Curriculum - 8Grade

High Priority Standards (Missouri Learning Standards, National, CREDE, etc.)

Missouri Learning Goal 6-8.PS1.A.2

Learning Goal	**Proficiency Scale**
Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.	4: Student demonstrates advanced application and understanding of chemical reactions. 3: Student demonstrates mastery with the learning goal as evidenced by: ● analyzing the data to identify patterns (i.e., similarities and differences), including the changes in physical and chemical properties of each substance before and after the interaction ● using the analyzed data to determine whether a chemical reaction has occurred. 2: Student demonstrates he/she is nearing proficiency by: ● organizing given data about the characteristic physical and chemical properties (e.g., density, melting point, boiling point, solubility, flammability, odor) of pure substances before and after they interact. 1: Student demonstrates limited understanding of chemical reactions.

Learning Targets - Chemistry Unit

Science and Engineering Practices
Analyze and interpret data to determine similarities and differences in findings.

Disciplinary Core Ideas

- 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.
- Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.

Cross Cutting Concept
Macroscopic patterns are related to the nature of atomic level structure.

Curriculum - 8Grade

<table>
<tr><th colspan="2">High Priority Standards (Missouri Learning Standards, National, CREDE, etc.)</th></tr>
<tr><td colspan="2">Missouri Learning Goal 6-8.PS1.B.1</td></tr>
<tr><td><u>Learning Goal</u>

Develop and use a model to describe how the total number of atoms remains the same during a chemical reaction and thus mass is conserved.</td><td><u>Proficiency Scale</u>

4: Student demonstrates advanced application and understanding of conservation of mass.

3: Student demonstrates mastery with the learning goal as evidenced by:
● developing a model in which they identify the relevant components for a given chemical reaction, including:
● The types and number of molecules that make up the reactants.
● The types and number of molecules that make up the products.
● using the model to provide a causal account that mass is conserved during chemical reactions because the number and types of atoms that are in the reactants equal the number and types of atoms that are in the products, and all atoms of the same type have the same mass regardless of the molecule in which they are found.
2: Student demonstrates he/she is nearing proficiency by:
● looking at a given model and describing the relationships between the components, including:
● Each molecule in each of the reactants is made up of the same type(s) and number of atoms.
● When a chemical reaction occurs, the atoms that make up the molecules of reactants rearrange and form new molecules (i.e., products).
● The number and types of atoms that make up the products are equal to the number and types of atoms that make up the reactants.
● Each type of atom has a specific mass, which is the same for all atoms of that type.
1: Student demonstrates limited understanding of the law of conservation of mass.</td></tr>
</table>

Curriculum - 8Grade

Learning Targets - Chemistry Unit

Science and Engineering Practices

Develop a model to predict and/or describe phenomena.

Disciplinary Core Ideas

- 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.
- The total number of each type of atom is conserved, and thus, the mass does not change.

Cross Cutting Concept

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

Curriculum - 8Grade

<table>
<tr><th colspan="2">High Priority Standards (Missouri Learning Standards, National, CREDE, etc.)</th></tr>
<tr><td colspan="2">Missouri Learning Goal 6-8.PS1.B.2</td></tr>
<tr><td><u>Learning Goal</u>

Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.</td><td><u>Proficiency Scale</u>

4: Student demonstrates advanced application and understanding of thermal energy.

3: Student demonstrates mastery with the learning goal as evidenced by:
● Creating a device that incorporates a transfer of heat.
● Describing the features of the given problem that are to be solved by the device.
● Using the results of their tests to systematically determine how well the design solution meets the criteria and constraints.
2: Student demonstrates he/she is nearing proficiency by:
● Creating a device that incorporates a transfer of heat.
OR
● Describing the features of the given problem that are to be solved by the device.
1: Student demonstrates limited understanding of thermal energy.</td></tr>
<tr><td colspan="2"><u>Learning Targets- Chemistry Unit</u>

Science and Engineering Practices
Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints.
Disciplinary Core Ideas
Some chemical reactions release energy, others store energy.
Cross Cutting Concept
The transfer of energy can be tracked as energy flows through a designed or natural system.</td></tr>
</table>

Curriculum - 8Grade

High Priority Standards (Missouri Learning Standards, National, CREDE, etc.)

Missouri Learning Goal 6-8.PS1.A.1

Learning Goal

Develop models to describe the atomic composition of simple molecules and extended structures.

Proficiency Scale

4: Student demonstrates advanced application and understanding of atomic composition.

3: Student demonstrates mastery with the learning goal as evidenced by:

- developing models of atomic composition of simple molecules and extended structures that vary in complexity. In the models, students identify the relevant components, including:
  - Individual atoms.
  - Molecules.
  - Extended structures with repeating subunits.
  - Substances (e.g., solids, liquids, and gases at the macro level).
- using the models to describe how the behavior of bulk substances depends on their structures at atomic and molecular levels, which are too small to see.

2: Student demonstrates he/she is nearing proficiency by:

- Using a model to describe the relationships between components, including:
  - Individual atoms, from two to thousands, combine to form molecules, which can be made up of the same type or different types of atom.
  - Some molecules can connect to each other.
  - In some molecules, the same atoms of different elements repeat; in other molecules, the same atom of a single element repeats.

1: Student demonstrates limited understanding of the periodic table.

Learning Targets - Chemistry Unit

Science and Engineering Practices

Develop a model to predict and/or describe phenomena.

Disciplinary Core Ideas

- Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms.

- Solids, liquids and gases may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).

Cross Cutting Concept

Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.

Curriculum - 8Grade

High Priority Standards (Missouri Learning Standards, National, CREDE, etc.)	
Missouri Learning Goal 6-8.PS1.A.3	
Learning Goal	**Proficiency Scale** 4: 3: 2: 1:

Learning Targets - Chemistry Unit

Science and Engineering Practices

Gather, read, and synthesize information from multiple appropriate sources, assess the credibility, accuracy, and possible bias of each publication and method used, and describe how they are supported or not supported by evidence.

Disciplinary Core Ideas

- 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.
- Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.

Cross Cutting Concept

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

Curriculum - 8Grade

<table>
<tr><th colspan="2">High Priority Standards (Missouri Learning Standards, National, CREDE, etc.)</th></tr>
<tr><td colspan="2">Missouri Learning Goal 6-8.PS1.A.4</td></tr>
<tr><td><u>Learning Goal</u>

Develop a model that describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.</td><td><u>Proficiency Scale</u>

4: Student demonstrates advanced application and understanding of matter and its interactions.

3: Student demonstrates mastery with the learning goal as evidenced by:
● Developing a model in which they identify the relevant components, including:
○ Particles, including their motion.
○ The system within which the particles are contained.
○ The average kinetic energy of particles in the system.
○ Thermal energy of the system.
○ Temperature of the system.
○ A pure substance in one of the states of matter (e.g., solid, liquid, gas at the macro scale).
● using their model to provide a causal account of the relationship between the addition or removal of thermal energy from a substance and the change in the average kinetic energy of the particles in the substance
2: Student demonstrates he/she is nearing proficiency by:
● Describing the relationships between..
○ The motion of molecules in a system and the kinetic energy of the particles in the system.
○ The average kinetic energy of the particles and the temperature of the system.
● Describing what an increase and decrease in kinetic energy of particles can cause.
1: Student demonstrates limited understanding of the Kinetic Theory Model to illustrate particle arrangement and movement in some states of matter.</td></tr>
</table>

Curriculum - 8Grade

Learning Targets - Chemistry Unit

Science and Engineering Practices

Develop a model to predict and/or describe phenomena.

Disciplinary Core Ideas

- Gases and liquids are made of molecules or inert atoms that are moving about relative to each other.
- In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations.
- The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter.
- The term “heat” as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects.
- 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.

Cross Cutting Concept

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

Curriculum - 8Grade

High Priority Standards (Missouri Learning Standards, National, CREDE, etc.)

Missouri Learning Goal 6-8.PS2.A.1

Learning Goal	**Proficiency Scale**
Apply physics principles to design a solution that minimizes the force of an object during a collision and develop an evaluation of the solution.	4: Student demonstrates advanced application and understanding of Newton's third law. 3: Student demonstrates mastery with the learning goal as evidenced by: ● designing a solution that models Newton's Third Law, ● taking into account criteria and constraints when designing solution (cost, mass, speed, time, and materials), and evaluating the design. 2: Student demonstrates he/she is nearing proficiency by: ● Identifying and describing the components within the system that are involved in the collision. ● Identifying and describing the force that will be exerted by the first object on the second object. ● Identifying and describing the technologies (i.e., any human-made material or device) that will be used in the solution. 1: Student demonstrates limited understanding of Newton's third law.

Learning Targets - Forces and Interactions

Science and Engineering Practices
Apply scientific ideas or principles to design an object, tool, process, or system.
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 an opposite direction. (Newton's third law)
Cross Cutting Concept
Models can be used to represent systems and their interactions, such as inputs, processes, and outputs, and energy and matter flows within systems.

Curriculum - 8Grade

High Priority Standards (Missouri Learning Standards, National, CREDE, etc.)

Missouri Learning Goal 6-8.PS2.A.2

Learning Goal

Plan and conduct 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.

Proficiency Scale

4: Student demonstrates advanced application and understanding of an object's motion.

3: Student demonstrates mastery with the learning goal as evidenced by:

- developing a plan for the investigation and describing in the plan that the following data will be collected:
  - Data on the motion of the object.
  - Data on the total forces acting on the object.
  - Data on the mass of the object.
  - Which data are needed to provide evidence for each of the following:
    - An object subjected to balanced forces does not change its motion (sum of F=0).
    - An object subjected to unbalanced forces changes its motion over time (sum of $F \neq 0$)
    - The change in the motion of an object subjected to unbalanced forces depends on the mass of the object.

2: Student demonstrates he/she is nearing proficiency by:

- providing evidence that the change in an object's motion is due to the following factors:
  - Balanced or unbalanced forces acting on the object.
  - The mass of the object.

1: Student demonstrates limited understanding of an object's motion

Learning Targets - Forces and Interactions

Science and Engineering Practices

Plan an investigation and identify the 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.

Disciplinary Core Ideas

Curriculum - 8Grade

- 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.

Cross Cutting Concept

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

Curriculum - 8Grade

High Priority Standards (Missouri Learning Standards, National, CREDE, etc.)

Missouri Learning Goal 6-8.PS2.B.1

Learning Goal	**Proficiency Scale**
Analyze diagrams and collect data to determine the factors that affect the strength of electric and magnetic forces.	4: Student demonstrates advanced application and understanding of electric and magnetic forces. 3: Student demonstrates mastery with the learning goal as evidenced by: ● collecting and recording data about the factors that affect the force. ● using data to identify and describe the attractive force. ● explaining why distance, charge/orientation, or magnitude can affect a force. 2: Student demonstrates he/she is nearing proficiency by: ● identifying and understanding that objects can interact at a distance, and a field exists between objects exerting forces. 1: Student demonstrates limited understanding of electric and magnetic forces.

Learning Targets - Foces and Interactions Unit

Science and Engineering Practices
Analyze and interpret data to provide evidence for phenomena.
Disciplinary Core Ideas
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.
Cross Cutting Concept
Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Curriculum - 8Grade

<table>
<tr><th colspan="2">High Priority Standards (Missouri Learning Standards, National, CREDE, etc.)</th></tr>
<tr><td colspan="2">Missouri Learning Goal 6-8.PS2.B.3</td></tr>
<tr><td><u>Learning Goal</u>

Conduct an investigation and evaluate the experimental design to provide evidence that electric and magnetic fields exist between objects exerting forces on each other even though the objects are not in contact.</td><td><u>Proficiency Scale</u>

4: Student demonstrates advanced application and understanding of electric and magnetic forces by conducting an investigation and evaluating the experimental design.

3: Student demonstrates mastery with the learning goal as evidenced by:

● making and recording observations according to the given plan. The data recorded may include observations of:
○ Motion of objects.
○ Suspension of objects.
○ Simulations of objects that produce either electric or magnetic fields through space and the effects of moving those objects closer to or farther away from each other.
○ A push or pull exerted on the hand of an observer holding an object.
● evaluating the experimental design by assessing whether or not the data produced by the investigation can provide evidence that fields exist between objects that act on each other even though the objects are not in contact.
2: Student demonstrates he/she is nearing proficiency by:
● providing evidence that fields exist between objects exerting forces on each other even though the objects are not in contact
● identifying and describing the data that will be collected to provide evidence for each of the following:
○ Evidence that two interacting objects can exert forces on each other even though the two interacting objects are not in contact with each other.
○ Evidence that distinguishes between electric and magnetic forces.
○ Evidence that the cause of a force on one object is the interaction with the second object (e.g., evidence for the presence of force disappears when the second object is removed from the vicinity of the first).</td></tr>
</table>

	1: Student demonstrates limited understanding of electric and magnetic forces by conducting an investigation and evaluating the experimental design.

Learning Targets - Forces and Interactions Unit

Science and Engineering Practices

Conduct an investigation and evaluate the experimental design (identify variables and controls, what tools are needed, how measurements are taken and recorded, how many trials are needed) to provide evidence that electric and magnetic fields exist between objects.

Disciplinary Core Ideas

Forces that act at a distance (e.g., electric, magnetic) can be explained by fields that extend through space and can be mapped by their effect on a test object (e.g., a charged object, ball).

Cross Cutting Concept

y be used to predict phenomena in natural or designed systems (i.e., electric and magnetic fields).

Curriculum - 8Grade

High Priority Standards (Missouri Learning Standards, National, CREDE, etc.)

Missouri Learning Goal 6-8.PS3.A.1

Learning Goal	**Proficiency Scale**
Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and the speed of an object.	4: Student demonstrates advanced application and understanding of kinetic energy. 3: Student demonstrates mastery with the learning goal as evidenced by: ● using graphs to organize mass, speed, and kinetic energy of an object in a way that can be interpreted ● interpreting data to show the relationship between kinetic energy and mass (KE $\propto$ m), and kinetic energy and speed (KE $\propto$ v2). 2: Student demonstrates he/she is nearing proficiency by: ● Using the graphical display, students identify that kinetic energy: ○ Increases if either the mass or the speed of the object increases or if both increase. ○ Decreases if either the mass or the speed of the object decreases or if both decrease. 1: Student demonstrates limited understanding of kinetic energy.

Learning Targets - Forces and Interactions Unit

Science and Engineering Practices
Construct and interpret graphical displays of data to describe relationships between kinetic energy and the mass of an object and the speed of the object.
Disciplinary Core Ideas
Motion energy is called kinetic energy. Kinetic energy is proportional to the mass of the moving object and grows with the speed of the object.
Cross Cutting Concept
Proportional relationships (speed as a ratio of distance traveled to time taken) between different types of quantities provide information about the magnitude, properties, and processes.

Curriculum - 8Grade

High Priority Standards (Missouri Learning Standards, National, CREDE, etc.)

Missouri Learning Goal 6-8.PS3.A.2

Learning Goal	**Proficiency Scale**
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.	4: Student demonstrates advanced application and understanding of potential energy. 3: Student demonstrates mastery with the learning goal as evidenced by: ● develop a model in which they identify the relevant components, including: ○ A system of two stationary objects that interact ○ Forces (electric, magnetic, or gravitational) through which the two objects interact. ○ Distance between the two objects. ○ Potential energy. ● identifying the relationship between distance and position and the energy that can be transferred, or the potential energy of the system. 2: Student demonstrates he/she is nearing proficiency by: ● identifying interaction of two stationary objects, forces between them, distance between them, and potential energy ● identifying the cause of change in potential energy. 1: Student demonstrates limited understanding of potential energy.

Learning Targets - Forces and Interactions Unit

Science and Engineering Practices

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.

Disciplinary Core Ideas

- A system of objects may also contain stored (potential) energy, depending on their relative positions.
- When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object.

Cross Cutting Concept

Models can be used to represent systems and their interactions, and energy and matter flows within systems.

Curriculum - 8Grade

High Priority Standards (Missouri Learning Standards, National, CREDE, etc.)

Missouri Learning Goal 6-8.PS3.A.3

Learning Goal	**Proficiency Scale**
Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.	4: Student demonstrates advanced application and understanding of thermal energy transfer. 3: Student demonstrates mastery with the learning goal as evidenced by: ● designing and building a solution to the problem that includes: ○ Identifying that thermal energy is transferred from hotter objects to colder objects. ○ Describing different types of materials used in the design solution and their properties (e.g., thickness, heat conductivity, reflectivity) and how these materials will be used to minimize or maximize thermal energy transfer. ○ Specify how the device will solve the problem. ● testing the device to determine its ability to maximize or minimize the flow of thermal energy, using the rate of temperature change as a measure of success. 2: Student demonstrates he/she is nearing proficiency by: ● describing criteria and constraints (including differences in max./min. temperature, amount of time, if device is meant to max. or min. transfer, materials, safety, cost. 1: Student demonstrates limited understanding of thermal energy transfer.

Learning Targets - Forces and Interactions Unit

Science and Engineering Practices
Apply scientific ideas or principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.

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.
- Energy is spontaneously transferred out of hotter regions or objects into colder ones.

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

Curriculum - 8Grade

<table>
<tr><th colspan="2">High Priority Standards (Missouri Learning Standards, National, CREDE, etc.)</th></tr>
<tr><td colspan="2">Missouri Learning Goal 6-8.PS3.A.4</td></tr>
<tr><td><u>Learning Goal</u>

Plan and conduct an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the temperature of the sample.</td><td><u>Proficiency Scale</u>

4: Student demonstrates advanced application and understanding of the relationships between temperature change of a sample and energy transferred, type of matter, mass, and kinetic energy.

3: Student demonstrates mastery with the learning goal as evidenced by:

● developing an investigation plan that describes the data to be collected and how the collected data will be used.
● describing:
○ How the mass of the materials are to be measured and in what units.
○ How and when the temperatures of the materials are to be measured and in what units.
○ Details of the experimental conditions that will allow the appropriate data to be collected to address the purpose of the investigation (e.g., time between temperature measurements, amounts of sample used, types of materials used), including appropriate independent and dependent variables and controls.
2: Student demonstrates he/she is nearing proficiency by:
● determining the relationships among the following factors:
○ The transfer of thermal energy.
○ The type of matter.
○ The mass of the matter involved in thermal energy transfer.
○ The change in the average kinetic energy of the particles.
1: Student demonstrates limited understanding of the relationships between temperature change of a sample and energy transferred, type of matter, mass, and kinetic energy.</td></tr>
</table>

Curriculum - 8Grade

Learning Targets - Forces and Interactions Unit

Science and Engineering Practices

Plan an investigation, 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 much data is needed to support a claim.

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 and the size of the sample.

Cross Cutting Concept

It is critical to recognize what is relevant at different measures of size, time, and energy and how it changes in scale and proportion affects the transfer of energy.

Curriculum - 8Grade

<table>
<tr><th colspan="2">High Priority Standards (Missouri Learning Standards, National, CREDE, etc.)</th></tr>
<tr><td colspan="2">Missouri Learning Goal 6-8.PS3.B.1</td></tr>
<tr><td><u>Learning Goal</u>

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.</td><td><u>Proficiency Scale</u>

4: Student demonstrates advanced application and understanding of kinetic energy.

3: Student demonstrates mastery with the learning goal as evidenced by:
● evaluating evidence for strengths and weaknesses including:
○ types of sources
○ Reliability
○ alternative interpretations of evidence
● describing a chain of reasoning that includes:
○ Based on changes in the observable features of the object (e.g., motion, temperature), the kinetic energy of the object changed.
○ When the kinetic energy of the object increases or decreases, the energy (e.g., kinetic, thermal, potential) of other objects or the surroundings within the system increases or decreases, indicating that energy was transferred to or from the object.
2: Student demonstrates he/she is nearing proficiency by:
● making a claim that includes the idea that when the kinetic energy of an object changes, energy is transferred to or from that object.
● identify and describing the given evidence that supports the claim, and includes:
○ The change in observable features (e.g., motion, temperature, sound) of an object before and after the interaction that changes the kinetic energy of the object.
○ The change in observable features of other objects or the surroundings in the defined system.
1: Student demonstrates limited understanding of kinetic energy.</td></tr>
</table>

Curriculum - 8Grade

Learning Targets - Forces and Interactions Unit

Science and Engineering Practices

Construct, use, and present written or oral arguments supported by evidence and scientific reasoning to support or refute an explanation for when the kinetic energy of an object changes, energy is transferred to or from the object.

Disciplinary Core Ideas

When the kinetic energy of an object changes, the energy is transferred from one object to another.

Cross Cutting Concept

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

Curriculum - 8Grade

High Priority Standards (Missouri Learning Standards, National, CREDE, etc.)

Missouri Learning Goal 6-8.PS4.A.1

Learning Goal	**Proficiency Scale**
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.	4: Student demonstrates advanced application and understanding of how the wave amplitude and energy is related. 3: Student demonstrates mastery with the learning goal as evidenced by: ● applying the mathematical wave model to a physical system to identify how wave model characteristics correspond with physical observations. ● using wave models to identify patterns and predict change including: ○ The amount of energy transferred by waves in a given time is proportional to frequency ○ The energy of the wave is proportional to the square of the amplitude. 2: Student demonstrates he/she is nearing proficiency by: ● identifying the characteristics of a wave model that include: ○ waves representing repeating quantities ○ Frequency ○ Amplitude ○ Wavelength 1: Student demonstrates limited understanding of how the wave amplitude and energy is related.

Learning Targets - Waves and Electromagnetic Radiation Unit

Science and Engineering Practices
Use mathematical representations to describe and/or support scientific conclusions and design solutions.
Disciplinary Core Ideas
A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.
Cross Cutting Concept
Graphs, diagrams, and charts can be used to identify patterns in data.

Curriculum - 8Grade

<table>
<tr><th colspan="2">High Priority Standards (Missouri Learning Standards, National, CREDE, etc.)</th></tr>
<tr><td colspan="2">Missouri Learning Goal 6-8.PS4.A.2</td></tr>
<tr><td><u>Learning Goal</u>

Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.</td><td><u>Proficiency Scale</u>

4: Student demonstrates advanced application and understanding of wave interaction with materials.

3: Student demonstrates mastery with the learning goal as evidenced by:

● Using their model to identify and describe the relationships between components, including:
○ Waves interact with materials by being:
■ Reflected.
■ Absorbed.
■ Transmitted.
○ Light travels in straight lines, but the path of light is bent at the interface between materials when it travels from one material to another.
○ Light does not require a material for propagation (e.g., space), but matter waves do require a material for propagation.
● using their model to describe why materials with certain properties are well-suited for particular functions
2: Student demonstrates he/she is nearing proficiency by:
● Developing a model and identifying:
○ Type of wave.
■ Matter waves (e.g., sound or water waves) and their amplitudes and frequencies.
■ Light, including brightness (amplitude) and color (frequency).
○ Various materials through which the waves are reflected, absorbed, or transmitted.
○ Relevant characteristics of the wave after it has interacted with a material (e.g., frequency, amplitude, wavelength).
○ Position of the source of the wave.</td></tr>
</table>

	1: Student demonstrates limited understanding of wave interaction with materials.

Learning Targets - Waves and Electromagnetic Radiation Unit

Science and Engineering Practices

Develop and use a model to describe phenomena.

Disciplinary Core Ideas

- 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.
- However, because light can travel through space, it cannot be considered to only move through matter, like sound or water waves.

Cross Cutting Concept

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