Cognia Science Alternate Assessment

High School Grade-Level Standards and Extended Performance Expectations (EPEs) for Maine Department of Education

FINAL

December 2019

AdvancED and Measured Progress are now cognia

High School Grade-Level Standards

Standards

NGSS Performance Expectation HS-ESS1-6	
HS-ESS1-6 Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history. [Clarification Stat ement: Emphasis is on using available evidence within the solar system to reconstruct the early history of Earth, which formed along with the rest of the solar system 4.6 billion years ago. Examples of evidence include the absolute ages of ancient materials (obtained by radiometric dating of meteorites, moon rocks, and Earth's oldest minerals), the sizes and compositions of solar system objects, and the impact cratering record of planetary surfaces.]	
Science and Engineering Practices (SEP)	**Constructing Explanations and Designing Solutions** • Apply scientific reasoning to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion.
Disciplinary Core Ideas (DCI)	**ESS1.C: The History of Planet Earth** • Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history. **PS1.C: Nuclear Processes** • Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials. (secondary)
Crosscutting Concepts (CCC)	**Stability and Change** • Much of science deals with constructing explanations of how things change and how they remain stable.

Extended Performance Expectation HS-ESS1-6			
	Level 1	***Level 2***	***Level 3***
	Less Complex ←···· ←···· ←····	←···· ←···· ·········→ ····→	····→ ····→ ····→ ***More Complex***
	HS-ESS1-6.1 Use data to identify patterns about ancient Earth materials, meteorites, or other planetary surfaces.	**HS-ESS1-6.2** Ask questions about ancient Earth materials, meteorites, or other planetary surfaces that can be used to construct an account of Earth's formation and early history.	**HS-ESS1-6.3** Use evidence (e.g., data about ancient Earth materials, meteorites, other planetary surfaces) to explain Earth's formation and early history.
Science and Engineering Practices (SEP)	**Target:** **Constructing Explanations and Designing Solutions** • Apply scientific reasoning to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion. **Supporting:** **Asking Questions and Defining Problems** **Analyzing and Interpreting Data**		
Disciplinary Core Ideas (DCI)	**ESS1.C: The History of Planet Earth**		

	• Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history.
Crosscutting Concepts (CCC)	**Target:** **Stability and Change** • Much of science deals with constructing explanations of how things change and how they remain stable. **Supporting:** **Patterns**

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NGSS Performance Expectation HS-ESS2-4	
HS-ESS2-4 Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. [Clarification Statement: Examples of the causes of climate change differ by timescale, over 1-10 years: large volcanic eruption, ocean circulation; 10-100s of years: changes in human activity, ocean circulation, solar output; 10-100s of thousands of years: changes to Earth's orbit and the orientation of its axis; and 10-100s of millions of years: long-term changes in atmospheric composition.] [Assessment Boundary: Assessment of the results of changes in climate is limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution.]	
Science and Engineering Practices (SEP)	**Developing and Using Models** • Use a model to provide mechanistic accounts of phenomena.
Disciplinary Core Ideas (DCI)	**ESS1.B: Earth and the Solar System** • Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes. **ESS2.A: Earth Materials and Systems** • The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. **ESS2.D: Weather and Climate** • The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space.
Crosscutting Concepts (CCC)	**Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Extended Performance Expectation HS-ESS2-4			
	Level 1	***Level 2***	***Level 3***
	Less Complex ←···· ←···· ←···· ←···· ←···· ·······→ ····→ ····→ ····→ ····→		***More Complex***
	HS-ESS2-4.1 Use a model to trace the flow of energy between two Earth systems.	**HS-ESS2-4.2** Use a model to describe how energy from the Sun drives Earth's climate system.	**HS-ESS2-4.3** Use models to predict and/or make conclusions about how various activities (e.g., large volcanic eruptions, human activity, solar output, changes to Earth's orbit and axis, changes to atmospheric composition, etc.) cause changes in climate (which

			can be measured as changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, biosphere distribution).

Science and Engineering Practices (SEP)	**Target:** **Developing and Using Models** • Use a model to provide mechanistic accounts of phenomena.
Disciplinary Core Ideas (DCI)	**ESS1.B: Earth and the Solar System** • Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes. **ESS2.A: Earth Materials and Systems** • The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. **ESS2.D: Weather and Climate** • The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space.
Crosscutting Concepts (CCC)	**Target:** **Cause and Effect** • **Empirical evidence is required to** differentiate between cause and correlation and **make claims about specific causes and effects**. **Supporting**: **Energy and Matter**

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Standards

NGSS Performance Expectation HS-ESS2-5	
HS-ESS2-5 Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. [Clarification Statement: Emphasis is on mechanical and chemical investigations with water and a variety of solid materials to provide the evidence for connections between the hydrologic cycle and system interactions commonly known as the rock cycle. Examples of mechanical investigations include stream transportation and deposition using a stream table, erosion using variations in soil moisture content, or frost wedging by the expansion of water as it freezes. Examples of chemical investigations include chemical weathering and recrystallization (by testing the solubility of different materials) or melt generation (by examining how water lowers the melting temperature of most solids).]	
Science and Engineering Practices (SEP)	**Planning and Carrying Out Investigations** • 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.
Disciplinary Core Ideas (DCI)	**ESS2.C: The Roles of Water in Earth's Surface Processes** • The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve, and transport materials, and lower the viscosities and melting points of rocks.
Crosscutting Concepts (CCC)	**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.

Extended Performance Expectation HS-ESS2-5			
	Level 1	***Level 2***	***Level 3***
	Less Complex	←→	***More Complex***
	HS-ESS2-5.1 Identify testable questions about the effect of water on Earth's materials and surface processes.	**HS-ESS2-5.2** Use data or observations to draw conclusions or make predictions about the effects of water on Earth materials and surfaces processes.	**HS-ESS2-5.3** Plan or conduct an investigation of the properties of water and its effects on Earth materials and surface processes (e.g., stream transportation and deposition using a stream table, or frost wedging by the expansion of water as it freezes, or chemical weathering and recrystallization by testing the solubility of different materials).
Science and Engineering Practices (SEP)	**Target:**		

	Planning and Carrying Out Investigations • 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. **Supporting:** **Analyzing and Interpreting Data** **Asking Questions and Defining Problems**
Disciplinary Core Ideas (DCI)	**ESS2.C: The Roles of Water in Earth's Surface Processes** • The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve, and transport materials, and lower the viscosities and melting points of rocks.
Crosscutting Concepts (CCC)	**Target:** **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. **Supporting:** **Cause and Effect**

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NGSS Performance Expectation HS-ESS3-4	
HS-ESS3-4 Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.* [Clarification Statement: Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or area changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).]	
Science and Engineering Practices (SEP)	**Constructing Explanations and Designing Solutions** • Design or refine a solution to a complex real-world problem based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations.
Disciplinary Core Ideas (DCI)	**ESS3.C: Human Impacts on Earth Systems** • Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. **ETS1.B: Developing Possible Solutions** • 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. (secondary)
Crosscutting Concepts (CCC)	**Stability and Change** • Feedback (negative or positive) can stabilize or destabilize a system.

Extended Performance Expectation HS-ESS3-4			
	Level 1	***Level 2***	***Level 3***
	Less Complex ←···· ←···· ←···· ←···· ←····	·······→ ····→ ····→ ····→ ····→	***More Complex***
	HS-ESS3-4.1 Use data to identify the impact of human activities (local) on natural systems.	**HS-ESS3-4.2** Make a claim about how a technological solution (local effort) works to reduce impacts of human activities on natural systems.	**HS-ESS3-4.3** Select, evaluate, or change the design of a technological solution (local effort) that reduces impacts of human activities on natural systems.
Science and Engineering Practices (SEP)	**Target:** **Constructing Explanations and Designing Solutions** • Design or refine a solution to a complex real-world problem based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations. **Supporting:** **Engaging in Argument from Evidence**		

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	Analyzing and Interpreting Data
Disciplinary Core Ideas (DCI)	**ESS3.C: Human Impacts on Earth Systems** • Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. **ETS1.B: Developing Possible Solutions** • 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 (CCC)	**Target:** **Stability and Change** • Feedback (negative or positive) can stabilize or destabilize a system. **Supporting:** **Cause and Effect**

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Standards

NGSS Performance Expectation HS-LS2-2	
HS-LS2-2 Use mathematical representations to support and revise explanations based on evidence 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.*]	
Science and Engineering Practices (SEP)	**Using Mathematics and Computational Thinking** • Use mathematical representations of phenomena or design solutions to support and revise explanations.
Disciplinary Core Ideas (DCI)	**LS2.A: 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. **LS2.C: 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.
Crosscutting Concepts (CCC)	**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.

Extended Performance Expectation HS-LS2-2			
	Level 1	***Level 2***	***Level 3***
	Less Complex ←→		***More Complex***
	HS-LS2-2.1 Use the provided information to identify factors that affect population size and/or biodiversity.	**HS-LS2-2.2** Interpret data to describe the effect of a factor in a specific ecosystem.	**HS-LS2-2.3** Use mathematical representations (e.g., averages, trends, graphs) to explain how a specific factor affects the biodiversity or sizes of populations in ecosystems of different scales.
Science and Engineering Practices (SEP)	**Target:** **Using Mathematics and Computational Thinking** • Use mathematical representations of phenomena or design solutions to support and revise explanations.		

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	Supporting: **Obtaining, Evaluating, and Communicating Information**
Disciplinary Core Ideas (DCI)	**LS2.A: 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.
Crosscutting Concepts (CCC)	**Target:** **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. **Supporting:** **Cause and Effect**

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Standards

NGSS Performance Expectation HS-LS3-1	
HS-LS3-1 Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]	
Science and Engineering Practices (SEP)	**Asking Questions and Defining Problems** • Ask questions that arise from examining models or a theory to clarify relationships.
Disciplinary Core Ideas (DCI)	**LS1.A: Structure and Function** • 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. (secondary) (Note: This Disciplinary Core Idea is also addressed by HS-LS1-1.) **LS3.A: 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 a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function.
Crosscutting Concepts (CCC)	**Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Extended Performance Expectation HS-LS3-1			
	Level 1	***Level 2***	***Level 3***
	Less Complex ⟵	⟷	⟶ ***More Complex***
	HS-LS3-1.1 Use provided reference information to identify the function of DNA or chromosomes.	**HS-LS3-1.2** Describe what a particular model shows about the way genes or traits are inherited.	**HS-LS3-1.3** Ask questions that will provide information about the cause-and-effect relationships among DNA/chromosomes and/or the traits passed from parents to offspring.
Science and Engineering Practices (SEP)	**Target:** **Asking Questions and Defining Problems** • Ask questions that arise from examining models or a theory to clarify relationships. **Supporting:** **Developing and Using Models** **Obtaining, Evaluating, and Communicating Information**		

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Disciplinary Core Ideas (DCI)	**LS1.A: Structure and Function** • 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. **LS3.A: 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 a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function.
Crosscutting Concepts (CCC)	**Target:** **Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. **Supporting:** **Patterns** **Structure and Function**

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Standards

NGSS Performance Expectation HS-LS4-1	
HS-LS4-1 Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. [Clarification Statement: Emphasis is on a conceptual understanding of the role each line of evidence has relating to common ancestry and biological evolution. Examples of evidence could include similarities in DNA sequences, anatomical structures, and order of appearance of structures in embryological development.]	
Science and Engineering Practices SEP)	**Obtaining, Evaluating, and Communicating Information** • Communicate scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).
Disciplinary Core Ideas (DCI)	**LS4.A: Evidence of Common Ancestry and Diversity** • Genetic information, like the fossil record, provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence.
Crosscutting Concepts (CCC)	**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.

Extended Performance Expectation HS-LS4-1			
	Level 1	***Level 2***	***Level 3***
	Less Complex ←····	······→	***More Complex***
	HS-LS4-1.1 Use the provided information to identify how organisms have changed over time.	**HS-LS4-1.2** Use various types of data (DNA sequences, amino acid sequences, structures found in organisms, embryos, fossils) to draw conclusions about patterns of relatedness among organisms.	**HS-LS4-1.3** Describe how patterns in data comparing DNA sequences, amino acid sequences, or structures found in organisms, embryos, and/or fossils are evidence for biological evolution and common ancestry of living things.
Science and Engineering Practices SEP)	**Target:** **Obtaining, Evaluating, and Communicating Information** • Communicate scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). **Supporting:** **Analyzing and Interpreting Data**		

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Disciplinary Core Ideas (DCI)	**LS4.A: Evidence of Common Ancestry and Diversity** • Genetic information, like the fossil record, provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence.
Crosscutting Concepts (CCC)	**Target:** **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. **Supporting:** **Stability and Change**

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Standards

NGSS Performance Expectation HS-LS4-3	
HS-LS4-3 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.] [Assessment Boundary: Assessment is limited to basic statistical and graphical analysis. Assessment does not include allele frequency calculations.]	
Science and Engineering Practices (SEP)	**Analyzing and Interpreting Data** • Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.
Disciplinary Core Ideas (DCI)	**LS4.B: 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. **LS4.C: 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.
Crosscutting Concepts (CCC)	**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.

Extended Performance Expectation HS-LS4-3			
	Level 1	***Level 2***	***Level 3***
	Less Complex ←····←····←····←····←···· ········→····→····→····→		***More Complex***
	HS-LS4-3.1 Use the provided information to identify traits that can vary for a given organism.	**HS-LS4-3.2** Use graphs to describe changes in the distribution of traits in a population in a given environment.	**HS-LS4-3.3** Use data comparing distributions of traits in a population as evidence that organisms with advantageous traits increase in proportion to organisms lacking the trait.
Science and Engineering Practices SEP)	**Target:** **Analyzing and Interpreting Data**		

	• Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. **Supporting:** **Obtaining, Evaluating, and Communicating Information**
Disciplinary Core Ideas (DCI)	**LS4.B: 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. **LS4.C: 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.
Crosscutting Concepts CCC)	**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.

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Standards

NGSS Performance Expectation HS-PS1-2	
HS-PS1-2 Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends **in the periodic table, and knowledge of the patterns of chemical properties.** [Clarification Statement Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen.] [Assessment Boundary: Assessment is limited to chemical reactions involving main group elements and combustion reactions.]	
Science and Engineering Practices (SEP)	**Constructing Explanations and Designing Solutions** • 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.
Disciplinary Core Ideas (DCI)	**PS1.A: Structure and Properties of Matter** • The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. **PS1.B: 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.
Crosscutting Concepts (CCC)	**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.

Extended Performance Expectation HS-PS1-2			
	Level 1	***Level 2***	***Level 3***
	Less Complex ←···· ←···· ←···· ←···· ←····	·······→ ····→ ····→ ····→ ····→	***More Complex***
	HS-PS1-2.1 Use provided information to complete a model of a chemical reaction.	**HS-PS1-2.2** Use the periodic table as a model to identify or classify elements that will behave similarly in chemical reactions.	**HS-PS1-2.3** Use the periodic table to construct an explanation for specific chemical reactions.
Science and Engineering Practices (SEP)	**Target:** **Constructing Explanations and Designing Solutions** • 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.		

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	Supporting: **Obtaining, Evaluating, and Communicating Information** **Developing and Using Models**
Disciplinary Core Ideas (DCI)	**PS1.A Structure and Properties of Matter** • The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. **PS1.B: 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.
Crosscutting Concepts (CCC)	**Target:** **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. **Supporting:** **Energy and Matter**

High School Grade-Level Standards

Standards

NGSS Performance Expectation HS-PS2-3	
HS-PS2-3 Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.* [Clarification Statement: Examples of evaluation and refinement could include determining the success of the device at protecting an object from damage and modifying the design to improve it. Examples of a device could include a football helmet or a parachute.] [Assessment Boundary: Assessment is limited to qualitative evaluations and/or algebraic manipulations.]	
Science and Engineering Practices (SEP)	**Constructing Explanations and Designing Solutions** • Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects.
Disciplinary Core Ideas (DCI)	**PS2.A: Forces and Motion** • 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. **ETS1.A: Defining and Delimiting an Engineering Problem** • Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. **ETS1.C: Optimizing the Design Solution** • Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.
Crosscutting Concepts (CCC)	**Cause and Effect** • Systems can be designed to cause a desired effect.

Extended Performance Expectation HS-PS2-3			
	Level 1	***Level 2***	***Level 3***
	Less Complex	←→	***More Complex***
	HS-PS2-3.1 Use a model to identify how forces are acting in a collision system.	**HS-PS2-3.2** Make a claim about how a particular device functions to minimize the forces on a macroscopic object during a collision.	**HS-PS2-3.3** Select, evaluate, or change a design to a device that minimizes the forces on a macroscopic object during a collision.
Science and Engineering Practices (SEP)	**Target:** **Constructing Explanations and Designing Solutions** • Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects. **Supporting:** **Engaging in Argument from Evidence**		

High School Grade-Level Standards

	Developing and Using Models
Disciplinary Core Ideas (DCI)	**PS2.A: Forces and Motion** • 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. **ETS1.A: Defining and Delimiting an Engineering Problem** • Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. **ETS1.C: Optimizing the Design Solution** • Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.
Crosscutting Concepts (CCC)	**Target:** **Cause and Effect** • Systems can be designed to cause a desired effect. **Supporting:** • Systems and System Models

High School Grade-Level Standards

Standards

NGSS Performance Expectation HS-PS2-5	
HS-PS2-5 Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current. [Assessment Boundary: Assessment is limited to designing and conducting investigations with provided materials and tools.]	
Science and Engineering Practices (SEP)	**Planning and Carrying Out Investigations** • 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.
Disciplinary Core Ideas (DCI)	**PS2.B: Types of Interactions** • Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. (HS-PS2-4) • Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. **PS3.A: Definitions of Energy** • "Electrical energy" may mean energy stored in a battery or energy transmitted by electric currents. (secondary)
Crosscutting Concepts (CCC)	**Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Extended Performance Expectation HS-PS2-5			
	Level 1	***Level 2***	***Level 3***
	Less Complex ←·········→		***More Complex***
	HS-PS2-5.1 Use observations and data to identify examples of electric current producing magnetic fields or magnetic fields producing electric current.	**HS-PS2-5.2** Use data to make predictions or draw conclusions about changes in systems or devices that involve the interaction of magnetic fields and electric current.	**HS-PS2-5.3** Plan or conduct an investigation to study cause-and-effect relationships between magnetic fields and electric current.
Science and Engineering Practices (SEP)	**Target:** **Planning and Carrying Out Investigations** • 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.		

High School Grade-Level Standards

	Supporting: **Analyzing and Interpreting Data** **Planning and Carrying Out Investigations**
Disciplinary Core Ideas (DCI)	**PS2.B: Types of Interactions** • Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. (HS-PS2-4) • Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. **PS3.A: Definitions of Energy** • "Electrical energy" may mean energy stored in a battery or energy transmitted by electric currents.
Crosscutting Concepts (CCC)	**Target:** **Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. **Supporting:** **Stability and Change**

High School Grade-Level Standards

Standards

NGSS Performance Expectation HS-PS3-2	
HS-PS3-2 Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects). [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.]	
Science and Engineering Practices (SEP)	**Developing and Using Models** • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.
Disciplinary Core Ideas (DCI)	**PS3.A: 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.
Crosscutting Concepts (CCC)	**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.

Extended Performance Expectation HS-PS3-2			
	Level 1	***Level 2***	***Level 3***
	Less Complex ←····	····→	***More Complex***
	HS-PS3-2.1 Identify questions that would determine if an object's kinetic energy is changing or if an object's potential energy is changing in a system.	**HS-PS3-2.2** Use models to show how energy changes when an object's position is moved or when the (particles) making up an object change their motion.	**HS-PS3-2.3** Develop or use models to describe how energy is conserved at the macroscopic or particle level when energy is transferred or converted from one form to another.
Science and Engineering Practices (SEP)	**Target:** **Developing and Using Models** • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. **Supporting:**		

	Asking Questions and Defining Problems
Disciplinary Core Ideas (DCI)	**PS3.A: 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.
Crosscutting Concepts (CCC)	**Target:** **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.