Science and Engineering Practices

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories.

- Apply scientific ideas or principles to design an object, tool, process or system.

Planning and Carrying Out Investigations
Planning & carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences & progresses to include investigations that use multiple variables & provide evidence to support explanations or design solutions.

- Plan an investigation individually & collaboratively, & in the design: identify independent & dependent variables & controls, what tools are needed to do the gathering, how measurements will be recorded, & how many data are needed to support claim.
- Conduct an investigation & evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation.

Asking Questions and Defining Problems
Asking questions and defining problems in grades 6–8 builds from grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.

- Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.

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 reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.

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.

Stability and Change Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales.

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

Skills by Level

Measurement Skills	Hypothesis Skills	Conclusion Skills	Data Skills
• Students can accurately measure with a metric ruler, stop watch, beaker, thermometer, graduated cylinder, and triple beam balance. • Students expected to measure with estimates between marked intervals on the measurement tool.	• Students are developing a testable statement based on research, making observations, and connecting to prior knowledge. • If…then…because format is provided by teacher.	• Definition: A statement of whether the hypothesis was or was not supported by the data. Should include the results of experiment, a comparison to the hypothesis, a list of experimental errors, and identifies new questions as a result of the experiment.	

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Eighth Grade • First Quarter

Science

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Revised 8.2017

Grade 8 Science First Quarter

UNIT 1 Forces and Motion		UNIT 2 Types of Interactions		
I CAN Statements				
☐ **I CAN** apply Newton's third law (for every action in nature, there is an equal and opposite reaction) to design a solution to a problem.	☐ **I CAN** plan and conduct an experiment to prove that the change in an object depends on the sum of the forces on the object and the mass of the object.	☐ **I CAN** determine factors that affect the strength of electric and magnetic forces.	☐ **I CAN** construct and present evidence supporting the argument that gravitational interactions are attractive and depend on the masses of the interacting objects.	☐ **I CAN** conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.
Standard MS.PS2.1	**Standard MS.PS2.2**	**Standard MS.PS2.3**	**Standard MS.PS2.4**	**Standard MS.PS2.5**
Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects. *Clarification Statement: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.*	**Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.** *Clarification Statement: Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units.*	**Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.** *Clarification Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor.*	**Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.** *Clarification Statement: Examples of evidence for arguments 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.*	**Conduct an investigation and evaluate the experimental design to provide evidence that fields 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.*
Disciplinary Core Ideas				
► For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law).	► The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. ► All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared.	► Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects.	► Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun.	► Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively).

Science and Engineering Practices

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- Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim

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 scientific reasoning to support or refute an explanation or a model for a phenomenon.

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.

Developing and Using Models
Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop and use a model to describe phenomena.

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.

Crosscutting Concepts

Scale, Proportion, and Quantity
Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes.

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

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

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.

Skills by Level

Measurement Skills	Hypothesis Skills	Conclusion Skills	Data Skills
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Eighth Grade • Second Quarter
Pacing Guide

Science

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Revised 8.2017

Grade 8 Science Second Quarter

UNIT 3 Energy		UNIT 4 Waves and Electromagnetic Radiation		
I CAN Statements				
☐ **I CAN** plan an investigation to determine relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.	☐ **I CAN** construct an argument and hold a conversation to support a claim that when the kinetic energy of an object changes, energy is transferred to or from the object.	☐ **I CAN** use mathematical representations to describea simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.	☐ **I CAN** develop and use a model to describe that waves are reflected, absorbed, or transmitted through various material	☐ **I CAN** integrate qualitative scientific and technical information to support the claim that digital signals are a more reliable way to encode and transmit information than analog signals.
Standard MS.PS3.4	**Standard MS.PS3.5**	**Standard MS.PS4.1**	**Standard MS.PS4.2**	**Standard MS.PS4.3**
Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. *Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.*	**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.*	**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.*	**Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.** *Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.*	**Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.** *Clarification Statement: Emphasis is on a basic understanding that waves can be used for communication purposes. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in wifi devices, and conversion of stored binary patterns to make sound or text on a computer screen.*
Disciplinary Core Ideas				
► 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. ► The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment.	► When the motion energy of an object changes, there is inevitably some other change in energy at the same time.	► A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.	► A sound wave needs a medium through which it is transmitted. ► When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. ► The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. ► A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. ► However, because light can travel through space, it cannot be a matter wave, like sound or water waves.	► Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.

Science and Engineering Practices

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 determine similarities and differences in findings.
- Analyze displays of data to identify linear and nonlinear relationships.

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.
- Apply scientific ideas to construct an explanation for real- world phenomena, examples, or events.
- Construct an explanation that includes qualitative or quantitative relationships between variable s that describe phenomena.

Using Mathematics and Computational Thinking
Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments.
- Use mathematical representations to support scientific conclusions and design solutions.

Crosscutting Concepts

Patterns
- Patterns can be used to identify cause and effect relationships.
- Graphs, charts, and images can be used to identify patterns in data.

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

Skills by Level

Measurement Skills	Hypothesis Skills	Conclusion Skills	Data Skills
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Eighth Grade • Third Quarter

Science

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Revised 8.2017

Grade 8 Science Third Quarter

UNIT 5 Natural Selection and Adaptations

I CAN Statements				
☐ **I CAN** give examples of major events that ocurred in the Earth's history based on evidence from rock strata. ☐ **I CAN** analyze and interpret patterns within data from the fossil record that demonstrate the existence, diversity, extinction, and change of life forms throughout Earth's history with the assumption that natural laws operate today as in the past.	☐ **I CAN** apply scientific ideas to explain the anatomical similarities and differences among modern organisms and between modern and fossil organisms so **I CAN** make inferences about evolutionary relationships.	☐ **I CAN** analyze pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.	☐ **I CAN** devise an explanation based on evidence that describes how genetic variations of traits in apopulation increase some individuals' probability of surviving and reproducing in a specific environment.	☐ **I CAN** use mathmatical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.
Standard MS.LS4.1, ESS1.4	**Standard MS.LS4.2**	**Standard MS.LS4.3**	**Standard MS.LS4.4**	**Standard MS.LS4.6**
Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history. *Clarification Statement: Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range from being very recent (such as the last Ice Age or the earliest fossils of homo sapiens) to very old (such as the formation of Earth or the earliest evidence* **Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.** *Clarification Statement: Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers.*	**Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.** *Clarification Statement: Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures.*	**Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.** *Clarification Statement: Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures.*	**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.*	**Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.** *Clarification Statement: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.*
Disciplinary Core Ideas				
► The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. ► The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale	► Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent.	► Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy.	► Natural selection leads to the predominance of certain traits in a population, and the suppression of others.	► Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes.

Science and Engineering Practices

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- Develop and use a model to describe phenomena.

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 determine similarities and differences in findings.

Crosscutting Concepts

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

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

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.

Skills by Level

Measurement Skills	Hypothesis Skills	Conclusion Skills	Data Skills
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Eighth Grade • Fourth Quarter

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Revised 8.2017

Grade 8 Science Fourth Quarter

UNIT 6 Space Systems

I CAN STATEMENTS		
☐ **I CAN** develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.	☐ **I CAN** develop and use a model to describe the role of gravity in the motions within the galaxies and the solar system.	☐ **I CAN** analyze and interpret data to determine skill properties of objects in the solar system.
Standard MS.ESS1.1	**Standard MS.ESS1.2**	**Standard MS.ESS1.3**
Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. *Clarification Statement: Examples of models can be physical, graphical, or conceptual.*	**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 students' school or state).*	**Analyze and interpret data to determine scale properties of objects in the solar system.** *Clarification Statement:* *Emphasis is on the analysis of data from Earth-based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects. Examples of scale properties include the sizes of an object's layers (such as crust and atmosphere), surface features (such as volcanoes), and orbital radius. Examples of data include statistical information, drawings and photographs, and models.*
Disciplinary Core Ideas		
► Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. ► This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year.	► Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. ► 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.	► 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.