Grade 7 Science

Priority Standards and Instructional Units 2021-2022

Quick Links

Unit 1: Kinetic Energy

(5 weeks = 25 days)

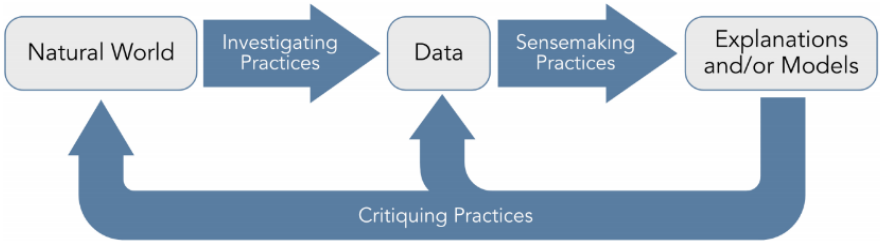
Essential Questions:

Core Idea PS3: Energy

How is energy transferred and conserved?

- What is energy?
- What is meant by conservation of energy? How is energy transferred between objects or systems?
- How do food and fuel provide energy? If energy is conserved, why do people say it is produced or used?

Possible Phenomena: Coming Soon



	Investigating Practices	Sensemaking Practices	Critiquing Practices
Science Practices	1. Asking questions	2. Developing and using models	7. Engaging in argument from evidence
	3. Planning and carrying out investigations	4. Analyzing and interpreting data	8. Obtaining, evaluating, and communication information
	5. Using mathematical and computational thinking	6. Constructing explanations	

MS-PS3-3 **Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.*** **[Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.]** **[Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]**	**Priority Standard**
MS-PS3-4 **Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.** **[Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]**	**Priority Standard**
MS-ETS1-1 **Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into**	**Supporting Standard**

account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.	
MS-ETS1-2 **Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.**	**Supporting Standard**

Science and Engineering Practices:

Developing and Using Models
Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems.
Develop a model to describe unobservable mechanisms. (07-PS3-2)
Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions ortest solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions.
Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.(07-PS3-4)
Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.
Construct and interpret graphical displays of data to identify linear and nonlinear relationships. (08-PS3-1)
Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.
Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system.(07-PS3-3)
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. (07-PS3-5)

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. (08-PS3-1),(07- PS3-4)
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. (07-PS3-2)
Energy and Matter
Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). (07-PS3-5)

The transfer of energy can be tracked as energy flows through a designed or natural system. (07-PS3-3)
Disciplinary Core Ideas:
PS3.A: Definitions of Energy Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed. (08-PS3-1) A system of objects may also contain stored (potential) energy, depending on their relative positions. (07-PS3-2) 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. (07-PS3-3),(07-PS3-4) PS3.B: Conservation of Energy and Energy Transfer When the motion energy of an object changes, there is inevitably some other change in energy at the same time. (07- PS3-5) The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. (07-PS3-4) Energy is spontaneously transferred out of hotter regions or objects and into colder ones.(07-PS3-3) **PS3.C: Relationship Between Energy and Forces** When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. (07-PS3-2) **ETS1.A: Defining and Delimiting anEngineering Problem** The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. (secondary to 07-PS3-3) **ETS1.B: Developing Possible Solutions** A solution needs to be tested, and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. (secondary to 07-PS3-3)

Unit 2: Chemical Reactions

(4.5 weeks = 18 days in Term 1 & 5 days in Term 2)

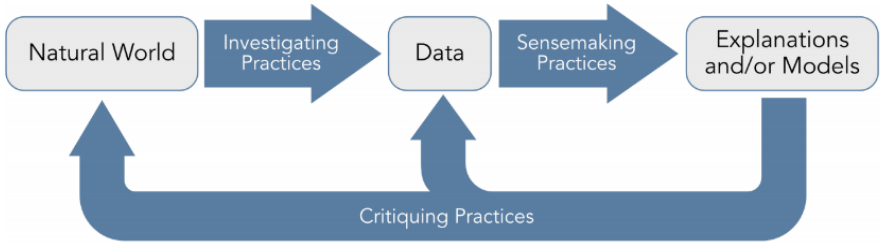
Essential Questions:

Core Idea PS1: Matter and Its Interactions

How can one explain the structure, properties, and interactions of matter?

- How do substances combine or change (react) to make new substances? How does one characterize and explain these reactions and predictions about them?

Possible Phenomena: Coming Soon



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MS-PS1-2 **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: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.] [Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.]**	**Priority Standard**
MS-PS1-5 **Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.** **[Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.] [Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.]**	**Priority Standard**
MS-PS1-6 **Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.*** **[Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions**	**Supporting Standard**

such as dissolving ammonium chloride or calcium chloride.] [Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.]	

Science and Engineering Practices:

Developing and Using Models
Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems.
Develop a model to describe unobservable mechanisms. (07-PS1- 5)
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. (07-PS1-2)
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.
Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. (07-PS1-6)

Crosscutting concepts:

Patterns
Macroscopic patterns are related to the nature of microscopic and atomic-level structure. (07-PS1- 2)
Energy and Matter
Matter is conserved because atoms are conserved in physical and chemical processes. (07-PS1-5)
The transfer of energy can be tracked as energy flows through a designed or natural system. (07- PS1-6)

Disciplinary Core Ideas:

PS1.A: Structure and Properties of Matter
Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (07-PS1-2) (Note: This Disciplinary Core Idea is also addressed by 06-PS1-3.)
PS1.B: Chemical Reactions
Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (07-PS1-2),(07-PS1-5) (Note: This Disciplinary Core Idea is also addressed by 06-PS1-3.)
The total number of each type of atom is conserved, and thus the mass does not change. (07-PS1-5)
Some chemical reactions release energy, others store energy. (07-PS1-6)
ETS1.B: Developing Possible Solutions
A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (secondary to 07-PS1-6)
ETS1.C: Optimizing the Design Solution
Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide

useful information for the redesign process—that is, some of the characteristics may be incorporated into the new design. (secondary to 07-PS1-6)
The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (secondary to 07-PS1-6)

Unit 3: Structure & Function

(4.5 weeks = 23 days)

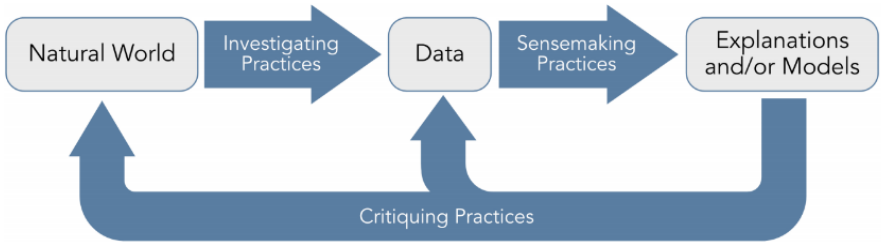
Essential Questions:

Core Idea LS1: Molecules to Organisms: Structures & Processes

How do organisms live, grow, respond to their environment, and reproduce?

- How do the structures of organisms enable life's functions?
- How do organisms grow and develop?
- How do organisms obtain and use the matter and energy they need to live and grow?

Possible Phenomena: Coming Soon



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MS-LS1-1 **Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.** **[Clarification Statement: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living things, and understanding that living things may be made of one cell or many and varied cells.]**	**Priority Standard**

MS-LS1-2 **Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. [Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.] [Assessment Boundary: Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.]**	**Priority Standard**
MS-LS1-6 **Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.** **[Clarification Statement: Emphasis is on tracing movement of matter and flow of energy.] [Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.]**	**Priority Standard**

Science and Engineering Practices:

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. (07-LS1-2)
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.
Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. (07-LS1-1)
Engaging in Argument from Evidence
Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).
Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. (07-LS1-3)
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6-8 builds on K-5 experiences and progresses to evaluating the merit and validity of ideas and methods.

Crosscutting concepts:

Scale, Proportion, and Quantity
Phenomena that can be observed at one scale may not be observable at another scale. (07-LS1-1)
Systems and System Models
Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. (07-LS1-3)
Structure and Function
Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural and designed structures/systems can be analyzed to determine how they function. (07- LS1-2)
Connections to Engineering, Technology, and Applications of Science
Interdependence of Science, Engineering, and Technology

Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (07-LS1-1)

Disciplinary Core Ideas:

LS1.A: Structure and Function
All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (07-LS1-1) Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (07- LS1-2)
In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (07-LS1-3)

Unit 4: Growth, Development, & Reproduction

(3 weeks = 15 days)

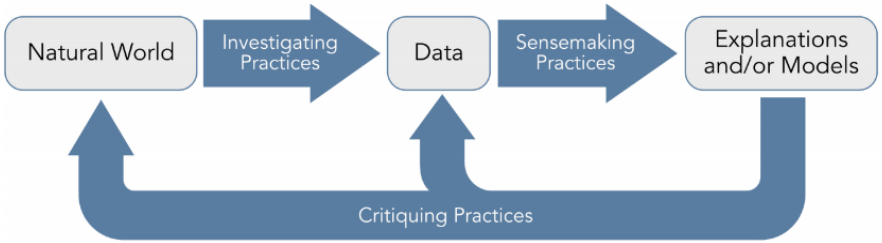
Essential Questions:

Core Idea LS1: Molecules to Organisms: Structures & Processes

How do organisms live, grow, respond to their environment, and reproduce?

- How do the structures of organisms enable life's functions?
- How do organisms grow and develop?
- How do organisms obtain and use the matter and energy they need to live and grow?
- How do organisms detect, process, and use information about the environment?

Possible Phenomena: Coming Soon



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MS-LS1-4 **Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.** **[Clarification Statement: Examples of behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds, and creating conditions for seed germination and growth. Examples of plant structures could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.]**	**Priority Standard**
MS-LS1-5 **Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.** **[Clarification Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.]** **[Assessment Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.]**	**Priority Standard**

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.
Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (07-LS1-5)
Engaging in Argument from Evidence
Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).
Use an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (07-LS1-4)

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. (07-LS1-4),(07-LS1-5),(08-LS4-5)

Disciplinary Core Ideas:

LS1.B: Growth and Development of Organisms
Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. (secondary to 08-LS3-2) Animals engage in

characteristic behaviors that increase the odds of reproduction. (07-LS1-4)
Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. (07-LS1-4)
Genetic factors as well as local conditions affect the growth of the adult plant. (07-LS1-5)

Unit 5: Body Systems

(5 weeks = 25 days)

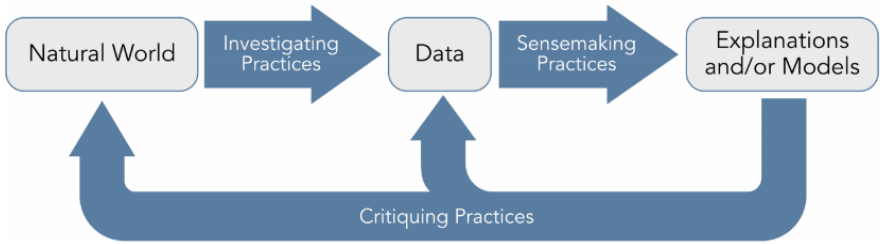
Essential Questions:

Core Idea LS1: Molecules to Organisms: Structures & Processes

How do organisms live, grow, respond to their environment, and reproduce?

- How do the structures of organisms enable life's functions?
- How do organisms grow and develop?
- How do organisms obtain and use the matter and energy they need to live and grow?

Possible Phenomena: Coming Soon



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MS-LS1-3

Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. [Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.] *[Assessment Boundary: Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.]*

Priority Standard

MS-LS1-7 **Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.** **[Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.] [Assessment Boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration.]**	**Priority Standard**

Science and Engineering Practices:

Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in 6-8 builds on K-5 experiences and progresses to evaluating the merit and validity of ideas and methods.
Developing and Using Models
Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
Develop a model to describe phenomena. (06-LS2-3) Develop a model to describe unobservable mechanisms. (07-LS1-7)
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
Engaging in Argument from Evidence
Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s) (07-LS1-3)

Crosscutting concepts:

Energy and Matter
Matter is conserved because atoms are conserved in physical and chemical processes. (07-LS1-7)
Within a natural system, the transfer of energy drives the motion and/or cycling of matter. (07- LS1-6)
Systems and System Models
Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. (07-LS1-3)

Disciplinary Core Ideas:

PS3.D: Energy in Chemical Processes and Everyday Life
The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. (secondary to 07-LS1-6)
Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (secondary to 07-LS1-7)
LS1.C: Organization for Matter and Energy Flow in Organisms
Plants,algae(including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use.(07-LS1-6)

Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (07-LS1-7)

LS1.A: Structure and Function

In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (07-LS1-3)

Unit 6: Electromagnetic and Mechanical Waves

(4 weeks = 20 days)

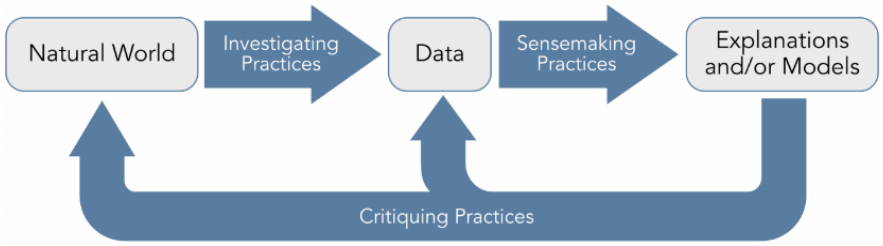
Essential Questions:

Core Idea PS4: Waves and their Applications in Technology for Information Transfer

How are waves used to transfer energy and information?

- What are the characteristic properties and behaviors of waves?
- What is light?
- How can one explain the varied effects that involve light?

Possible Phenomena: Coming Soon



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MS-PS4-1

Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.

[Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.] [Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.]

Priority Standard

MS-PS4-2 **Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.** **[Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.]** ***[Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves.]***	**Priority Standard**
MS-PS4-3 **Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.** **[Clarification Statement: Emphasis is on a basic understanding that waves can be used for communication purposes. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in wifi devices, and conversion of stored binary patterns to make sound or text on a computer screen.] [Assessment Boundary: Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device.]**	**Supporting Standard**

Science and Engineering Practices:

Developing and Using Models
Modeling in 6–8 builds on K–5 and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
Develop and use a model to describe phenomena. (07-PS4-2)
Using Mathematics and Computational Thinking
Mathematical and computational thinking at the 6–8 level builds on K–5 and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments.
Use mathematical representations to describe and/or support scientific conclusions and design solutions. (07-PS4-1)
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. (07-PS4- 3)
Connections to Nature of Science
Scientific Knowledge is Based on Empirical Evidence
Science knowledge is based upon logical and conceptual connections between evidence and explanations. (07-PS4-1)

Crosscutting concepts:

Patterns
Graphs and charts can be used to identify patterns in data. (07-PS4-1)
Structure and Function
Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (07- PS4-2)
Structures can be designed to serve particular functions. (07-PS4-3)
Connections to Engineering, Technology, and Applications of Science
Influence of Science, Engineering, and Technology on Society and the Natural World

Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations. (07- PS4-3)
Connections to Nature of Science
Science is a Human Endeavor Advances in technology influence the progress of science and science has influenced advances in technology. (07- PS4-3)

Disciplinary Core Ideas:

PS4.A: Wave Properties
A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (07-PS4-1)
A sound wave needs a medium through which it is transmitted. (07-PS4-2)
PS4.B: Electromagnetic Radiation
When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. (07-PS4-2) 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. (07-PS4-2)
A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. (07-PS4-2)
However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (07-PS4-2)
PS4.C: Information Technologies and Instrumentation
Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (07-PS4-3)

Unit 7: Magnetism & Electricity

(4 weeks = 20 days)

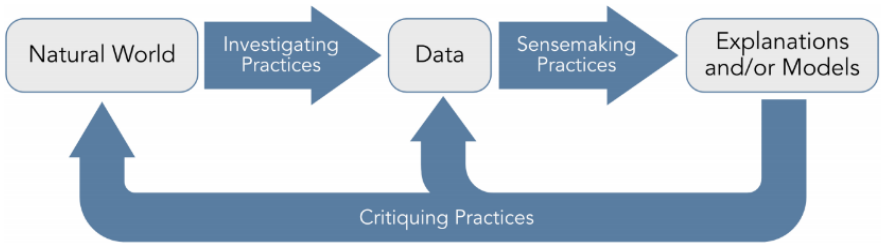
Essential Questions:

Core Idea PS2: Motion and Stability: Forces and Interactions

How can one explain and predict interactions between objects and within systems of objects?

- What underlying forces explain the variety of interactions observed?

Possible Phenomena: Coming Soon



	Investigating Practices	Sensemaking Practices	Critiquing Practices
Science Practices	1. Asking questions	2. Developing and using models	7. Engaging in argument from evidence
	3. Planning and carrying out investigations	4. Analyzing and interpreting data	8. Obtaining, evaluating, and communication information
	5. Using mathematical and computational thinking	6. Constructing explanations	

MS-PS2-3 **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.] [Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.]**	**Priority Standard**
MS-PS2-5 **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.] [Assessment Boundary: Assessment is limited to electric and magnetic fields, and limited to qualitative evidence for the existence of fields.]**	**Priority Standard**
MS-PS2-4 **Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.**	**Supporting Standard**

[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.] [Assessment Boundary: Assessment does not include Newton's Law of Gravitation or Kepler's Laws.]	

Science and Engineering Practices:

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. (07-PS2-3)
Planning and Carrying Out Investigations
Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation. (07- PS2-5)
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
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. (07-PS2-4)

Crosscutting concepts:

Cause and Effect
Cause and effect relationships may be used to predict phenomena in natural or designed systems. (07-PS2-3),(07-PS2-5)
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. (06-PS2-1),(07-PS2-4)

Disciplinary Core Ideas:

PS2.B: Types of Interactions
Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. (07-PS2-3)
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. (07-PS2- 4)
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). (07-PS2-5)

Unit 8: Transfer of Gravitational Energy

(5 weeks = 25 days)

Essential Questions:

Core Idea PS2: Motion and Stability: Forces and Interactions

How can one explain and predict interactions between objects and within systems of objects?

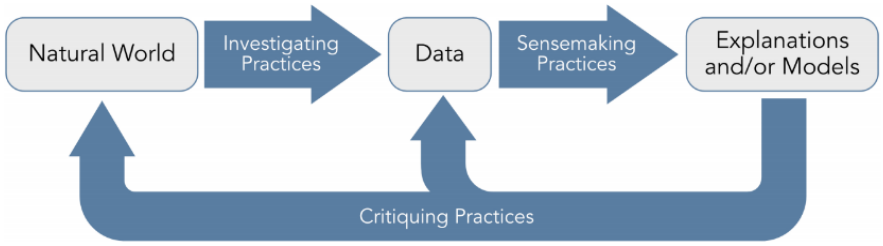
- How can one predict an object's continued motion, changes in motion, or stability?
- What underlying forces explain the variety of interactions observed?

Core Idea PS3: Energy

How is energy transferred and conserved?

- What is meant by conservation of energy? How is energy transferred between objects or systems?
- How are forces related to energy?

Possible Phenomena: Coming Soon



	Investigating Practices	Sensemaking Practices	Critiquing Practices
Science Practices	1. Asking questions	2. Developing and using models	7. Engaging in argument from evidence
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	5. Using mathematical and computational thinking	6. Constructing explanations	

MS-PS2-4 **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.] [Assessment Boundary: Assessment does not include Newton's Law of Gravitation or Kepler's Laws.]**	**Priority Standard**
MS-PS3-2 **Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.** **[Clarification Statement: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a**	**Priority Standard**

balloon with static electrical charge being brought closer to a classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.] [Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions.]	
MS-PS3-5 **Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.** **[Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of objects.]** **[Assessment Boundary: Assessment does not include calculations of energy.]**	**Priority Standard**

Science and Engineering Practices:

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. (07-PS2-4)
Developing and Using Models
Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to describe unobservable mechanisms. (07-PS3-2)
Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions ortest solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions. Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.(07-PS3-4)
Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.
Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.
Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system.(07-PS3-3)
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. (07-PS3- 5)
Connections to Nature of Science
Scientific Knowledge is Based on Empirical Evidence Science Knowledge is based upon logical and conceptual connections between evidence and explanations (07-PS3-4),(07-PS3-5)

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. (06-PS2-1),(07-PS2-4) **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. (07-PS3-2) **Energy and Matter** Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). (07-PS3-5) The transfer of energy can be tracked as energy flows through a designed or natural system. (07-PS3-3)
Disciplinary Core Ideas:
PS2.B: Types of Interactions Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. (07-PS2-3) 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. (07-PS2- 4) 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). (07-PS2-5) **PS3.A: Definitions of Energy** Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed. (08-PS3-1) A system of objects may also contain stored (potential) energy, depending on their relative positions. (07-PS3-2) 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. (07-PS3-3),(07-PS3-4) **PS3.B: Conservation of Energy and Energy Transfer** When the motion energy of an object changes, there is inevitably some other change in energy at the same time. (07- PS3-5) The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. (07-PS3-4) Energy is spontaneously transferred out of hotter regions or objects and into colder ones.(07-PS3-3) **PS3.C: Relationship Between Energy and Forces** When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. (07-PS3-2) **ETS1.A: Defining and Delimiting an Engineering Problem** The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. (secondary to 07-PS3-3)