying out investigations to answer questions or test solutions to problems in 9–12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical and empirical models. Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering) Engaging in argument from evidence Obtaining, evaluating, and communicating information 	 Conservation of Energy and Energy Transfer: Energy cannot be created or destro- but it can be transported from one place to another and transferred between systems. Uncontrolled systems always evolve toward more stable states— that is, toward more uniform energy distribut (e.g., water flows downhill, objects hotter than their surrounding environm cool down). 	Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined	

Crosscutting Concepts: System and System Models

• When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.

ELA/Literacy	Mathematics
 ST.9-10.1 Cite specific textual evidence to support analysis of cience and technical texts, attending to the precise detail s of xplanations or descriptions. VHST .9 -12.7 Conduct short as well as more sustained research rojects to answer a question (including a self-generated question) r solve a problem; narrow or broaden the inquiry when approriate; synthesize multiple sources on the subject, demonstrating nderstanding of the subject under investigation. VHST.11-12.8 Gather relevant information from multiple uthoritative print and digital sources, using advanced searches ffectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate formation into the text selectively to maintain the flow of ideas, voiding plagiarism and overreliance on any one source and bilowing a standard format for citation. VHST.9-12.9 Draw evidence from informational texts to support nalysis, reflection, and research. 	MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics.

Oklahoma Academic Standards Connections

Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations
 Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Mathematical and computational thinking at the 9–12 level builds on K-8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations. Constructing explanations (for science) and designing solutions (for engineering) Engaging in argument from evidence Obtaining, evaluating, and communicating information 	Wave Properties: The wavelength and frequency of a wave are related to one another b the speed of travel of the wave, wh depends on the type of wave and t medium through which it is passing 	the Use mathematical

Crosscutting Concepts: Cause and Effect

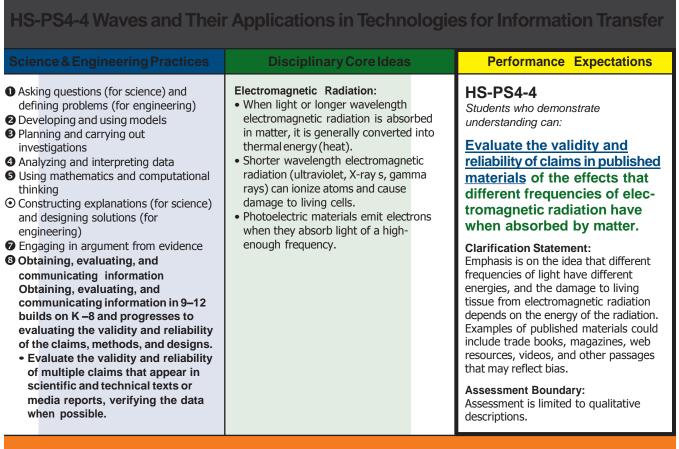
• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Oklahoma Academic Standards Connections		
ELA/Literacy	Mathematics	
RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g. table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HAS-SSE.A.1 Interpret expressions that represent a quantity in terms of its context. HAS-SSE.A.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. HAS.CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. 	

9-12

HS-PS4-2 Waves and Their Applications in Technologies for Information Transfer				
Science & Engineering Practices	Disciplinary	Core Ideas		Performance Expectations
 Asking questions (for science) and defining problems (for engineering) Asking questions and defining problems in grades 9–12 builds from grades K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for science) and designing solutions (for engineering) Engaging in argument from evidence Obtaining, evaluating, and communicating information 	 Disciplinary Core Ideas Mave Properties: Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. * Connections to Engineering, Technology, and Application of Science Modern civilization depends on major technological systems. Bigineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. 		HS-PS4-2 Students who demonstrate understanding can: Sevential equestions about the advantages and disadvantages of using a digital transmission and storage of information.* Clarification Statement: Examples of advantages could include that digital information is stable because it can be stored reliably in computer memory, transferred easily, and copied and shared rapidly. Disadvantages could include issues of easy deletion, security, and theft. MA	
• Systems can be designed for greater or le	· · · · · · · · · · · · · · · · · · ·			
Oklahoma Academic Standards Connections				
ELA/Literacy			Mathematics	
RST.9-10.8 Assess the extent to which the revidence in a text support the author's claim or for solving a scientific or technical problem. RST.9-10.1 Cite specific textual evidence to science and technical texts, attending to the explanations or descriptions.	a recommendation	N/A		

9-12



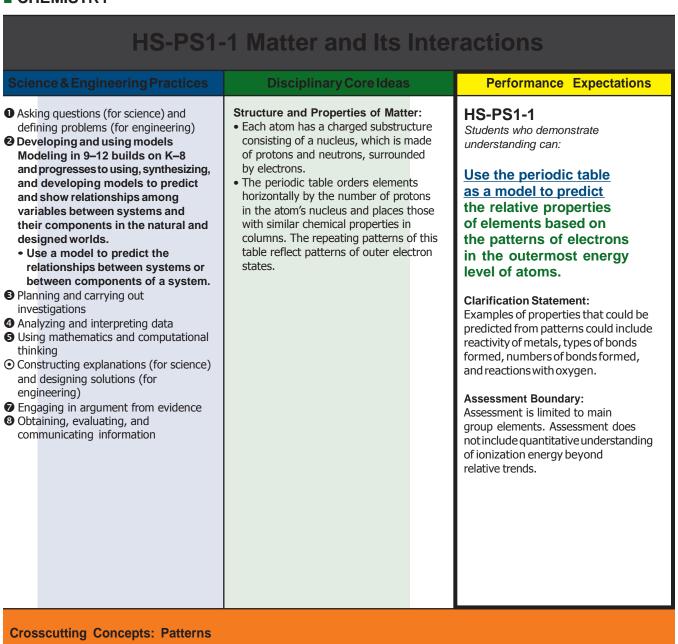
Crosscutting Concepts: Cause and Effect

• Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
 RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. RST.9-10.7 Translate quantitative or technical information expressed in worlds in a text into visual forms (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. WHST. 9-10.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. 	N/A

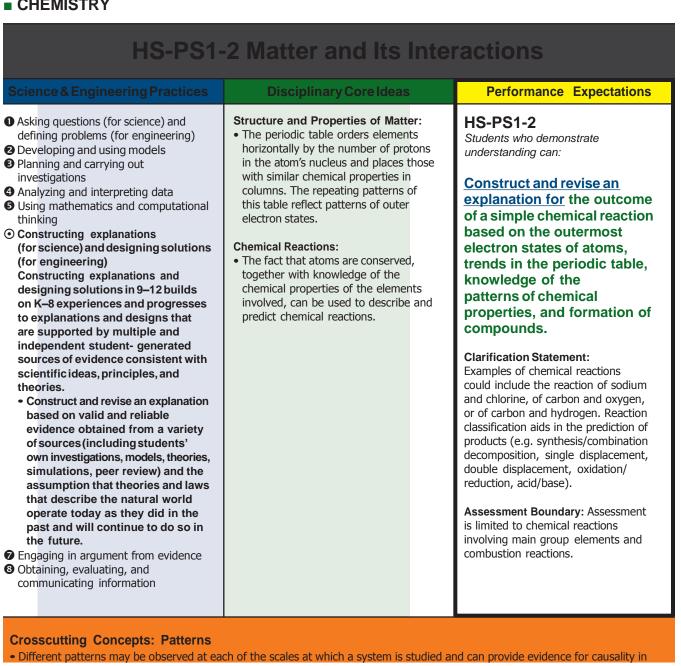
CHEMISTRY



• Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

Oklahoma Academic Standards Connections		
ELA/Literacy	Mathematics	
RST.9-10.7 Translate quantitative or technical information express d in words in a text into visual form (e.g., a table or chart)and translate information expressed visually or mathematically (e.g., in an equation) into words.	N/A	

CHEMISTRY



explanations of phenomena.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
 WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. 	HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale an the origin in graphs and data displays. HSN-Q.A.3 Choose a level of accuracy appropriate to limitation on measurement when reporting quantities.

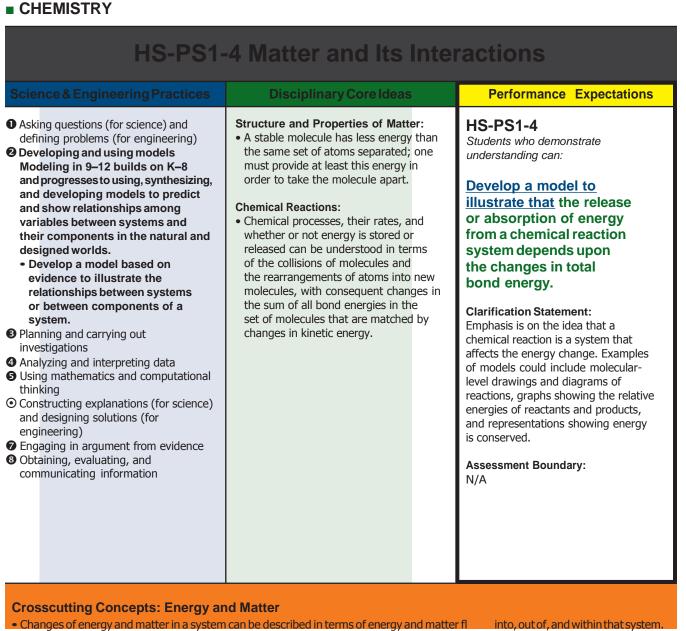
HS-PS1-3 Matter and Its Interactions			
Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations	
 Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Planning and carrying out investigations to answer questions or test solutions to problems in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical and empirical models. Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for science) and designing solutions (for science) and design and going solutions (for science) and design and going solutions (for science) and design and going and interpreting data Obtaining, evaluating, and communicating information 	Structure and Properties of Matter: • The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms.	 HS-PS1-3 Students who demonstrate understanding can: Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. Clarification Statement: Emphasis is on understanding the strengths of forces between particles, not on naming specific intermolecular forces (such as dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite). Examples of bulk properties of substances could include the melting point and boiling point, vapor pressure, and surface tension. The intent of the performance expectation is limited to evaluation of bulk scale properties and not micro scale properties. Assessment does not include Raoult's law calculations of vapor pressure. 	

Crosscutting Concepts: Patterns

- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in
- explanations of phenomena.

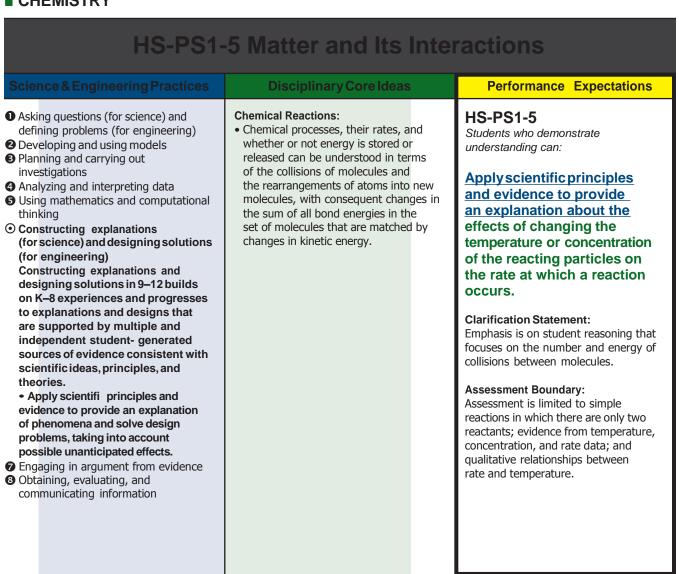
Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
 RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. WHST.9-12.7.9 Draw evidence from informational texts to support analysis, reflection, and research. 	 HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.



Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.	 MP.4 Model with mathematics. HS-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HS-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HS-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

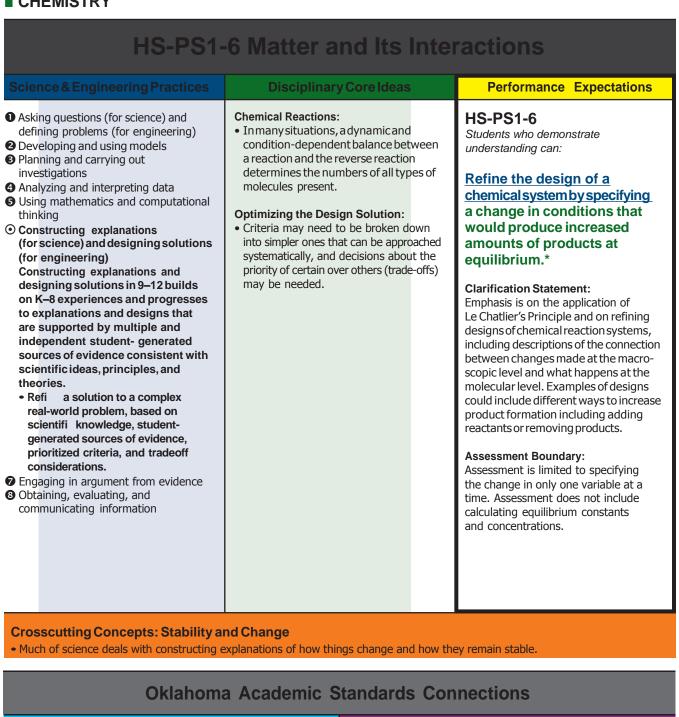


Crosscutting Concepts: Patterns

• Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

Oklahoma Academic Standards Connection

ELA/Literacy	Mathematics	
 RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. 	 MP.2 Reason abstractly and quantitatively. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. 	



ELA/Lit	eracy	Mathematics
WHST12.7 Conduct short as w 9 projects to answer a quest researched question) or solve a pro- generat iry when appropriate; synt the inquubject, demonstrating und on the svestigation. under in	stion (including a self- oblem; narrow or broaden hesize multiple sources	N/A

Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations
 Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Mathematical and computational thinking Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical representations of phenomena to support claims. Constructing explanations (for science) and designing solutions (for engineering) Engaging in argument from evidence Obtaining, evaluating, and communicating information 	Chemical Reactions: The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. 	 HS-PS1-7 Students who demonstrate understanding can: Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. Clarification Statement: Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale (i.e., Conservation of Mass and Stoichiometry). Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques. Assessment does not include complex chemical reactions.

• The total amount of energy and matter in closed systems is conserved.

Oklahoma Academic Standards Connections		
ELA/Literacy	Mathematics	
N/A	 MP.2 Reason abstractly and quantitatively. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to li nitations on measurement when reporting quantities. 	

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

9-12

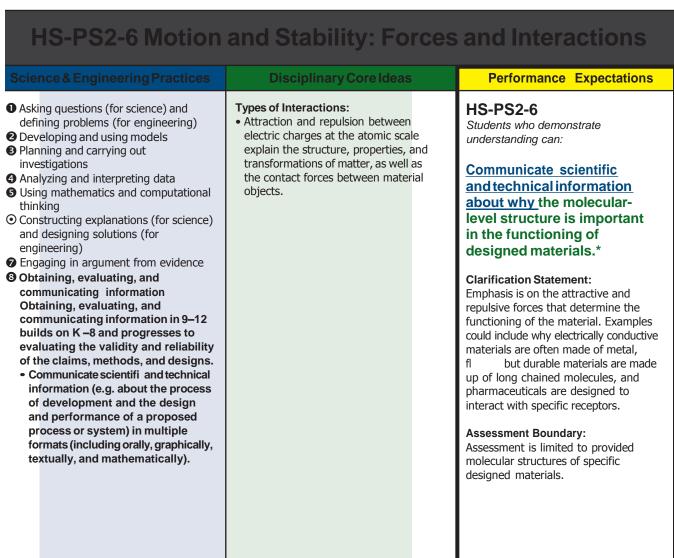
HS-PS1-8 Matter and Its Interactions			
Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations	
 Asking questions (for science) and defining problems (for engineering) Developing and using models Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. Develop a model based on evidence to illustrate the relationships between systems or between components of a system. Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering) Engaging in argument from evidence Obtaining, evaluating, and communicating information 	Nuclear Processes: • Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy.	<section-header><text><text><section-header><section-header><text><text></text></text></section-header></section-header></text></text></section-header>	

Crosscutting Concepts: Energy and Matter

• In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.

Oklahoma Academic Standards Connections		
ELA/Literacy	Mathematics	
N/A	 MP.2 Reason abstractly and quantitatively. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to li nitations on measurement when reporting quantities. 	

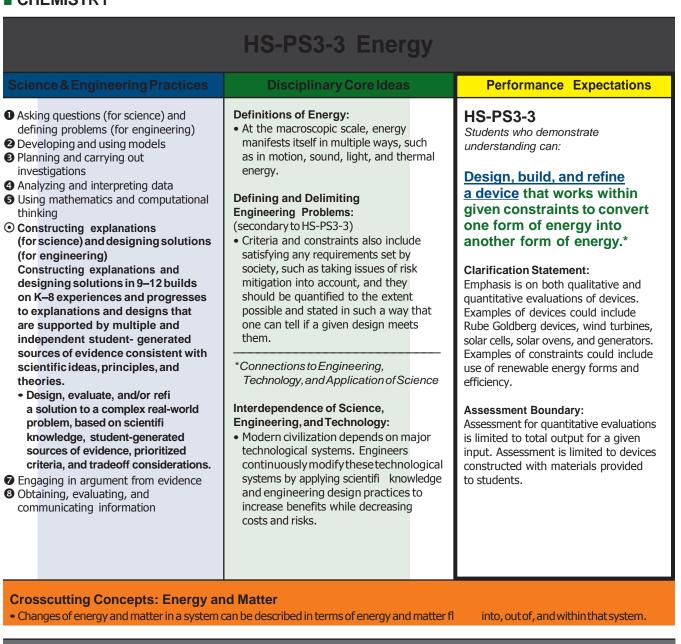
9-12



Crosscutting Concepts: Structure and Function

 Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.

Oklahoma Academic Standards Connections		
ELA/Literacy	Mathematics	
 RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. 	 HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. 	



Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
WH ST .9 -12.7 Conduct short as w ell as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to limitation on measurement when reporting quantities.

HS-PS3-4 Energy			
Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations	
 Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations to answer questions or test solutions to problems in 9–12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical and empirical models. Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering) Engaging in argument from evidence Obtaining, evaluating, and communicating information 	 Conservation of Energy and Energy Transfer: Energy cannot be created or destroyed but it can be transported from one place to another and transferred between systems. Uncontrolled systems always evolve toward more stable states— that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down). 	Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two	

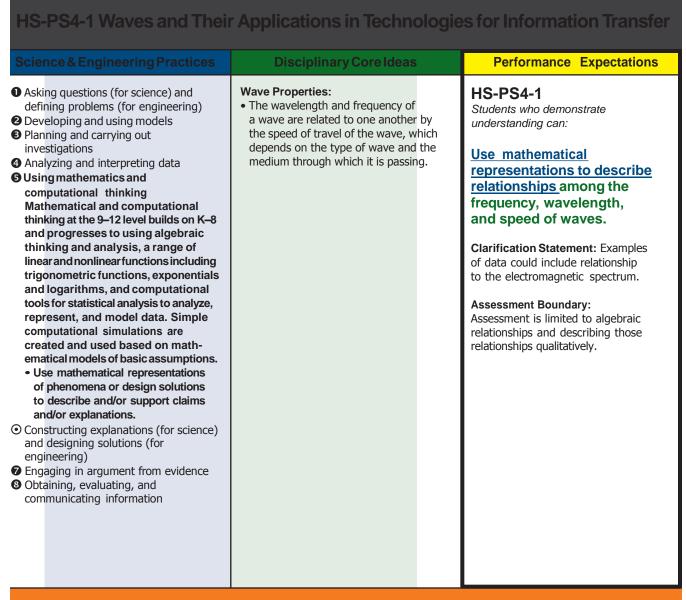
Crosscutting Concepts: System and System Models

• When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.

Okianoma Academic Standards Connections	
ELA/Literacy	Mathematics
 RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. WHST .9 -12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. 	MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics.

Oklahoma Academic Standards Connections

9-12



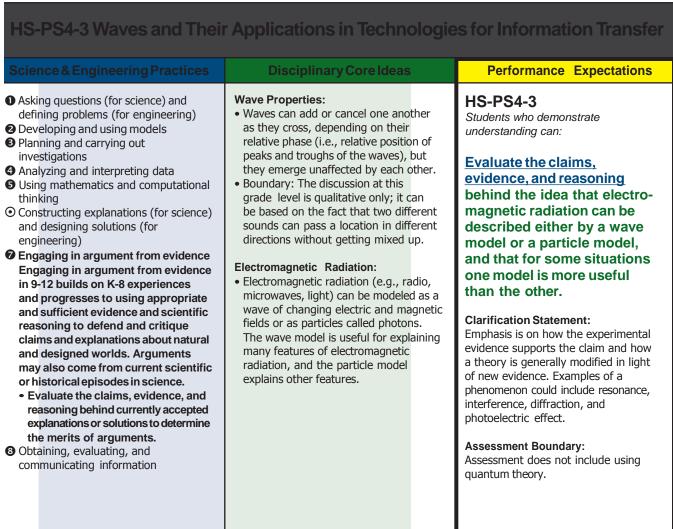
Crosscutting Concepts: Cause and Effect

• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Oklahoma Academic Standards Connections	
---	--

ELA/Literacy	Mathematics
RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HAS-SSE.A.1 Interpret expressions that represent a quantity in terms of its context. HAS-SSE.A.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. HAS.CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

- 9-1

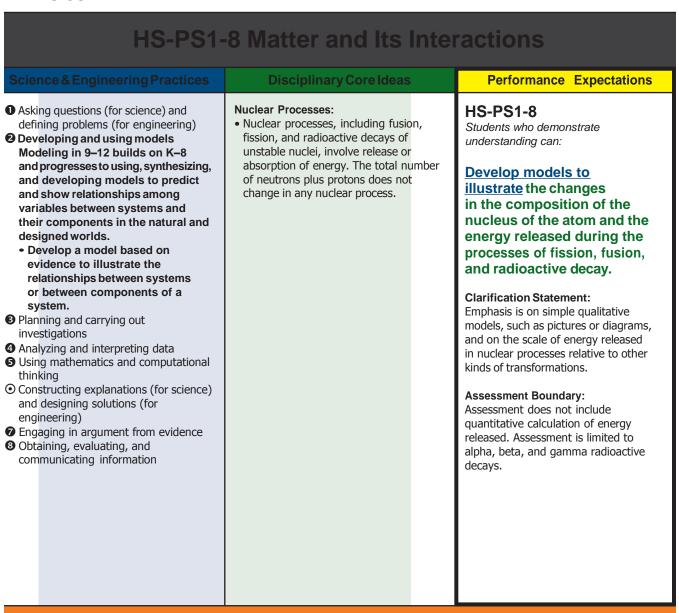


Crosscutting Concepts: Cause and Effect

 Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions— including energy, matter, and information flows-within and between systems at different scales.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. (H S - RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.	 MP.2 Reason abstractly and quantitatively. HAS-SSE.A.1 Interpret expressions that represent a quantity in terms of its context. HAS-SSE.A.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. HAS.CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.



Crosscutting Concepts: Energy and Matter

• In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.

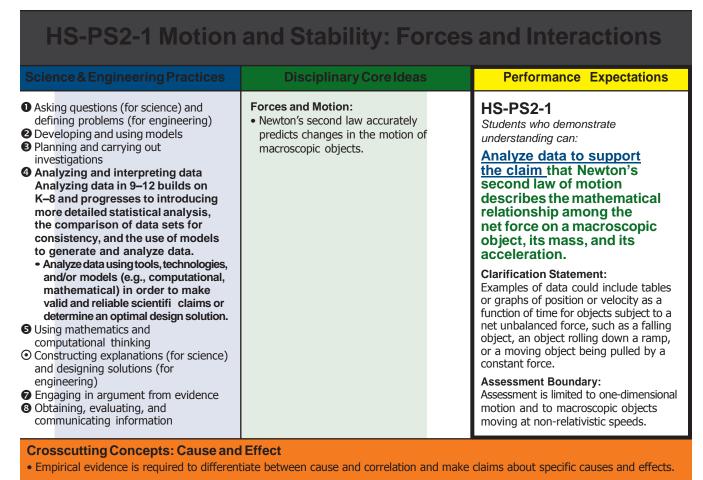
Oklahoma Academic Standards Connections		
	ELA/Literacy	Mathematics
/Α		MP.4 Model with mathematics. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and irterpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
		HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

N//

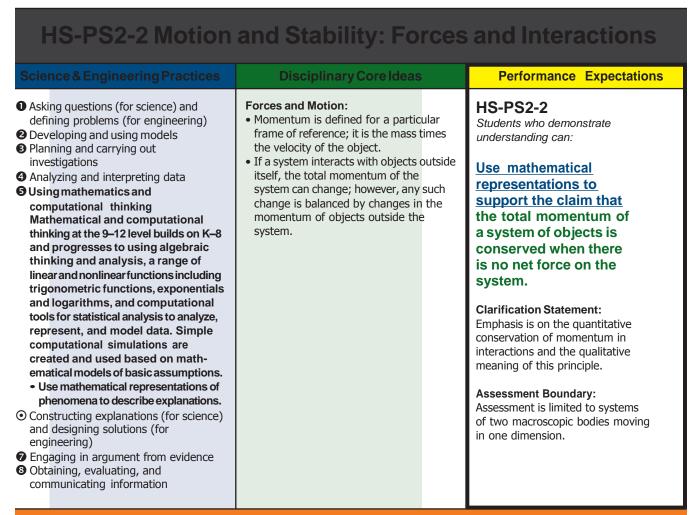
HSN-Q.A.3 Choose a level of accuracy appropriate to li nitations

on measurement when reporting quantities.



Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
 RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. 	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context. HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. HSA-CED.A.1 Create equations and inequalities in one variable and use them to solve problems. HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by in hand in simple cases and using technology for more complicated cases. HSS-ID.A.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).

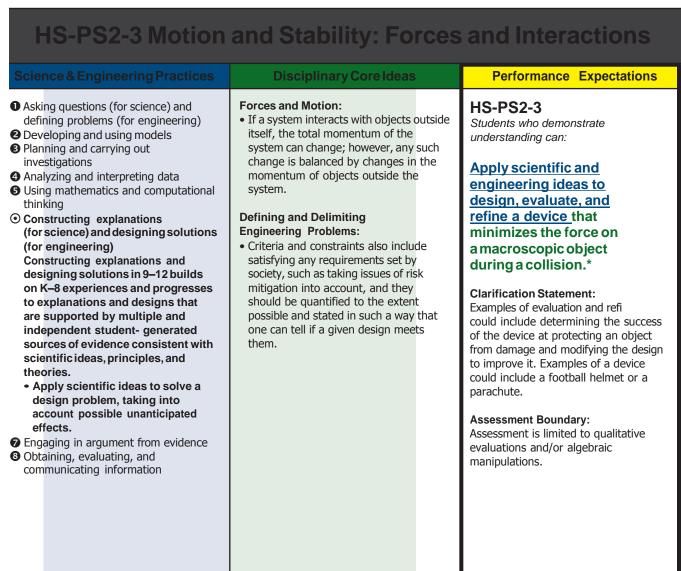


Crosscutting Concepts: Systems and System Models

• When investigating or describing a system, the boundaries and initial conditions of the system need to be defined.

ELA/Literacy	Mathematics
 2ST.9-10.1 Cite specific textual evidence to support analysis f science and technical texts, attending to the precise details f explanation and descriptions. 2ST.9-10.7 Translate quantitative or technical information xpressed in words in a text into visual form (e.g., a table r chart) and translate information expressed visually or nathematically (e.g., in an equation) into words. VHST.9-12.9 Draw evidence from informational texts to support nalysis, reflection, and research. 	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSA-CED.A.1 Create equations and inequalities in one variable and use them to solve problems. HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

Oklahoma Academic Standards Connections

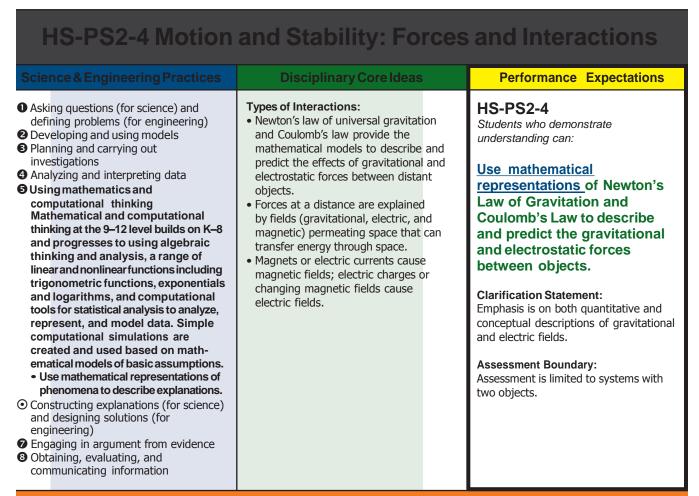


Crosscutting Concepts: Cause and Effect

• Systems can be designed to cause a desired effect.

Oklahoma Academic Standards Connections

	ELA/Literacy	Mathematics
1 researcl generat	1-12.7 Conduct short as well as more sustained projects to answer a question (including a selfed question) or solve a problem; narrow or broaden iry when appropriate; synthesize multiple sources ubject, demonstrating understanding of the investigation.	MP.4 Model with mathematics. MP.5 Use appropriate tools strategically.



Crosscutting Concepts: Patterns

• Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

ELA/Literacy	Mathematics
N∕A	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to limitation on measurement when reporting quantities. HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context. HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

Oklahoma Academic Standards Connections

HS-PS2-5 Motion and Stability: Forces and Interactions Disciplinary Core Ideas Performance Expectations Types of Interactions: Asking questions (for science) and HS-PS2-5 defining problems (for engineering) • Forces at a distance are explained Students who demonstrate **2** Developing and using models by fields (gravitational, electric, and understanding can: • Planning and carrying out magnetic) permeating space that can investigations transfer energy through space. Plan and conduct an Planning and carrying out Magnets or electric currents cause investigation to provide investigations to answer questions magnetic fields; electric charges or evidence that an electric or test solutions to problems in 9changing magnetic fields cause 12 builds on K–8 experiences and current can produce a electric fields. progresses to include investigations magnetic field and that a that provide evidence for and test **Definitions of Energy:** changing magnetic field can conceptual, mathematical, physical (secondarytoHS-PS2-5). produce an electric current. and empirical models. • "Electrical energy" may mean Plan and conduct an investigation energy stored in a battery or energy individually and collaboratively to Clarification Statement: transmitted by electric currents. produce data to serve as the basis N/A for evidence, and in the design: decide on types, how much, and Assessment Boundary: accuracy of data needed to Assessment is limited to designing produce reliable measurements and conducting investigations with and consider limitations on the provided materials and tools. precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. Analyzing and interpreting data **G** Using mathematics and computational thinking • Constructing explanations (for science) and designing solutions (for engineering)

- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

Crosscutting Concepts: Cause and Effect

• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Oklahoma Academic S	tandards Connections
ELA/Literacy	Mathematics

WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of specific tasks, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source following a standard format for citation.

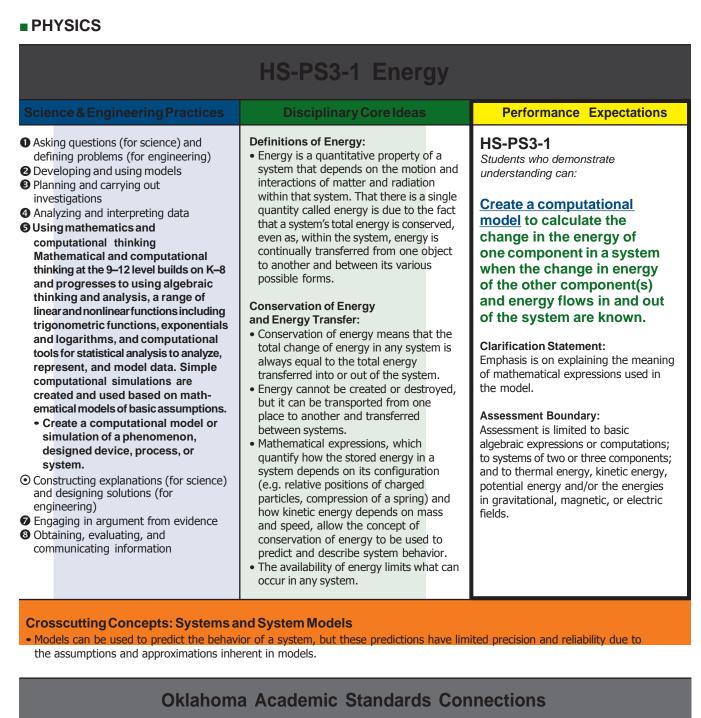
WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.

HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.

HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

9-12



ELA/Literacy	Mathematics
SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSN-Q.A.1 Use units as away to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

HS-PS3-2 Energy

Science & Engineering Practices

defining problems (for engineering)

Modeling in 9-12 builds on K-8

and show relationships among

Develop a model based on

evidence to illustrate the

designed worlds.

Planning and carrying out

Analyzing and interpreting data

and designing solutions (for

communicating information

³ Obtaining, evaluating, and

system.

investigations

engineering)

thinking

variables between systems and

and progresses to using, synthesizing,

their components in the natural and

relationships between systems

or between components of a

G Using mathematics and computational

• Constructing explanations (for science)

• Engaging in argument from evidence

and developing models to predict

• Asking questions (for science) and

2 Developing and using models

Disciplinary Core Ideas

Definitions of Energy:

- Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms.
- At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.
- These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space.

Performance Expectations

HS-PS3-2

Students who demonstrate understanding can:

Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as either motions of particles or energy stored in fields.

Clarification Statement:

Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the earth, and the energy stored between two electrically-charged plates. Examples of models could include diagrams, drawings, descriptions, and computer simulations.

Assessment Boundary:

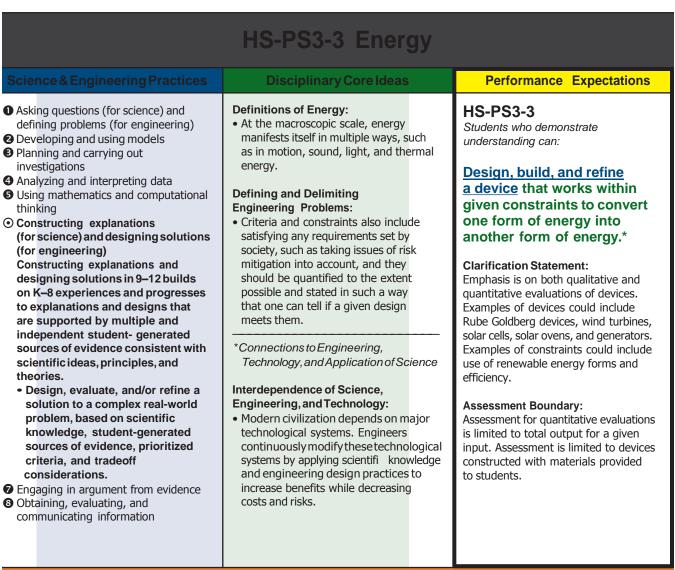
Assessment does not include quantitative calculations.

Crosscutting Concepts: Energy and Matter

• Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems.

ELA/Literacy	Mathematics
SL.11-1 2.5	MP.2 Reason abstractly and quantitatively.
Make stategic use of digital media (e.g., textual, graphical, audio, vsual, and interactive elements) in presentations to enhanceunderstanding of findings, reasoning, and evidence and to add interest.	MP.4 Model with mathematics.

Oklahoma Academic Standards Connections



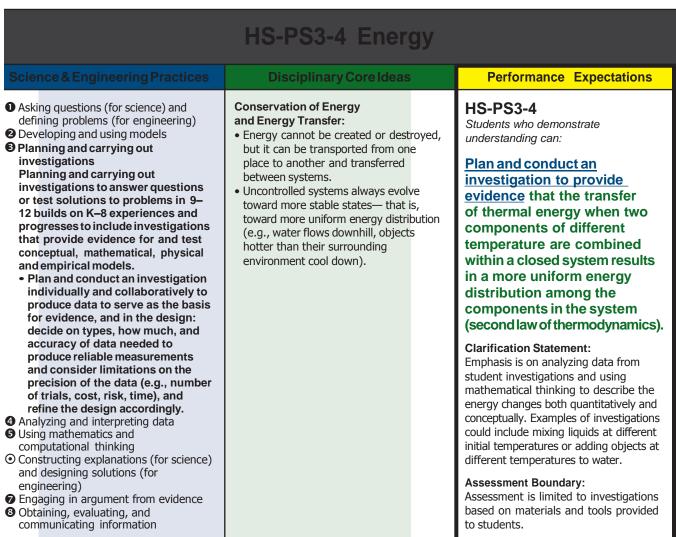
Crosscutting Concepts: Energy and Matter

• Changes of energy and matter in a system can be described in terms of energy and matter fl into, out of, and within that system.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
WHST .9 -12.7 Conduct short as w ell as more sustained re- search projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to limitation on measurement when reporting quantities.

174



Crosscutting Concepts: System and System Models

• When investigating or describing a system, the boundaries and initial conditions of the sy stem need to be defined and their inputs and outputs analyzed and described using models.

Okianoma Academic Standards Connections		
ELA/Literacy	Mathematics	
 RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. WH ST .9 -12.7 Conduct short as w ell as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. 	MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics.	



	HS-PS3-5 Energy	
Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations
 Asking questions (for science) and defining problems (for engineering) Developing and using models Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. Develop a model based on evidence to illustrate the relationships between systems or between components of a system. Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering) Engaging in argument from evidence Obtaining, evaluating, and communicating information 	Relationship Between Energy and Forces: • When two objects interacting through a field change relative position, the energy stored in the field is changed.	 HS-PS3-5 Students who demonstrate understanding can: Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction. Clarification Statement: Examples of models could include drawings, diagrams, and texts, such as drawings of what happens when two charges of opposite polarity are near each other, including an explanation of how the change in energy of the field. Assessment Boundary: Assessment is limited to systems containing two objects.

Crosscutting Concepts: Energy and Matter

• Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system..

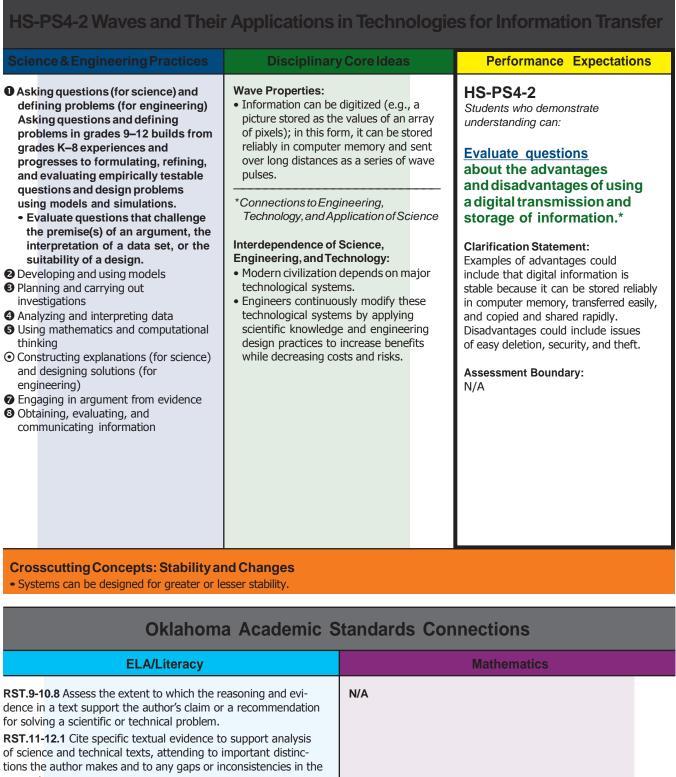
Oklahoma Academic Standards Connections		
ELA/Literacy	Mathematics	
 WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of specific tasks, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source following a standard format for citation. WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. 	MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics.	

Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations
 Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations. Constructing explanations (for science) and designing solutions (for science) and designing solutions (for science) and designing solutions (for science) and communicating information 	Wave Properties: • The wavelength and frequency of a wave are related to one another b the speed of travel of the wave, wh depends on the type of wave and t medium through which it is passing	the Use mathematical

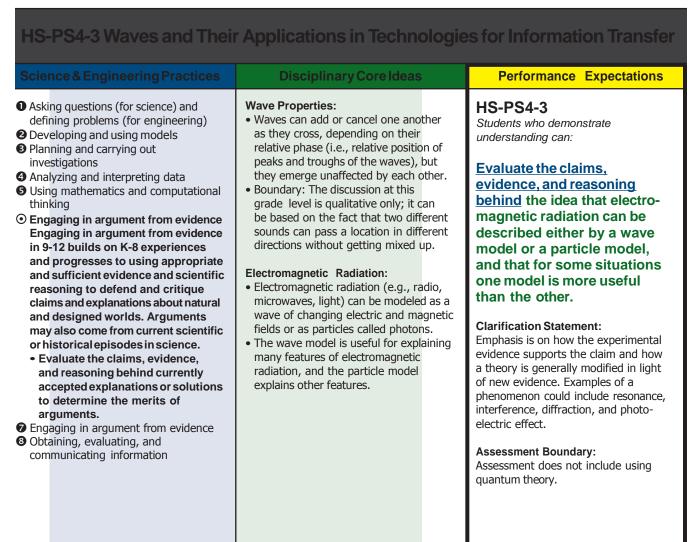
Crosscutting Concepts: Cause and Effect

• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Oklahoma Academic Standards Connections		
ELA/Literacy	Mathematics	
RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HAS-SSE.A.1 Interpret expressions that represent a quantity in terms of its context. HAS-SSE.A.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. HAS.CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. 	



account. RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.



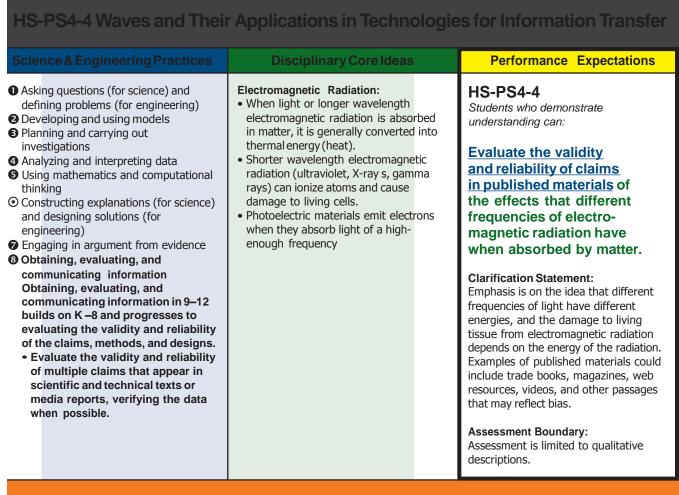
Crosscutting Concepts: Cause and Effect

• Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions— including energy, matter, and information flows—within and between system at different scales.

Oklahoma	Academic	Standards	Connections
----------	----------	------------------	-------------

ELA/Literacy	Mathematics
 RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. 	 MP.2 Reason abstractly and quantitatively. HAS-SSE.A.1 Interpret expressions that represent a quantity in terms of its context. HAS-SSE.A.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. HAS.CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

9-12

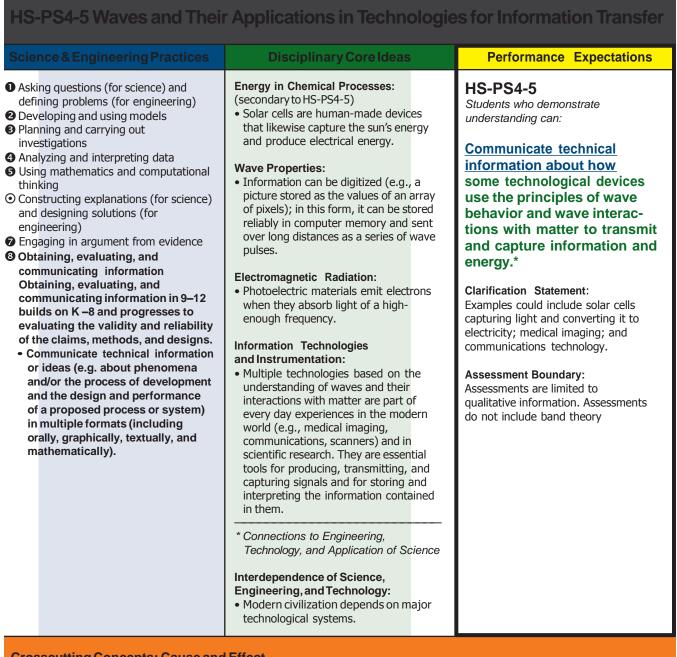


Crosscutting Concepts: Cause and Effect

- Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is know n about smaller scale mechanisms within the system.

Oklahoma Academic Standards Connections	ards Connections	Standards	Academic	Oklahoma
---	------------------	-----------	----------	----------

ELA/Literacy	Mathematics
 RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solvie a problem. RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. WHST. 11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. 	N/A



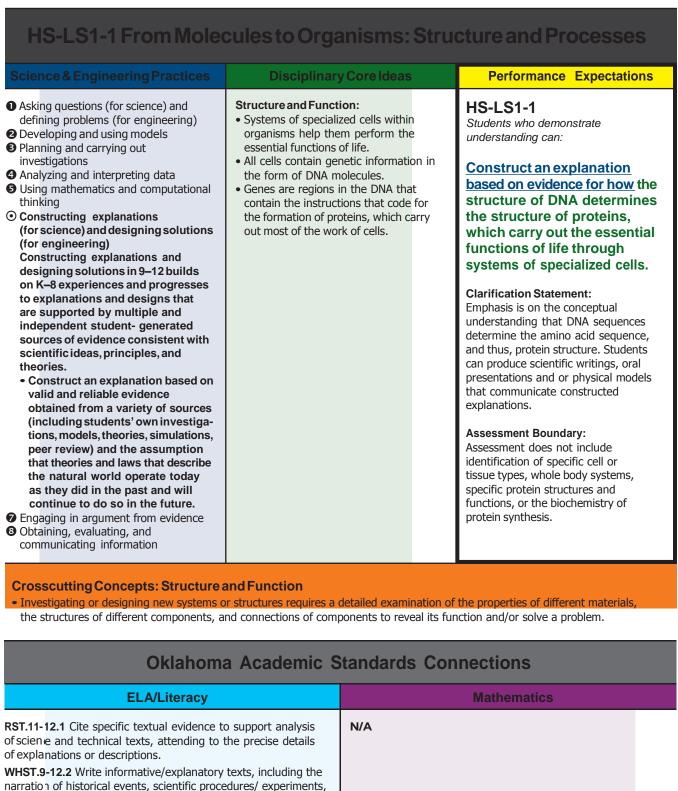
Crosscutting Concepts: Cause and Effect • Systems can be designed to cause a desired effect.

 Oklahoma Academic Standards Connections

 ELA/Literacy
 Mathematics

 WHST. { -12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or techncal processes.
 N/A

 *The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.



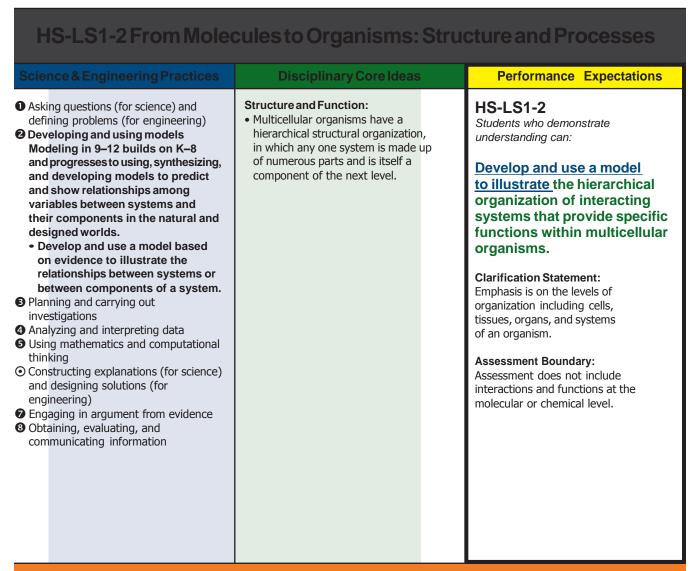
9-12

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

or technical processes.

analysis, reflection, and research.

WHST.9-12.9 Draw evidence from informational texts to support



Crosscutting Concepts: Systems and System Models

 Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions— including energy, matter, and information flows—within and between systems at different scales.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
 SL.9- 5 Make strategic use of digital media 12. tual, graphical, audio, visual, and interactive (e.g., tɛs) in presentations to enhance understanding of element reasoning, and evidence and to add interest. findings, 	N/A

HS-LS1-3 From Molecules to Organisms: Structure and Processes

Science & Engineering Practices

Disciplinary Core Ideas

Performance Expectations

HS-LS1-3

understanding can:

Students who demonstrate

Plan and conduct an

investigation to provide

• Asking questions (for science) and defining problems (for engineering)

2 Developing and using models

Planning and carrying out investigations

Planning and carrying out investigations to answer questions or test solutions to problems in 9– 12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical and empirical models.

• Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.

- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations (for science) and designing solutions (for engineering)
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

• Eeedback mechanisms maint

• 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. Outside that range (e.g., at a too high or tool low external temperature, with too little food or water available) the organism cannot survive.

evidence of the importance of maintaining homeostasis in living organisms. Clarification Statement:

A state of homeostasis must be maintained for organisms to remain alive and functional even as external conditions change within some range. Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, root development in response to water levels, and cell response to hyper and hypotonic environments.

Assessment Boundary:

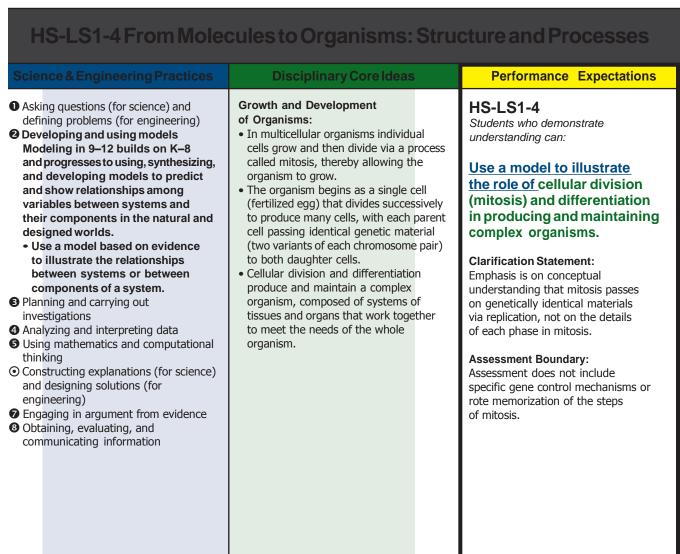
Assessment does not include the cellular processes involved in the feedback mechanism.

Crosscutting Concepts: Stability and Change

• Feedback (negative or positive) can stabilize or destabilize a system.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
 WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. WHST.9-10.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the researchquestion; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation. 	N/A

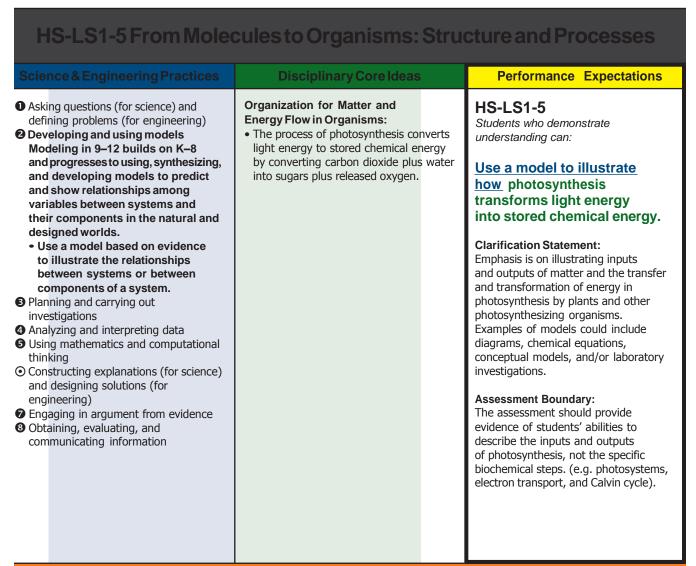


Crosscutting Concepts: Systems and System Models

 Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions— including energy, matter, and information flows—within and between systems at different scales.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
SL.9- 5 Make strategic use of digital media 12. : tual, graphical, audio, visual, and interactive (e.g., tes) in presentations to enhance understanding of element reasoning, and evidence and to add interest. findings,	 MP.4 Model with mathematics. HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. HSF-BF.A.1 Write a function that describes a relationship between two quantities.



Crosscutting Concepts: Energy and Matter

• Changes of energy and matter in a system can be described in terms of energy and matter fl

into, out of, and within that system.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
 SL.9- 5 Make strategic use of digital media 12. tual, graphical, audio, visual, and interactive (e.g., tɛs) in presentations to enhance understanding of element reasoning, and evidence and to add interest. findings, 	N/A

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

186

HS-LS1-6 From Molecules to Organisms: Structure and Processes

Science & Engineering Practices

- Asking questions (for science) and defining problems (for engineering)
- **2** Developing and using models
- B Planning and carrying out investigations
- Analyzing and interpreting data
- Analyzing and interpreting data
 Using mathematics and computational thinking
- Constructing explanations (for science) and designing solutions (for engineering)
 Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student- generated sources of evidence consistent with scientific ideas, principles, and theories.
 - Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) 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.
- Engaging in argument from evidence
 Obtaining, evaluating, and communicating information

Disciplinary Core Ideas

Organization for Matter and Energy Flow:

- (Builds on HS-LS1-5) The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into large molecules that can be assembled into large molecules (such as proteins or DNA), used for example to form new cells.
- As matter and energy flow through different organization levels of living systems, chemical elements are recombined in different ways to form different products.

Performance Expectations

HS-LS1-6

Students who demonstrate understanding can:

<u>Construct and revise an</u> <u>explanation based on</u> <u>evidence for how</u> carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.

Clarification Statement:

Emphasis is on students constructing explanations for how sugar molecules are formed through photosynthesis and the components of the reaction (i.e., carbon, hydrogen, oxygen). This hydrocarbon backbone is used to make amino acids and other carbon-based molecules that can be assembled (anabolism) into larger molecules (such as proteins or DNA).

Assessment Boundary:

Assessment does not include the details of the specific chemical reactions or identification of macromolecules.

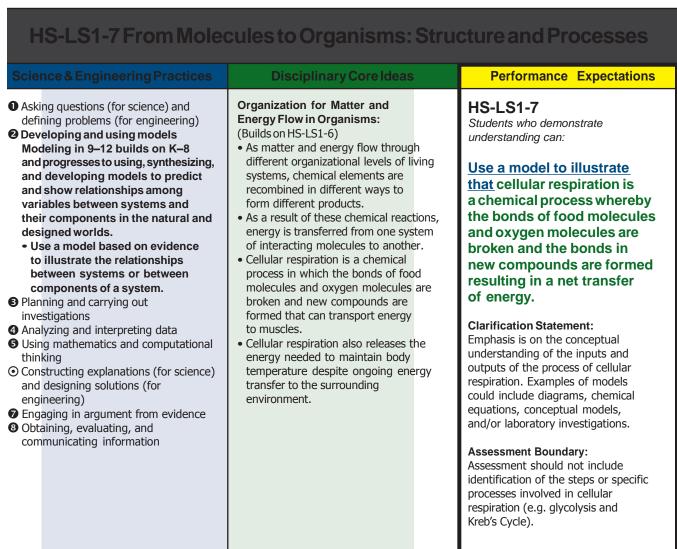
Crosscutting Concepts: Energy and Matter

• Changes of energy and matter in a system can be described in terms of energy and matter fl

into, out of, and within that system.

Oklahoma Academic Standards Connections ELA/Literacy Mathematics N/A RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations and descriptions. WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.

9-12



Crosscutting Concepts: Energy and Matter

• Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
 SL.9- 5 Make strategic use of digital media 12. tual, graphical, audio, visual, and interactive (e.g., tes) in presentations to enhance understanding of element reasoning, and evidence and to add interest. findings, 	N/A

HS-LS2-1 Ecosystems: Interactions, Energy, and Dynamics

- Asking questions (for science) and defining problems (for engineering)
- **2** Developing and using models
- B Planning and carrying out
- investigations
- Analyzing and interpreting data
- **O** Using mathematics and computational thinking Mathematical and computational thinking at the 9-12 level builds on K-8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.
 - Use mathematical and/or computational representations of phenomena or design solutions to support explanations.
- Constructing explanations (for science) and designing solutions (for engineering)
- Engaging in argument from evidence
- 3 Obtaining, evaluating, and communicating information

Disciplinary Core Ideas

Interdependent Relationships

- in Ecosystems:
- Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease.
- Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.

Performance Expectations

HS-LS2-1

Students who demonstrate understanding can:

Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.

Clarification Statement:

Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate and competition. Examples of mathematical comparisons could include graphs, charts, histograms, or population changes gathered from simulations or historical data sets.

Assessment Boundary:

Assessment does not include deriving mathematical equations to make comparisons.

Crosscutting Concepts: Scale, Proportion, and Quantity

• The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs

Oklahoma Academic Standards Connections ELA/Literacy Mathematics RST.9-10.1 Cite specific textual evidence to support analysis MP.2 Reason abstractly and quantitatively. of science and technical texts, attending to precise details and MP.4 Model with mathematics. explanations or descriptions. HSN-Q.A.1 Use units as a way to understand problems and to WHST.9-12.2 Write informative/explanatory texts, including the quide the solution of multi-step problems; choose and interpret narration of historical events, scientific procedures/ experiments, units consistently in formulas; choose and interpret the scale and or technical processes. the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.



HS-LS2-2 Ecosystems: Interactions, Energy, and Dynamics

Science & Engineering Practices

- Asking questions (for science) and defining problems (for engineering)
- 2 Developing and using models
- Planning and carrying out
- investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.
 - Use mathematical representations of phenomena or design solutions to support and revise explanations.
- Constructing explanations (for science) and designing solutions (for engineering)
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

Disciplinary Core Ideas

Interdependent Relationships

in Ecosystems:

- Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease.
- Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.

Ecosystem Dynamics, Functioning, and Resilience:

- A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions.
- If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem.
- Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.

Performance Expectations

HS-LS2-2

Students who demonstrate understanding can:

<u>Use mathematical</u> <u>representations to support</u> <u>and revise explanations</u> <u>based on evidence</u> about factors affecting biodiversity and populations in ecosystems of different scales.

Clarification Statement:

Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data.

Assessment Boundary:

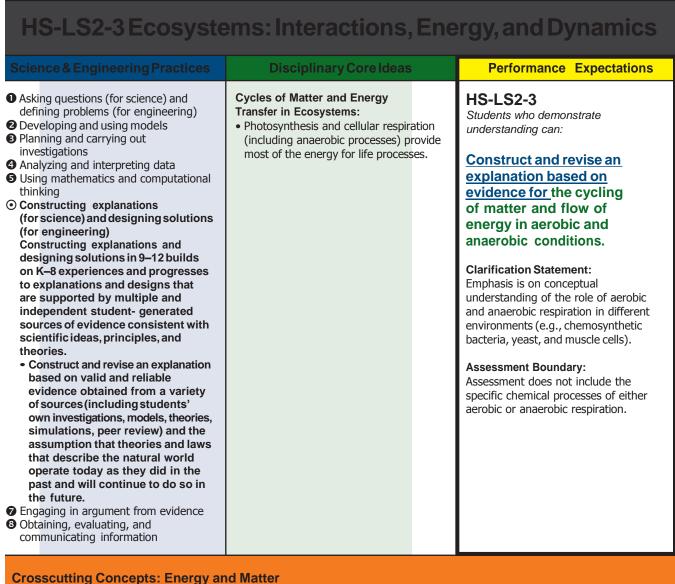
Assessment is limited to provided data.

Crosscutting Concepts: Scale, Proportion, and Quantity

- Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale.

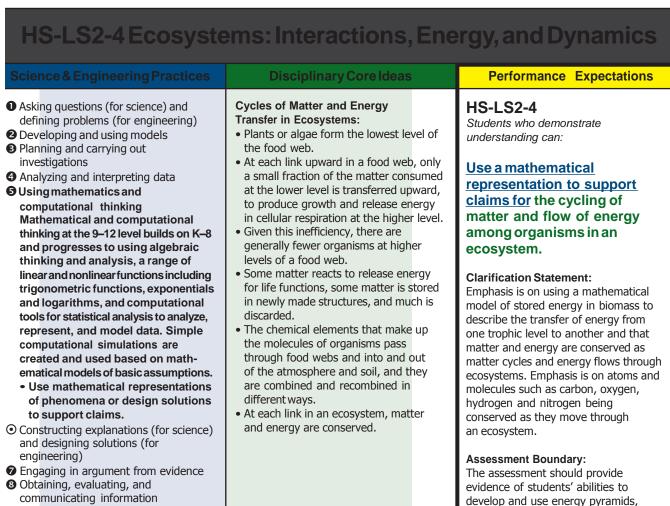
Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to precise details and explanations or descriptions. WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale an the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to limitation on measurement when reporting quantities.



Crosscutting Concepts: Energy and Matter
 energy drives the cycling of matter within and between systems

ELA/Literacy	Mathematics
 ST.9-10.1 Cite specific textual evidence to support analysis is science and technical texts, attending to precise details and eplanations or descriptions. HST.9-12.2 Write informative/explanatory texts, including the arration of historical events, scientific procedures/ experiments, technical processes. HST.9-12.5 Develop and strengthen writing as needed by anning, revising, editing, rewriting, or trying a new approach, is most significant for a specific urpose and audience. 	N/A



Crosscutting Concepts: Energy and Matter

 Energy cannot be created or destroyed- it only moves between one place and another place, between objects and/or fields, or between systems.

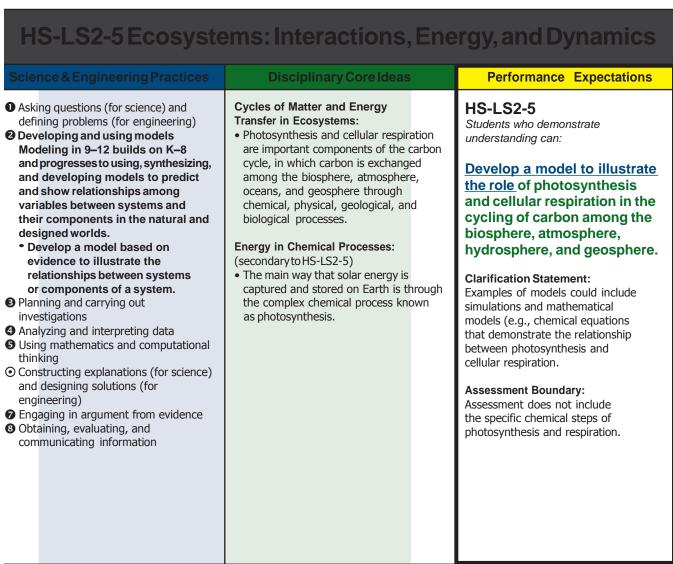
Oklahoma Academic Standards Connections

food chains, food webs, and other

models from data sets.

ELA/Literacy	Mathematics
N/A	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to li nitation on measurement when reporting quantities.

-12



Crosscutting Concepts: Systems and Models

 Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions— including energy, matter, and information flows—within and between systems at different scales.

Oklahoma Academic Standards Connections	
ELA/Literacy	Mathematics
N/A	MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics.

9-12

HS-LS2-6 Ecosystems: Interactions, Energy, and Dynamics

Science & Engineering Practices

- Asking questions (for science) and defining problems (for engineering)
- **2** Developing and using models
- Planning and carrying out
- investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations (for science) and designing solutions (for engineering)
- Engaging in argument from evidence Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed worlds. Arguments may also come from current scientific or historical episodes in science.
 - Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.
- Obtaining, evaluating, and communicating information

Disciplinary Core Ideas

Ecosystem Dynamics,

- Functioning, and Resilience:A complex set of interactions within
- an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions.
- If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem.
- Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.

Performance Expectations

HS-LS2-6

Students who demonstrate understanding can:

Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

Clarification Statement:

Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise.

Assessment Boundary:

The assessment should provide evidence of students' abilities to derive trends from graphical representations of population trends. Assessments should focus on describing drivers of ecosystem stability and change, not on the organismal mechanisms of responses and interactions.

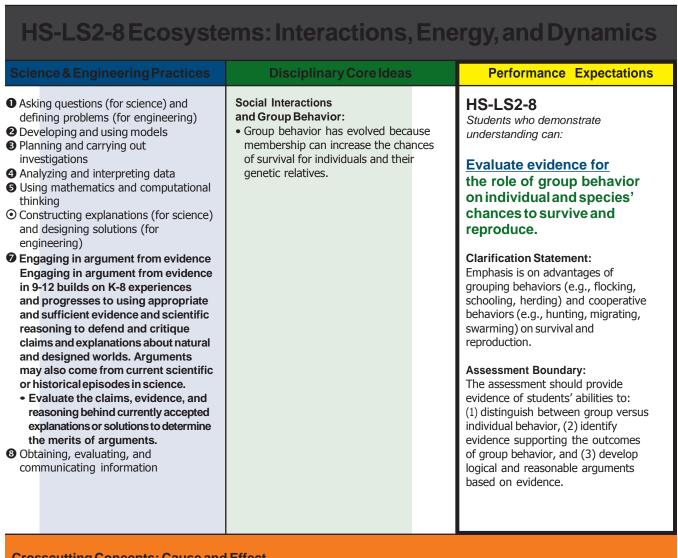
Crosscutting Concepts: Stability and Change

• Much of science deals with constructing explanations of how things change and how they remain stable.

Oklahoma Academic Standards Connections	
ELA/Literacy	Mathematics
 RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations and descriptions. RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g. a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. 	 MP.2 Reason abstractly and quantitatively. HSS-ID.A.1 Represent data with plots on the real number line. HSS-IC.A.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population. HSS-IC.B.6 Evaluate reports based on data.

9-12

SCIENCE STANDARDS • OKLAHOMA STATE DEPARTMENT OF EDUCATION



Crosscutting Concepts: Cause and Effect

• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Oklahoma Academic Standards Connections		
ELA/Literacy	Mathematics	
 RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations and descriptions. RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g. a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. 	N/A	

9-12



Science & Engineering Practices

• Asking questions (for science) and

Asking guestions and defining

grades K-8 experiences and

defining problems (for engineering)

problems in grades 9–12 builds from

progresses to formulating, refining,

and evaluating empirically testable

examining models or a theory to

questions and design problems

using models and simulations.

Ask question that arise from

clarify relationships

B Planning and carrying out

³Obtaining, evaluating, and

communicating information

investigations

thinking

engineering)

2 Developing and using models

Analyzing and interpreting data

S Using mathematics and computational

 Constructing explanations (for science) and designing solutions (for

• Engaging in argument from evidence

Disciplinary Core Ideas

Performance Expectations

Structure and Function:

(secondary to HS-LS3-1)

 All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins.

Inheritance of Traits:

- Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA.
- The instructions for forming species' characteristics are carried in DNA.
- All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways.
- Not all DNA codes for protein, some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known functions.

HS-LS3-1 Students who demonstrate understanding can:

Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

Clarification Statement:

Emphasis should be on asking questions and making predictions to obtain reliable information about the role of DNA and chromosomes in coding the instructions for traits (e.g., pedigrees, karyotypes, genetic disorders, Punnett squares).

Assessment Boundary:

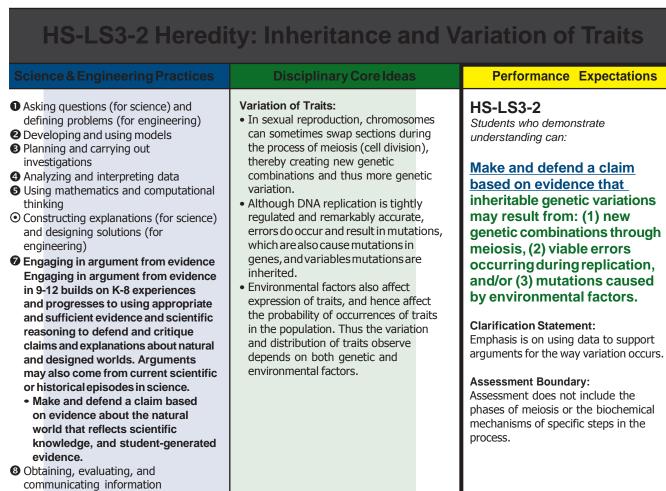
Assessments may include codominance, incomplete dominance, and sex-linked traits, but should not include dihybrid crosses.

Crosscutting Concepts: Cause and Effect

• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Oklahoma Academic Standards Connections

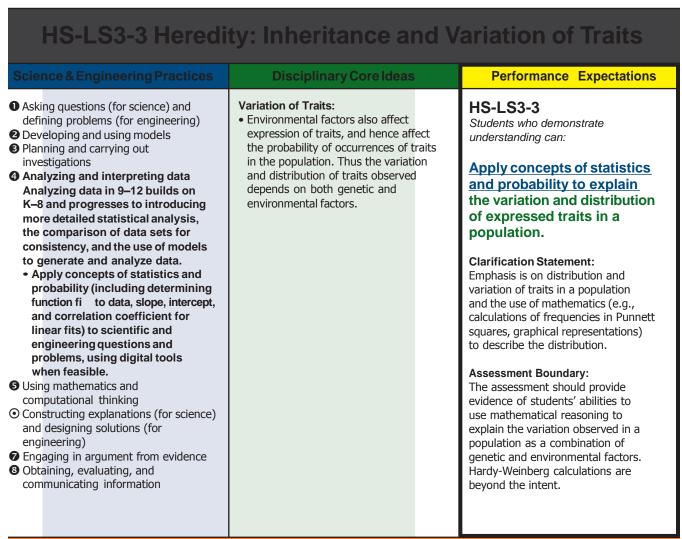
ELA/Literacy	Mathematics
RST.9-1 0.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations and descriptions.	N/A



Crosscutting Concepts: Cause and Effect

Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

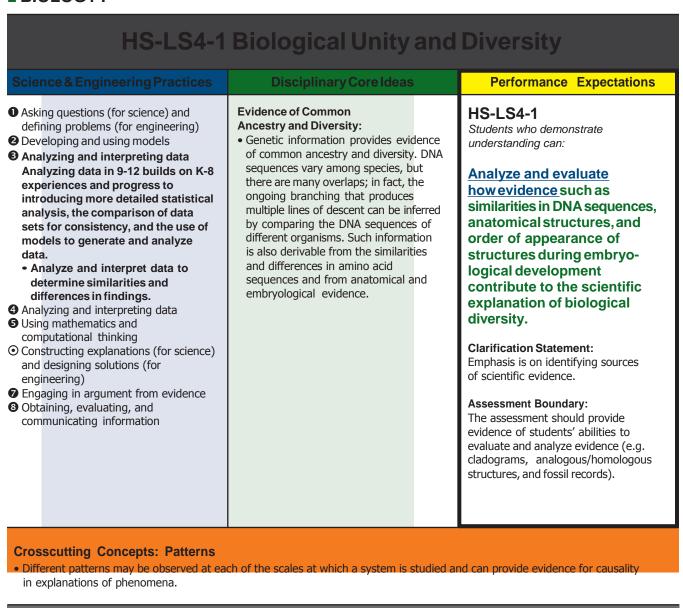
Oklahoma Academic Standards Connections	
ELA/Literacy	Mathematics
RST.9-10.1 Cite specific textual evidence to support analysis of sciene and technical texts, attending to precise details or explanations or descriptions. WHST.9-12.1 Write arguments focused on discipline-specific content.	MP.2 Reason abstractly and quantitatively.



Crosscutting Concepts: Scale, Proportion and Quantity

• Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).

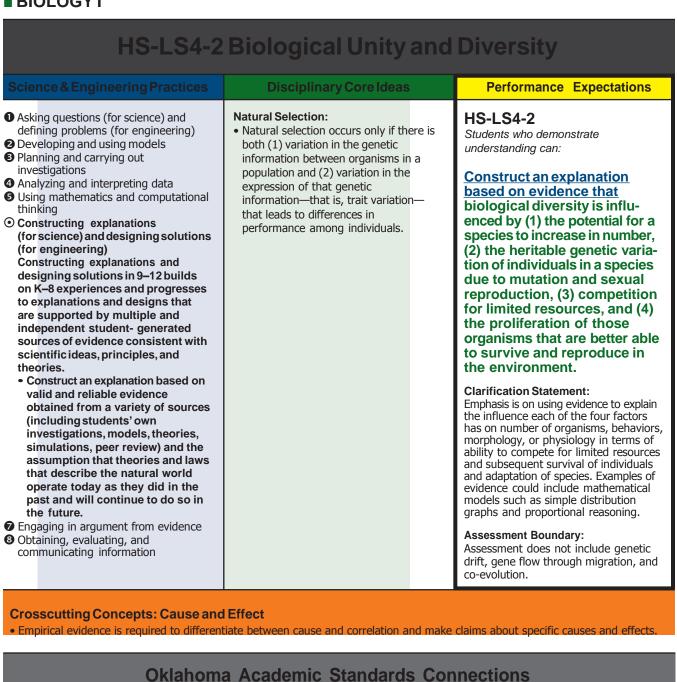
Oklahoma Academic Standards Connections		
ELA/Literacy Mathematics		Mathematics
N/A		MP.2 Reason abstractly and quantitatively.



Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.	MP.2 Reason abstractly and quantitatively.
WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.	
WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.	
SL.11-12.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.	

9-12



ELA/Literacy	Mathematics
RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments,	MP.2 Reason abstractly and quantitatively. MP. 4 Model with mathematics.
or technical processes. WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.	
SL.11-12.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.	

HS-LS4-3 Biological Unity and Diversity

Science & Engineering Practices

• Asking questions (for science) and

- defining problems (for engineering)Developing and using models
- B Planning and carrying out
- investigations
- Analyzing and interpreting data Analyzing data in 9–12 builds on K–8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.
 - Apply concepts of statistics and probability (including determining function fi to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.
- Using mathematics and computational thinking
- Constructing explanations (for science) and designing solutions (for engineering)
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

Disciplinary Core Ideas

Natural Selection:

- Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals.
- The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population.

Adaptation:

- Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not.
- Adaptation also means that the distribution of traits in a population can change when conditions change.

Performance Expectations

HS-LS4-3

Students who demonstrate understanding can:

Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.

Clarification Statement:

Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations for adaptations.

Assessment Boundary:

The assessment should provide evidence of students' abilities to analyze shifts in numerical distribution of traits as evidence to support explanations. Analysis is limited to basic statistical and graphical analysis, not gene frequency calculations.

Crosscutting Concepts: Patterns

• Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations and phenomena.

Oklahoma Academic Standards Connections

	ELA/Literacy	Mathematics	
analysis of distinction in the acc WHST. 9 narration or techn	 2.1 Cite specific textual evidence to support of science and technical texts, attending to important ons the author makes and to any gaps or inconsistencies ount. 12.2 Write informative/explanatory texts, including the of historical events, scientific procedures/ experiments, cal processes. 12.9 Draw evidence from informational texts to support reflection, and research. 	MP.2 Reason abstractly and quantitatively.	

HS-LS4-4 Biological Unity and Diversity

Science & Engineering Practices

- Asking questions (for science) and defining problems (for engineering)
- Developing and using models
- Planning and carrying out
- investigations
- Analyzing and interpreting data
- **9** Using mathematics and computational thinking
- Constructing explanations (for science) and designing solutions (for engineering)
 Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student- generated sources of evidence consistent with scientific ideas, principles, and theories.
 - Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) 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.
- Engaging in argument from evidence
 Obtaining, evaluating, and communicating information

Disciplinary Core Ideas

Adaptation:

- Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment.
- That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not.
- 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.

Performance Expectations

HS-LS4-4

Students who demonstrate understanding can:

<u>Construct an explanation</u> <u>based on evidence for how</u> natural selection leads to adaptation of populations.

Clarification Statement:

Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or adaptation of other organisms) contribute to a change in gene frequency over time, leading to adaptation of populations. One example could be that as climate became more arid, grasses replaced forests, which led to adaptation in mammals over time (e.g. Increase tooth enamel and size of teeth in herbivores).

Assessment Boundary:

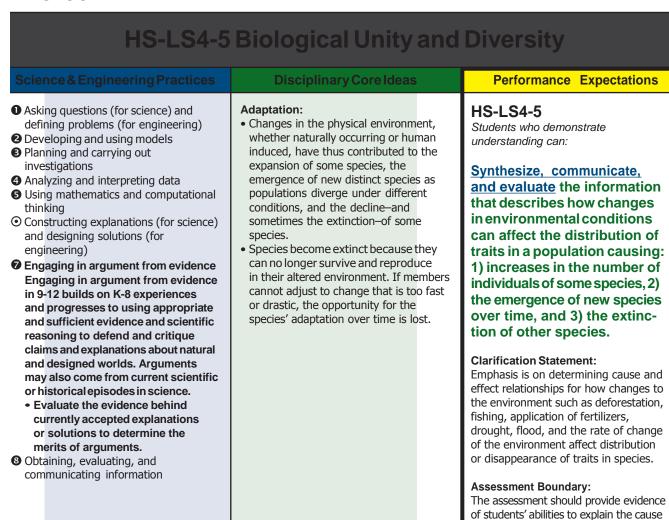
The assessment should measure students' abilities to differentiate types of evidence used in explanations.

Crosscutting Concepts: Cause and Effect

• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Okianoma Academic Standards Connections	
ELA/Literacy	Mathematics
 RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or techncal processes. WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. 	MP.2 Reason abstractly and quantitatively.

9-12



Crosscutting Concepts: Cause and Effect

• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Oklahoma Academic Standards Connections		
ELA/Literacy	Mathematics	
RST.11-12.8 Assess the extent to which the reasoning and evic ence in a text support the author's claim or a recommendation for solving a scientific or technical problem. WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.	MP.2 Reason abstractly and quantitatively.	

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

and effect for how changes to the environment affect distribution or disappearance of traits in species.

HS-ESS1-1 Earth's Place in the Universe			
Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations	
 Asking questions (for science) and defining problems (for engineering) Developing and using models Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. Develop a model based on evidence to illustrate the relationships between systems or components of a system. Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering) Engaging in argument from evidence Obtaining, evaluating, and communicating information 	 The Universe and Its Stars: The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. Energy in Chemical Processes and Everyday Life: (secondary to HS-ESS1-1) Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation. 	that eventually reaches Earth	

Crosscutting Concepts: Scale, Proportion, and Quantity

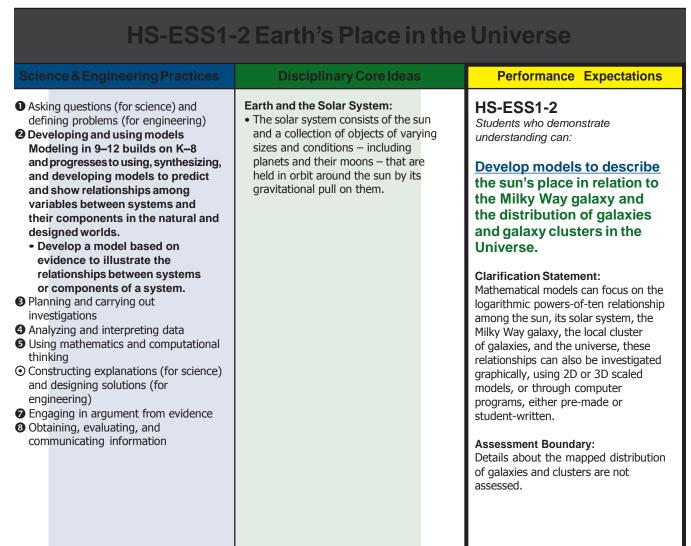
• The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.

Oklahoma Academic Standards Connections		
ELA/Literacy	Mathematics	
RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. HAS-SSE.A.1 Interpret expressions that represent a quantity in terms of its context. HAS-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. HAS-CED.A.2 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. 	

9-12

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

SCIENCE STANDARDS • OKLAHOMA STATE DEPARTMENT OF EDUCATION

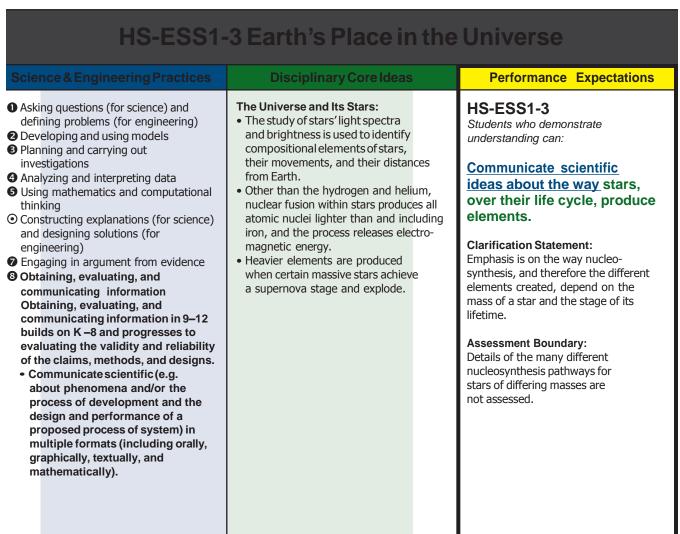


Crosscutting Concepts: Scale, Proportion, and Quantity

• The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.

Oklahoma Academic Standards Connections		
ELA/Literacy	Mathematics	
N/A	MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics.	

9-12



Crosscutting Concepts: Energy and Matter

• In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.

ELA/Literacy	Mathematics
 VHST.9-12.2 Write informative/explanatory texts, including the arration of historical events, scientific procedures/ experiments, r technical processes. SL.11-12.4 Present claims and findings, emphasizing salient oints in a focused, coherent manner with relevant evidence, ound valid reasoning, and w ell-chosen details; use appropriate ye contact, adequate volume, and clear pronunciation. 	MP.2 Reason abstractly and quantitatively.

Oklahoma Academic Standards Connectic

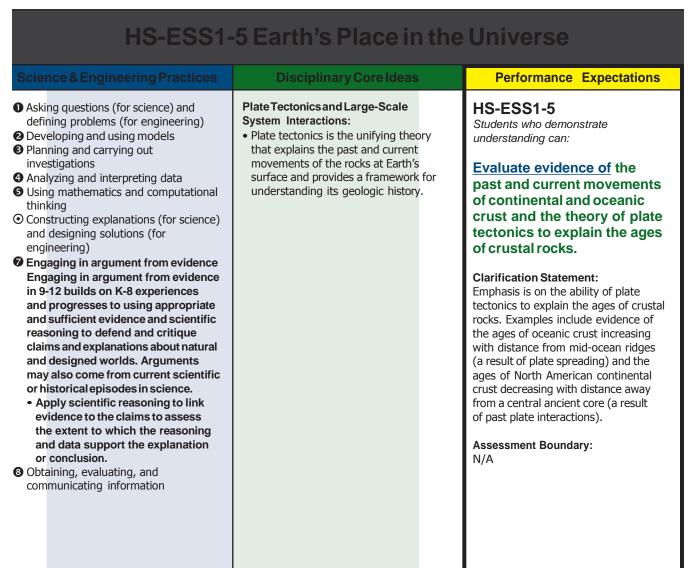
9-12

HS-ESS1-4 Earth's Place in the Universe			
Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations	
 Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Mathematical and computational thinking and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical representations of phenomena or design solutions to support and revise explanations. Constructing explanations (for science) and designing solutions (for science) and designing solutions (for engineering) Engaging in argument from evidence Obtaining, evaluating, and communicating information 	 Earth and the Solar System: Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. * Connections to Engineering, Technology, and Application of Science Interdependence of Science, Engineering, and Technology: Science and engineering compliment each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise. 	 HS-ESS1-4 Students who demonstrate understanding can: Use mathematical or computational represent- ations to predict the motion of orbiting objects in the solar system. Clarification Statement: Emphasis is on Newtonian gravitational laws governing orbital motions, which apply to human-made satellites as well as planets and moons. (e.g. graphical representations of orbits) Assessment Boundary: Mathematical representations for the gravitational attraction of bodies and Kepler's Laws of orbital motions should not deal with more than two bodies, nor involve calculus. 	

Crosscutting Concepts: Scale, Proportion, and Quantity

• Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).

Oklanoma Academic Standards Connections		
ELA/Literacy	Mathematics	
N/A	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. HAS-SSE.A.1 Interpret expressions that represent a quantity in terms of its context. HAS-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. HAS-CED.A.2 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. 	

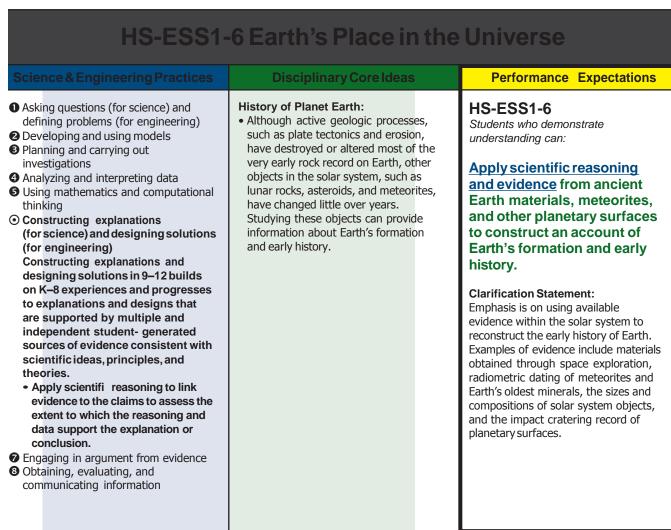


Crosscutting Concepts: Stability and Change

- Much of science deals with constructing explanations of how things change and how they remain stable.

ELA/Literacy	Mathematics
RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. RST.11-12.8 Evaluate the hypotheses, data, analysis and conclusion in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.	 MP.2 Reason abstractly and quantitatively. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to limitation on measurement when reporting quantities.

Oklahoma Academic Standards Connection



Crosscutting Concepts: Stability and Change

• Much of science deals with constructing explanations of how things change and how they remain stable.

Oklahoma	Academic	Standards	Connections
----------	----------	------------------	-------------

ELA/Literacy	Mathematics
RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. RST.11-12.8 Evaluate the hypotheses, data, analysis and conclusion in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. WHST.9-12.1 Write arguments focused on discipline-specific content.	 MP.2 Reason abstractly and quantitatively. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. HSF-IF.B.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. HSS-ID.B.6 Represent data on two quantitative variables on a scatter plot, and describe how those variables are related.

HS-ESS2-1 Earth's Systems			
Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations	
 Asking questions (for science) and defining problems (for engineering) Developing and using models Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. Develop a model based on evidence to illustrate the relationships between systems or components of a system. Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering) Engaging in argument from evidence Obtaining, evaluating, and communicating information 	 Earth Materials and Systems: Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. Plate Tectonics and Large-Scale System Interactions: Plate tectonics is the unifying theory that explains the past and current movements of rocks at Earth's surface and provides a framework for understanding its geologic history. Plate movements are responsible for most continental and ocean-floor features and for the distribution of most rocks and minerals within Earth's crust. 	 HS-ESS2-1 Students who demonstrate understanding can: Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features. Clarification Statement: Emphasis is on how the appearance of land features (such as mountains, valleys, and plateaus) and sea-floor features (such as trenches, ridges, and seamounts) are a result of both constructive forces (such as volcanism, tectonic uplift, and orogeny) and destructive mechanisms (such as weathering, erosion, and mass wasting). Assessment does not include memorization of the details of the formation of specific geographic features of Earth's surface. 	

Crosscutting Concepts: Stability and Change

• Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presenta- tions to enhance understanding of findings, reasoning, and evidence and to add interest.	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. HSF-IF.B.6 Calculate and interpret the average rate of change of function (presented symbolically or as a table) over specified interval. Estimate the rate of change from a graph.

9-12

HS-ESS2-2 Earth's Systems			
Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations	
 Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Analyzing data in 9–12 builds on K-8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering) Engaging in argument from evidence Obtaining, evaluating, and communicating information 	 Earth Materials and Systems: Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. Weather and Climate: The foundation for Earth's: global climate system 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. 	<section-header><section-header><section-header><section-header><section-header><text></text></section-header></section-header></section-header></section-header></section-header>	

Crosscutting Concepts: Stability and Change

• Feedback (negative or positive) can stabilize or destabilize a system

Oklahoma Academic Standards Connections	
ELA/Literacy	Mathematics
RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. RST.11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.	 MP.2 Reason abstractly and quantitatively. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

HS-ESS2-3 Earth's Systems

Science & Engineering Practices

2 Developing and using models

Modeling in 9-12 builds on K-8

and show relationships among

Develop a model based on

evidence to illustrate the

Analyzing and interpreting data

and designing solutions (for

3 Obtaining, evaluating, and

communicating information

designed worlds.

Planning and carrying out

investigations

engineering)

thinking

variables between systems and

and progresses to using, synthesizing,

their components in the natural and

relationships between systems

9 Using mathematics and computational

• Constructing explanations (for science)

Engaging in argument from evidence

or components of a system.

and developing models to predict

Disciplinary Core Ideas

Asking questions (for science) and defining problems (for engineering) Earth Materials and Systems: Evidence from deep probes a

- Evidence from deep probes and seismic waves, reconstructions of historical changes in Earth's surface features, its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle and crust.
 - Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from Earth's interior and gravitational movement of denser materials toward the interior.

Plate Tectonics and Large-Scale System Interactions:

- The radioactive decay of unstable isotopes continually generates new energy within Earth's crust and mantle, providing the primary source of the heat that drives mantle convection.
- Plate tectonics can be viewed as the surface expression of mantle convection.

Waves Properties:

(secondary to HS-ESS2-3)

 Geologists use seismic waves and their reflection at interfaces between layers to probe structures deep in the planet.

Performance Expectations

HS-ESS2-3

Students who demonstrate understanding can:

Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.

Clarification Statement:

Emphasis is on both a one-dimensional model of Earth, with radial layers determined by density, and a threedimensional model, which is controlled by mantle convection and the resulting plate tectonics. Examples of evidence include maps of the Earth's surface features as well as three-dimensional structure in the subsurface, obtained from seismic waves, records of the rate of change of Earth's magnetic field (as constraints on convection in the outer core), and prediction of the composition of Earth's layers from highpressure laboratory experiments.

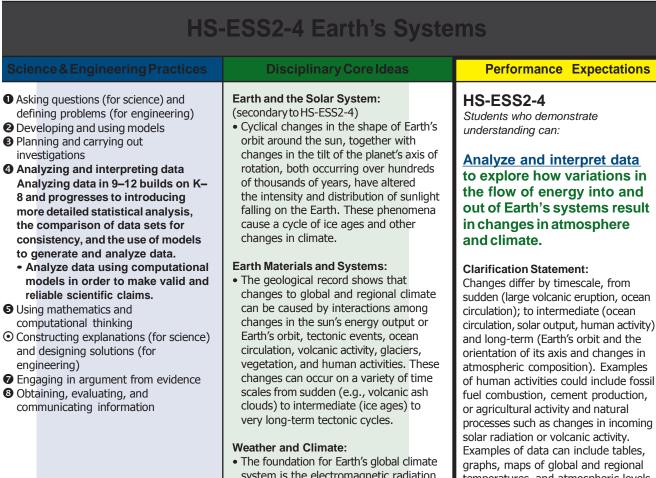
Assessment Boundary: N/A

Crosscutting Concepts: Energy and Matter

• Energy drives the cycling of matter within and between systems

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to limitation on measurement when reporting quantities.



system 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 reradiation into space.

Assessment Boundary: N/A

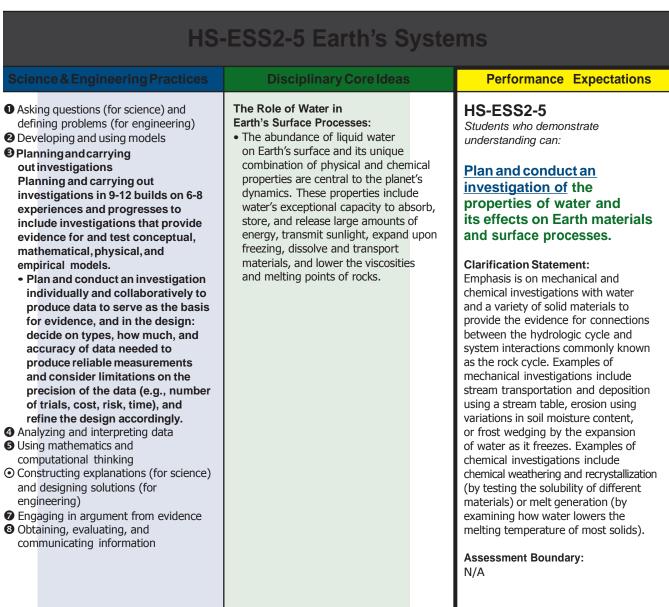
Crosscutting Concepts: Cause and Effect

• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects

Oklahoma Academic Standards Connections		
ELA/Literacy	Mathematics	
SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. 	

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

circulation, solar output, human activity) of human activities could include fossil processes such as changes in incoming temperatures, and atmospheric levels of gases.



Crosscutting Concepts: Structure and Function

• The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
WHST.9-12.7 Conduct short as well as more sustained research rojects to answer a question (including a self-generated question) or solve problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating inderst; nding of the subject under investigation.	HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

9-12

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

214

HS-ESS2-6 Earth's Systems			
Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations	
 Asking questions (for science) and defining problems (for engineering) Developing and using models Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. Develop a model based on evidence to illustrate the relationships between systems or components of a system. Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for science) and designing solutions (for science) and designing in argument from evidence Obtaining, evaluating, and communicating information 	 Biogeology: Organisms ranging from bacteria to human beings are a major driver of the global carbon and they influence global climate by modifying the chemical makeup of the atmosphere. The abundance of carbon in the atmosphere is reduced through the ocean floor accumulation of marine sediments and the accumulation of plant biomass. 	 HS-ESS2-6 Students who demonstrate understanding can: Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. Clarification Statement: Emphasis is on modeling biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms. Assessment Boundary: N/A 	

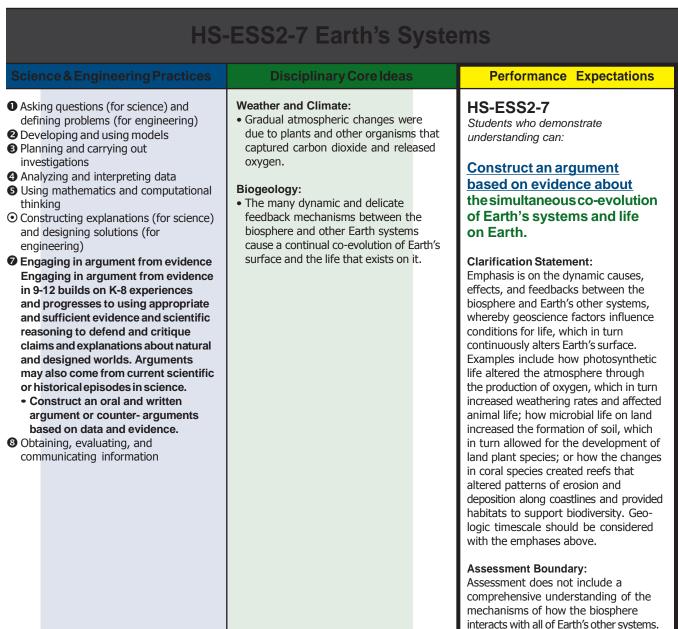
Crosscutting Concepts: Energy and Matter

• The total amount of energy and matter in closed systems is conserved.

Oklahoma Academic Standards Connections		
ELA/Literacy	Mathematics	
N/A	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to li nitations on measurement when reporting quantities. 	

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

9-12

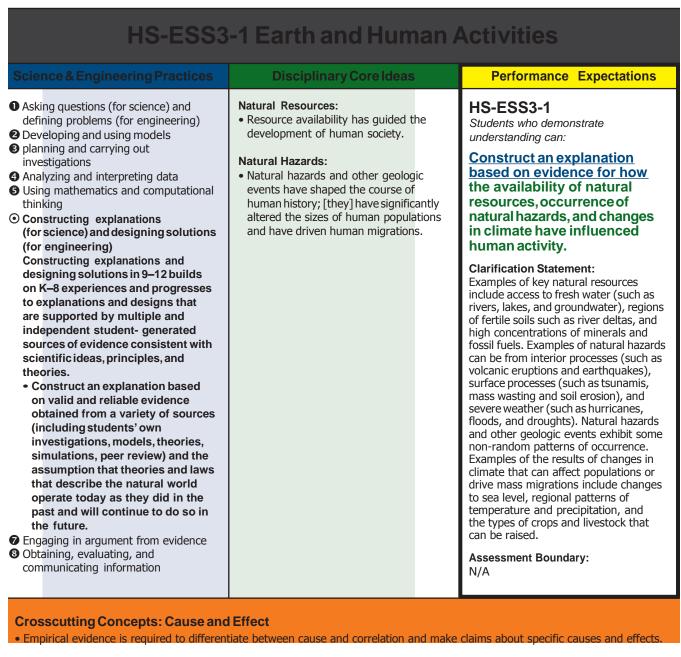


Crosscutting Concepts: Stability and Change

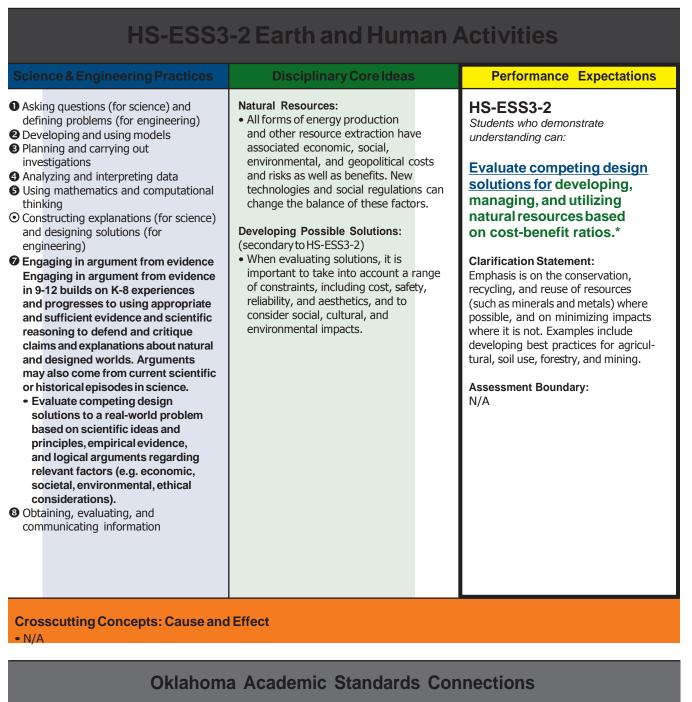
• Much of science deals with constructing explanations of how things change and how they remain stable.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
WHST.9-12.1 Write arguments focused on discipline-specific content.	N/A



Oklahoma Academic Standards Connections	
ELA/Literacy	Mathematics
RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.	 MP.2 Reason abstractly and quantitatively. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.



ELA/Literacy	Mathematics
RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.	MP.2 Reason abstractly and quantitatively.

	Disciplinary Core Ideas	Performance Expectations
Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering) Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student- generated sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) 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. Engaging in argument from evidence Obtaining, evaluating, and communicating information	Natural Resources: • Most elements exist in Earth's crust at concentrations too low to be extracted, but in some locations-where geological processes have concentrated them- extraction is economically viable.	HS-ESS3-5 Students who demonstrate understanding can: Construct a scientific explanation from evidence for how geological processes lead to uneven distribution of natural resources. Clarification Statement: Emphasis is on how geological processes have led to geological sedimentary basins that provide significant accumulations of crude oil and natural gas in some areas and not others and how geological processes lead to diverse soil profiles that support a diversity and range of agricultural crops and how plate- tectonics leads to concentrations of mineral deposits. Assessment Boundary: N/A

• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Oklahoma Academic Standards Connections		
ELA/Literacy	Mathematics	
 RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. conclusions with other sources of information. 	N/A	

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

9-12

HS-LS2-1 Ecosystems: Interactions, Energy, and Dynamics

Science & Engineering Practices

- Asking questions (for science) and defining problems (for engineering)
- **2** Developing and using models
- Planning and carrying out
- investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.
 - Use mathematical and/or computational representations of phenomena or design solutions to support explanations.
- Constructing explanations (for science) and designing solutions (for engineering)
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

Disciplinary Core Ideas

Interdependent Relationships

in Ecosystems:

- Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support.
- These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease.
- Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite.
- This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.

Performance Expectations

HS-LS2-1

Students who demonstrate understanding can:

<u>Use mathematical</u> <u>and/or computational</u> <u>representations to support</u> <u>explanations</u> of factors that affect carrying capacity of ecosystems at different scales.

Clarification Statement:

Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate and competition. Examples of mathematical comparisons could include graphs, charts, histograms, or population changes gathered from simulations or historical data sets.

Assessment Boundary:

Assessment does not include deriving mathematical equations to make comparisons.

Crosscutting Concepts: Scale, Proportion, and Quantity

• The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

HS-LS2-2 Ecosystems: Interactions, Energy, and Dynamics

Science & Engineering Practices

- Asking questions (for science) and defining problems (for engineering)
- Overlapping and using models
- Planning and carrying out
- investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.
 - Use mathematical representations of phenomena or design solutions to support and revise explanations.
- Constructing explanations (for science) and designing solutions (for engineering)
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

Disciplinary Core Ideas

Interdependent Relationships

- in Ecosystems:
- Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support.
- These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease.
- Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite.
- This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.

Ecosystem Dynamics, Functioning, and Resilience:

- A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions.
- If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem.
- Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.

Performance Expectations

HS-LS2-2

Students who demonstrate understanding can:

<u>Use mathematical</u> <u>representations to support</u> <u>and revise explanations</u> <u>based on evidence</u> about factors affecting biodiversity and populations in ecosystems of different scales.

Clarification Statement:

Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data.

Assessment Boundary:

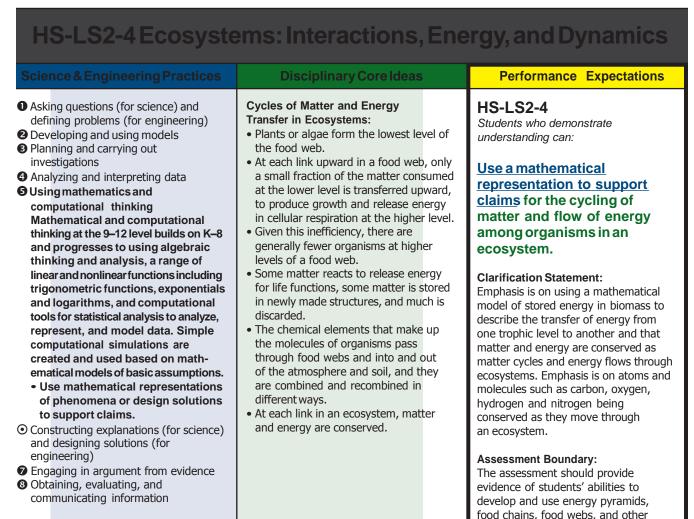
The assessments should provide evidence of students' abilities to analyze and interpret the effect new information has on explanations (e.g., DDT effects on raptor populations, effects of water temperature below reservoirs on fish spawning, invasive species effects when spread to larger scale).

Crosscutting Concepts: Scale, Proportion, and Quantity

• Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
 RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. 	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.



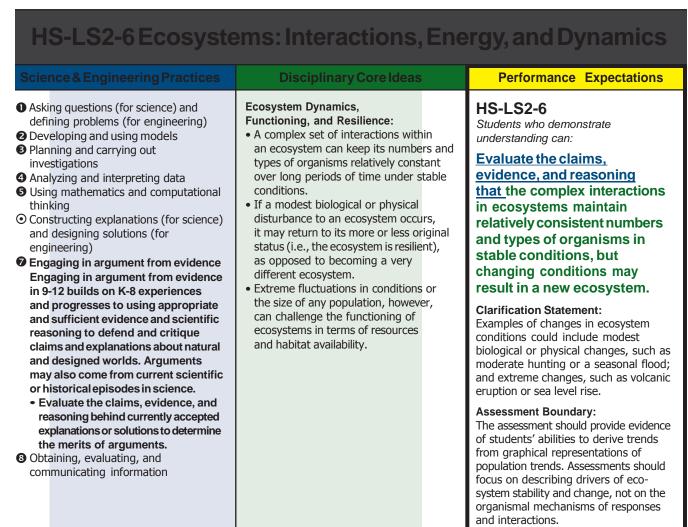
Crosscutting Concepts: Stability and Change

• Energy cannot be created or destroyed- it only moves between one place and another place, between objects and/or fields, or between systems.

Oklahoma Academic Standards Connections

models from data sets.

ELA/Literacy	Mathematics
N/A	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to li nitation on measurement when reporting quantities.



Crosscutting Concepts: Stability and Change

• Much of science deals with constructing explanations of how things change and how they remain stable.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
 RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. 	 MP.2 Reason abstractly and quantitatively. HSS-ID.A.1 Represent data with plots on the real number line. HSS-IC.A.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population. HSS-IC.B.6 Evaluate reports based on data.

HS-LS2-7 Ecosystems: Interactions, Energy, and Dynamics **Disciplinary Core Ideas Performance Expectations** Asking questions (for science) and **Ecosystem Dynamics**, HS-LS2-7 Functioning, and Resilience: defining problems (for engineering) Students who demonstrate • Anthropogenic changes (induced by **2** Developing and using models understanding can: human activity) in the environment can B Planning and carrying out disrupt an ecosystem and threaten the investigations Design, evaluate, and survival of some species. Analyzing and interpreting data refine a solution for **G** Using mathematics and computational reducing the impacts of **Biodiversity and Humans:** thinking (secondary to HS-LS2-7) human activities on the • Constructing explanations · Biodiversity is increased by the formation environment biodiversity.* (for science) and designing solutions of new species (speciation) and decreased (for engineering) by the loss of species (extinction). Constructing explanations and **Clarification Statement:** • Humans depend on the living world designing solutions in 9–12 builds Examples of human activities can for the resources and other benefits on K-8 experiences and progresses include urbanization, building dams, provided by biodiversity. But human to explanations and designs that and dissemination of invasive species. activity is also having adverse impacts are supported by multiple and on biodiversity. independent student- generated Assessment Boundary: Thus sustaining biodiversity so that sources of evidence consistent with N/A ecosystem functioning and productivity scientific ideas, principles, and are maintained is essential to supporting theories. and enhancing life on Earth. Design, evaluate, and refine a • Sustaining biodiversity also aids solution to a complex real-world humanity by preserving landscapes problem, based on scientific of recreational or inspirational value. knowledge, student-generated sources of evidence, prioritized **Developing Possible Solutions:** criteria, and tradeoff considerations. • When evaluating solutions it is important Engaging in argument from evidence to take into account a range of constraints

- Obtaining, evaluating, and communicating information
- When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts.

Crosscutting Concepts: Stability and Change

- Much of science deals with constructing explanations of how things change and how they remain stable.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
 RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. 	 MP.2 Reason abstractly and quantitatively. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to limitation on measurement when reporting quantities.

HS-ESS2-1 Earth's Systems		
Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations
 Asking questions (for science) and defining problems (for engineering) Developing and using models Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. Develop a model based on evidence to illustrate the relationships between systems or components of a system. Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering) Engaging in argument from evidence Obtaining, evaluating, and communicating information 	 Earth Materials and Systems: Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. Plate Tectonics and Large-Scale System Interactions: Plate tectonics is the unifying theory that explains the past and current movements of rocks at Earth's surface and provides a framework for understanding its geologic history. Plate movements are responsible for most continental and ocean-floor features and for the distribution of most rocks and minerals within Earth's crust. 	 HS-ESS2-1 Students who demonstrate understanding can: Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features. Clarification Statement: Emphasis is on how the appearance of land features (such as mountains, valleys, and plateaus) and sea-floor features (such as trenches, ridges, and seamounts) are a result of both constructive forces (such as volcanism, tectonic uplift, and orogeny) and destructive mechanisms (such as weathering, mass wasting, and coastal erosion). Assessment Boundary: Assessment does not include memorization of the details of the formation of specific geographic features of Earth's surface.

Crosscutting Concepts: Stability and Change

• Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.

Oklahoma Academic Standards Connections	
ELA/Literacy	Mathematics
SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. HSF-IF.B.6 Calculate and interpret the average rate of change of function (presented symbolically or as a table) over specified interval. Estimate the rate of change from a graph.

HS-ESS2-2 Earth's Systems		
Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations
 Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Analyzing data in 9–12 builds on K-8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering) Engaging in argument from evidence Obtaining, evaluating, and communicating information 	 Earth Materials and Systems: Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. Weather and Climate: The foundation for Earth's global climate system 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-ESS2-2 Students who demonstrate understanding can: Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks and interactions that cause changes to other Earth's systems. Clarification Statement: Examples could be taken from system interactions, such as how the loss of ground vegetation causes an increase in water runoff and soil erosion, which limits additional vegetation patterns; how dammed rivers increase ground-water recharge, decrease sediment transport, and increase coastal erosion; or how the loss of wetlands causes a decrease in local humidity that further reduces the wetland extent. Examples could also include climate feedbacks that increase surface temperatures through geologic time. Assessment Boundary: N/A

Crosscutting Concepts: Stability and Change • Feedback (negative or positive) can stabilize or destabilize a system.

ELA/Literacy	Mathematics
RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinc- ions the author makes and to any gaps or inconsistencies in the account. RST.11-12.2 Determine the central ideas or conclusions of a ext; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.	 MP.2 Reason abstractly and quantitatively. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.3 Choose a level of accuracy appropriate to limitation on measurement when reporting quantities.

Oklahoma Academic Standards Connections

HS-ESS2-3 Earth's Systems

Science & Engineering Practices

2 Developing and using models

Modeling in 9-12 builds on K-8

and show relationships among

• Develop a model based on

evidence to illustrate the

Analyzing and interpreting data

and designing solutions (for

3 Obtaining, evaluating, and

communicating information

designed worlds.

Planning and carrying out

investigations

engineering)

thinking

variables between systems and

and progresses to using, synthesizing,

their components in the natural and

relationships between systems

9 Using mathematics and computational

Constructing explanations (for science)

Engaging in argument from evidence

or components of a system.

and developing models to predict

Disciplinary Core Ideas

Asking questions (for science) and defining problems (for engineering) Earth Materials and Systems: Evidence from deep probes a

- Evidence from deep probes and seismic waves, reconstructions of historical changes in Earth's surface features, its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle and crust.
 - Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from Earth's interior and gravitational movement of denser materials toward the interior.

Plate Tectonics and Large-Scale System Interactions:

- The radioactive decay of unstable isotopes continually generates new energy within Earth's crust and mantle, providing the primary source of the heat that drives mantle convection.
- Plate tectonics can be viewed as the surface expression of mantle convection.

Waves Properties:

(secondary to HS-ESS2-3)

 Geologists use seismic waves and their reflection at interfaces between layers to probe structures deep in the planet.

Performance Expectations

HS-ESS2-3

Students who demonstrate understanding can:

<u>Develop a model based on</u> <u>evidence</u> of Earth's interior to <u>describe</u> the cycling of matter by thermal convection.

Clarification Statement:

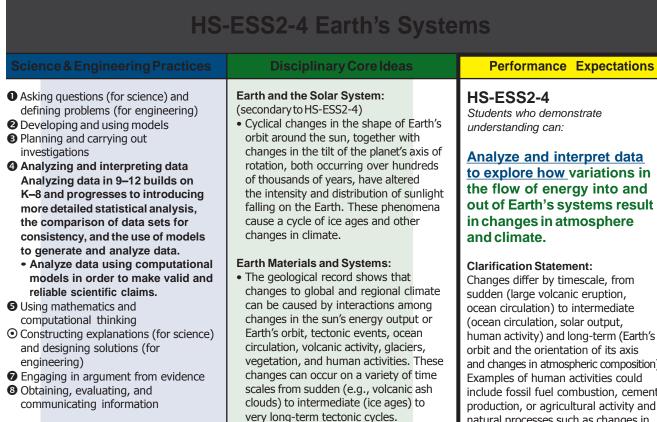
Emphasis is on both a one-dimensional model of Earth, with radial lavers determined by density, and a threedimensional model, which is controlled by mantle convection and the resulting plate tectonics. Examples of evidence include maps of the Earth's surface features as well as three-dimensional structure in the subsurface, obtained from seismic waves, records of the rate of change of Earth's magnetic field (as constraints on convection in the outer core), and identifi of the composition of Earth's layers from high-pressure laboratory experiments.

Assessment Boundary: N/A

Crosscutting Concepts: Energy and Matter

• Energy drives the cycling of matter within and between systems

Oklahoma Academic Standards Connections	
ELA/Literacy	Mathematics
 RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. 	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to limitation on measurement when reporting quantities.



Weather and Climate:

• The foundation for Earth's global climate system 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.

to explore how variations in the flow of energy into and out of Earth's systems result

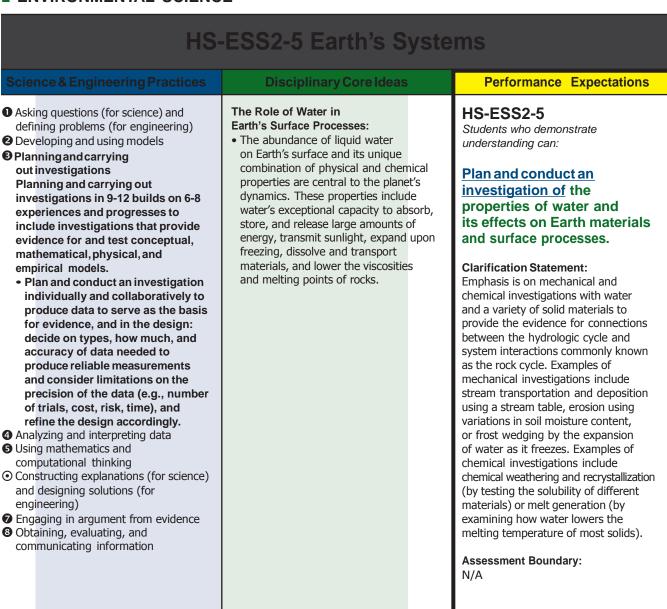
human activity) and long-term (Earth's and changes in atmospheric composition). include fossil fuel combustion, cement production, or agricultural activity and natural processes such as changes in incoming solar radiation or volcanic activity. Examples of data can include tables, graphs, and maps of global and regional temperatures, and atmospheric levels of gases.

Assessment Boundary: N/A

Crosscutting Concepts: Cause and Effect

Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Oklahoma Academic Standards Connections	
ELA/Literacy	Mathematics
SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.



Crosscutting Concepts: Structure and Function

• The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating underst; nding of the subject under investigation.	HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

9-12

HS-ESS2-6 Earth's Systems		
Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations
 Asking questions (for science) and defining problems (for engineering) Developing and using models Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. Develop a model based on evidence to illustrate the relationships between systems or components of a system. Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering) Engaging in argument from evidence Obtaining, evaluating, and communicating information 	 Biogeology: Organisms ranging from bacteria to human beings are a major driver of the global carbon and they influence global climate by modifying the chemical makeup of the atmosphere. The abundance of carbon in the atmosphere is reduced through the ocean floor accumulation of marine sediments and the accumulation of plant biomass. 	 HS-ESS2-6 Students who demonstrate understanding can: Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. Clarification Statement: Emphasis is on modeling biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms. Assessment Boundary: N/A

Crosscutting Concepts: Energy and Matter

• The total amount of energy and matter in closed systems is conserved.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
N/A	 MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to li nitations on measurement when reporting quantities.

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

230

9-12

HS-ESS2-7 Earth's Systems		
Science & Engineering Practices	Disciplinary Core Ideas	Performance Expectations
 Asking questions (for science) and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering) Engaging in argument from evidence Engaging in argument from evidences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed worlds. Arguments may also come from current scientific or historical episodes in science. Construct an oral and written argument or counter- arguments based on data and evidence. Obtaining, evaluating, and communicating information 	 Weather and Climate: Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. Biogeology: The many dynamic and delicate feedback mechanisms between the biosphere and other Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it. 	 HS-ESS2-7 Students who demonstrate understanding can: Construct an argument based on evidence about the simultaneous co-evolution of Earth's systems and life on Earth. Clarification Statement: Thy pasis is on the dynamic causes, effects, and feedbacks between the biosphere and Earth's other systems, whereby geoscience factors influence conditions for life, which in turn continuously alters Earth's surface. Examples include how photosynthetic life altered the atmosphere through the production of oxygen, which in turn increased weathering rates and affected animal life; how microbial life on land increased the formation of soil, which in turn allowed for the development of land plant species; or how the changes in coral species created reefs that altered patterns of erosion and deposition along coastlines and provided habitats to support biodiversity. Geologic timescale should be considered with the emphases above. Assessment does not include a comprehensive understanding of the mechanisms of how the biosphere interacts with all of Earth's other systems.

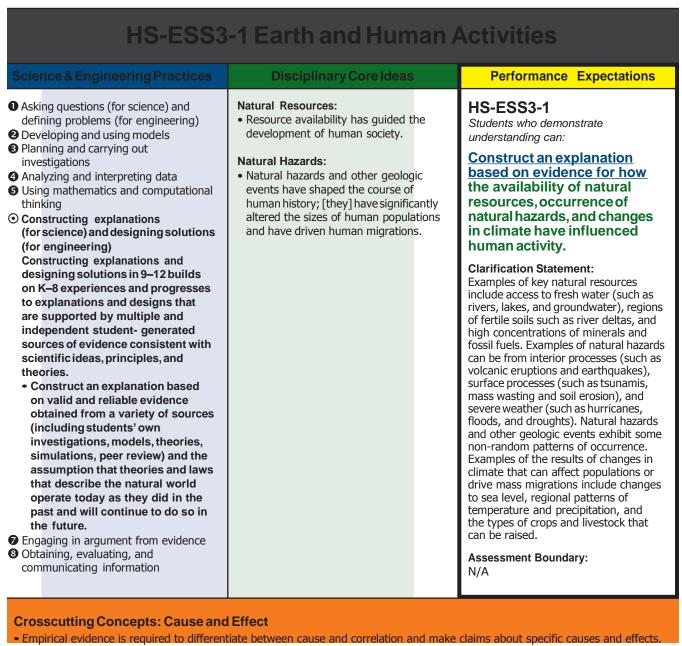
Crosscutting Concepts: Stability and Change

• Much of science deals with constructing explanations of how things change and how they remain stable.

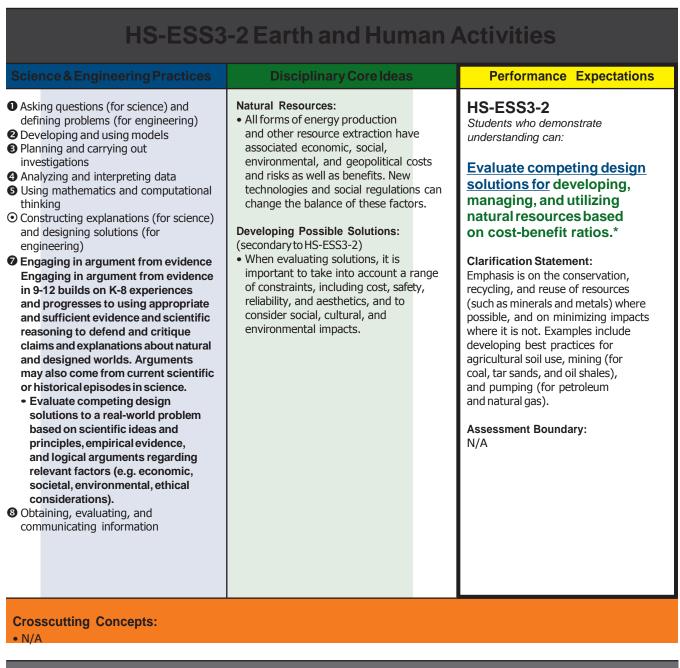
Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
WHST.9-12.1 Write arguments focused on discipline-spec content.	fic N/A

9-12

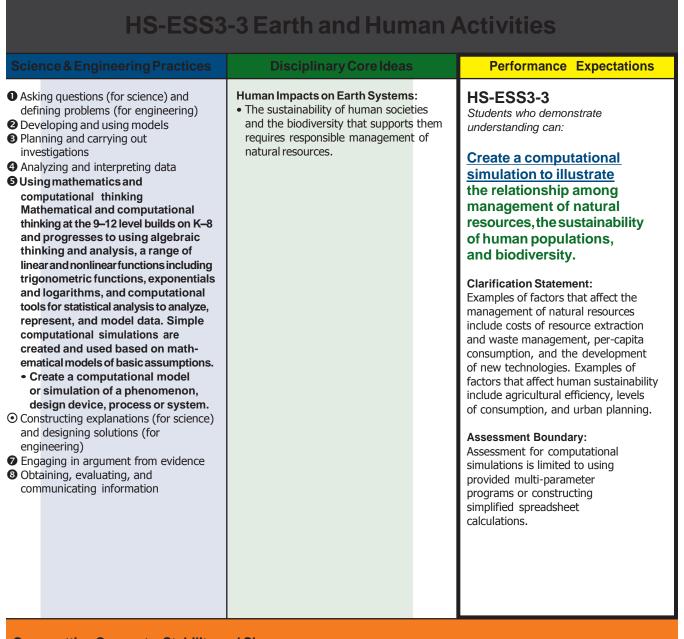


Oklahoma Academic Standards Connections **ELA/Literacy Mathematics RST.11-12.1** Cite specific textual evidence to support analysis MP.2 Reason abstractly and quantitatively. of science and technical texts, attending to important distinc-HSN-Q.A.1 Use units as a way to understand problems and to tions the author makes and to any gaps or inconsistencies in the quide the solution of multi-step problems; choose and interpret account. units consistently in formulas; choose and interpret the scale and **WHST.9-12.2** Write informative/explanatory texts, including the the origin in graphs and data displays. narration of historical events, scientific procedures/ experiments, HSN-Q.A.2 Define appropriate quantities for the purpose of or technical processes. descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.



Oklahoma Academic Standards Connections	
ELA/Literacy	Mathematics
RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinc- tions the author makes and to any gaps or inconsistencies in the account. RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.	MP.2 Reason abstractly and quantitatively.

9-12

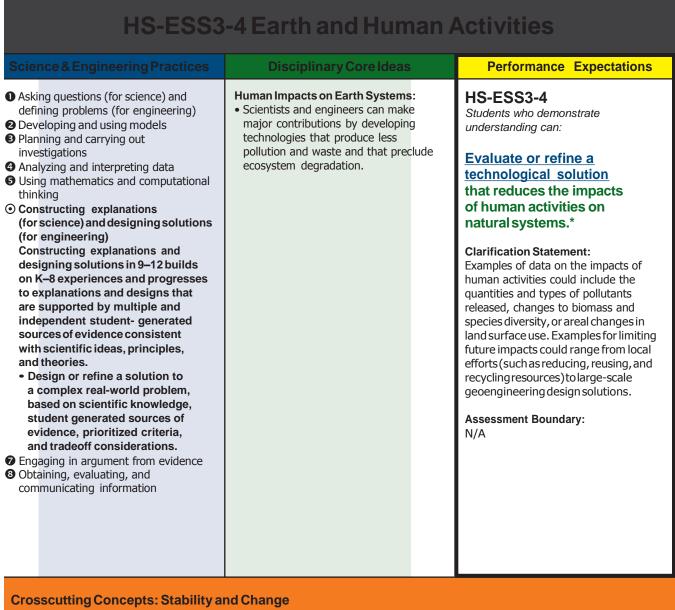


Crosscutting Concepts: Stability and Change

• Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.

Oklahoma Academic Standards Connections

ELA/Literacy	Mathematics
N/A	MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics.



• Feedback (negative or positive) can stabilize or destabilize a system.

Oklahoma Academic Standards Connections	
ELA/Literacy	Mathematics
RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.	 MP.2 Reason abstractly and quantitatively. HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

SCIENCE STANDARDS • OKLAHOMA STATE DEPARTMENT OF EDUCATION

S C I E N C E



OKLAHOMA ACADEMIC STANDARDS

