Physical Science Framework K-12

(NGSS in Parentheses)

Kindergarten								
Grade	**Big Idea**	**Essential Questions**	**Concepts**	**Competencies**	**Vocabulary**	**2002 Standards**	**SAS Standards**	**Assessment Anchor Eligible Content**
K	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	Different materials are suited to different purposes.	Analyze data from testing objects made from different materials to determine if a proposed object functions as intended.	Data Test	3.2.4.A 3.2.4.C 3.4.4.A	3.2.K. A1	S4.C.1.1.2 S4.A.1.1 S4.1.3.1 S4.A.2.1.4
K	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	A variety of objects can be built up from small parts.	Design an object built from a small set of pieces to solve a problem and compare solutions designed by peers given the same set of pieces.	Problem solving	3.1.4.A 3.2.4.A 3.2.4.D 3.4.4.A	3.2.2.A4	S4.A.3.2.B S4.A.3.2 S4.A.1.1 S4.1.3.1 S4.A.2.1.4
K	Interactions between any two objects can cause changes in one or both.	How can one explain and predict interactions between objects within systems?	Pushes and pulls can have different strengths and directions. (PS2.A)	Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. (KPS2-1; KPS2-2)	Cause and effect Explanation Motion Push Pull Speed	3.2.4.C 3.4.4.C	3.2.3.B1 3.2.4.B1 3.2.4.A	S4.A.1.1 S4.C.3.1 S4.A.1.1 S4.1.3.1 S4.A.2.1.4
K	Interactions between any two objects can cause changes in one or both.	How can one explain and predict interactions between objects within systems?	Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. (PS2.A)	Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. (K-PS2-1; K-PS2-2)	Cause and effect Explanation Motion Push Pull Speed	3.2.4.C 3.4.4.C	3.2.3.B1 3.2.4.A	S4.A.1.1 S4.C.3.1 S4.A.1.1 S4.1.3.1 S4.A.2.1.4
K	Interactions between any two objects can cause	How can one explain and predict interactions between	Objects pull or push each other when they collide or are	Analyze data to determine if a design solution works as intended to change	Cause and effect	3.2.4.C 3.4.4.C	3.2.3.B1	S4.C.3.1 S4.A.1.1

	changes in one or both.	objects within systems?	connected and can change motion. (PS2.B)	the direction or speed of an object with a push or a pull. (K-PS2-1)	Design Speed			S4.1.3.1 S4.A.2.1.4
K	Interactions between any two objects can cause changes in one or both.	How can one explain and predict interactions between objects within systems?	A bigger push or pull makes things speed up or slow down more quickly. (PS3.C)	Plan and conduct a simple test to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. (K-PS2-1)	Investigation Speed	3.2.4.C 3.4.4.C	3.2.3.B1 3.2.4.B1	S4.C.3.1 S4.A.1.1 S4.1.3.1 S4.A.2.1.2 S4.A.2.1.4
K	Interactions between any two objects can cause changes in one or both.	How can one explain and predict interactions between objects within systems?	When objects touch or collide, they push on one another and can change motion. (PS3.B)	Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or pull. (K-PS2-1)	Data Design Solution	3.2.4.C 3.4.4.C	3.2.3.B1 3.2.6.B1	S4.C.3.1 S4.A.1.1 S4.1.3.1 S4.A.2.1.4
K	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	The more an object is pushed or pulled makes things speed up or slow down. (PS3.C)	Carry out investigations to provide evidence that energy is being transferred or conserved by objects. (K-PS2-1)	Conserved Energy Investigation Transfer	3.2.4.C 3.4.4.C	3.2.4.B1 3.2.4.B2 3.2.4.B6	S4.C.3.1.1 S4.C.3.1.2 S4.3.1.3 S4.A.1.1 S4.1.3.1 S4.A.2.1.2 S4.A.2.1.4
K	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	The amount and position of mass affect how an object moves. (PS2.A)	Carry out investigations to provide evidence that energy is being transferred or conserved by objects. (K-PS2-1)	Balance Conserved Energy Investigation Mass Rotate Transfer	3.4.4.C	3.2.4.B1 3.2.4.B2	S4.C.3.1.1 S4.C.3.1.2 S4.3.1.3 S4.A.1.1 S4.1.3.1 S4.A.2.1.4
K	Waves are a repeating pattern of motion that transfers energy from place to place without	How are waves used to transfer energy and information?	N/A	N/A	N/A	N/A	N/A	N/A

	overall displacement of matter.							
First Grade								
Grade	**Big Idea**	**Essential Questions**	**Concepts**	**Competencies**	**Vocabulary**	**2002 Standards**	**SAS Standards**	**Assessment Anchor Eligible Content**
1	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	N/A	N/A	N/A	N/A	N/A	N/A
1	Interactions between any two objects can cause changes in one or both.	How can one explain and predict interactions between objects within systems?	N/A	N/A	N/A	N/A	N/A	N/A
1	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	N/A	N/A	N/A	N/A	N/A	N/A
1	Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of matter.	How are waves used to transfer energy and information?	Sound can make matter vibrate, and vibrating matter can make sound. (PS4.A)	Plan and conduct investigations to provide evidence that vibrating materials can make sound. (1-PS4-1)	Energy Investigation Materials Sound Vibration Waves	3.4.4.C 3.2.4.A 3.2.4.B 3.2.4.C	3.2.3.B5 3.2.4.B5 3.2.1.B5	S4.A.1.1 S4.1.3.1 S4.A.2.1.4 S4.A.1. 3.3
1	Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of	How are waves used to transfer energy and information?	An object can be seen when light reflected from its surface enters the eyes. (PS4.B)	Investigate and explain that for an object to be seen, light must be reflected off the object and enter the eye. (1-PS4-2)	Energy Light Reflection Surface Wave	3.4.4.C 3.2.4.A 3.2.4.B 3.2.4.C	3.2.3.B5 3.2.4.B5 3.2.1.B5	S4.A.1.1 S4.1.3.1 S4.A.2.1.4 S4.A.1. 3.3

	matter.							
1	Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of matter.	How are waves used to transfer energy and information	Light travels from place to place. (PS4.B)	Make observations to construct an evidence-based account that light travels from place to place.	Light	3.2.4.B	3.2.3.B5	S4A1.3.3 S4A.2.1.3
1	Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of matter.	How are waves used to transfer energy and information?	Mirrors can be used to reflect light. (PS4.B)	Plan and conduct an investigation to redirect light beams using mirrors. (1-PS4-3)	Light beam Mirror Reflection	3.4.4.C 3.4.4.B 3.2.4.A 3.2.4.B 3.2.4.C	3.2.3.B5 3.2.4.B5 3.2.1.B5	S4.A.1.1 S4.1.3.1 S4.A.2.1.4
1	Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of matter.	How are waves used to transfer energy and information?	Materials allow light to pass through them in varying degrees. (PS4.B)	Investigate to determine the effect of placing objects made of different materials in a beam of light. (1-PS4-3)	Materials Opaque Translucent Transparent	3.2.4.C	3.2.3.B5	S4.A.1.3.2 S4.A.2.1.3
1	Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of matter.	How are waves used to transfer energy and information?	Objects can be seen if light is available to illuminate the object or if they give off their own light. (PS4.B)	Make observations to construct an evidence-based account that objects can be seen when illuminated. (1-PS4-2)	Illuminate Light	3.2.4.B	3.2.1.B5 3.2.1.B7	S.4.A.2.1.3
1	Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of matter.	How are waves used to transfer energy and information?	A variety of devices are used to communicate over long distances. (PS4.C)	Use tools and materials to design a device that uses light or sound to solve the problem of communicating over a distance. (1-PS4-4)	Communicate Distance Sound	3.2.4.D 3.8.4. A 3.8.4.B	3.4.3.D1 3.2.1.B7	S4.A.2.2
1	Waves are a repeating pattern of motion that transfers energy from place to place without	How are waves used to transfer energy and information?	People depend on various technologies in their lives; human lives would be different without technology.	Design and build a device that uses light to communicate. (1-PS4-4)	Communicate Design Device	3.2.4.D 3.8.4. A 3.8.4.B	3.2.1.B7 3.4.3.E4	S.4.A.1.1.

	overall displacement of matter.		(PS4.C)					
Second Grade								
Grade	**Big Idea**	**Essential Question**	**Concepts**	**Competencies**	**Vocabulary**	**2002 Standards**	**SAS Standards**	**Anchor Eligible Content**
2	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	Different kinds of matter exist in various states. (PS1.A)	Observe, describe, and classify matter by properties and uses (e.g., size, shape, weight, solid, liquid, gas). (2-PS1-1)	Classify Describe Gas Liquid Matter Patterns Solid Weight	3.4.4A	3.2.3.A1 3.2.4.A1 3.2.3.A2	S4.C.1.1.1 S4.A.1.1 S4.1.3.1 S4.A.2.1.4
2	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	Matter can be described and classified by its observable properties. (PS1.A)	Observe, describe, and classify matter by properties and uses (e.g., size, shape, weight, texture, flexibility, hardness, color, etc.). (2-PS1-1)	Color Flexibility Gas Liquid Matter Properties Solid Texture Weight	3.4.4A	3.2.3.A1 3.2.4.A1 3.2.3.A2 3.2.K.A.1	S4.C.1.1.1 S4.A.1.1 S4.1.3.1 S4.A.2.1.4
2	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	Different kinds of matter exist in various states, depending on temperature. (PS1.A)	Plan and carry out investigations to test the idea that warming some materials causes them to change from solid to liquid and cooling causes them to change from liquid to solid. (2-PS1-1)	Investigations Liquid Solid	3.4.4A	3.2.1.A.1 3.2.1.A.3 3.2.2.A.3 3.2.3.A.3.	S4.C.1.1.1 S4.A.1.1 S4.1.3.1 S4.A.2.1.4
2	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	Matter can be described and classified by its observable properties. (PS1.B)	Plan and carry out investigations to test the idea that warming some materials causes them to change from solid to liquid and cooling causes them to change from liquid to	Liquid Solid	3.4.4A	3.2.1.A.3 3.2.1.A.4 3.2.K.A.1	S4.1.1.2 S4.A.1.1 S4.1.3.1 S4.A.2.1.4

				solid. (2PS1-4)				
2	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not. (PS1.B)	Construct an argument and provide evidence that some changes caused by heating or cooling can be reversed and some cannot. (2-PS1-4)	Argument Boiling Cause and effect Evidence Freezing Melting Reverse	3.4.4A	3.2.2.A.3 3.2.1.A.4	S4.C.1.1.1 S4.A.1.1 S4.1.3.1 S4.A.2.1.4
2	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	Different properties are suited for different purposes. (PS1.A)	Analyze data from testing objects made from different materials to determine if a proposed object functions as intended. (2-PS1-2)	Data Functions Test	3.4.4A		S4.C.1.1.2 S4.A.1.1 S4.1.3.1 S4.A.2.1.4
2	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	A great variety of objects can be built up from a small set of pieces. (PS1.A)	Design an object built from a small set of pieces to solve a problem and compare solutions designed by peers given the same set of pieces. (2-PS1-3)	Construct Design Engineer Problem solving Solutions	3.1.4 3.2.4C		S4.A.3.2.B S4.A.3.2 S4.A.1.1 S4.1.3.1 S4.A.2.1.4
2	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	A great variety of objects can be built up from a small set of pieces. (PS1.A)	Make observations of how an object made of small set of pieces can be disassembled and made into a new object. (2-PS1-3)	Construct Design Disassemble Engineer Problem solving Solutions	3.1.4 3.2.4C		S4.A.3.2.B S4.A.3.2 S4.A.1.1 S4.1.3.1 S4.A.2.1.4
2	Interactions between any two objects can cause changes in one or both.	How can one explain and predict interactions between objects within systems?	N/A	N/A	N/A	N/A	N/A	N/A
2	Interactions of objects or systems of objects can be	How is energy transferred and conserved?	N/A	N/A	N/A	N/A	N/A	N/A

	predicted and explained using the concept of energy transfer and conservation.							
2	Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of matter.	How are waves used to transfer energy and information?	N/A	N/A	N/A	N/A	N/A	N/A
Third Grade								
Grade	**Big Idea**	**Essential Questions**	**Concepts**	**Competencies**	**Vocabulary**	**2002 Standards**	**SAS Standards**	**Assessment Anchor Eligible Content**
3	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	N/A	N/A	N/A	N/A	N/A	N/A
3	Interactions between any two objects can cause changes in one or both.	How can one explain and predict interactions between objects within systems?	Each force acts on one particular object and has both strength and a direction. (PS2.A)	Investigate the variables that may affect how objects move across a floor, down a ramp, etc. (3-PS2-1)	Acceleration Force Speed Velocity	3.2.4.C 3.4.4.C	3.2.3.B1 3.2.3.B2 3.2.4.B1 3.2.4.B2 3.2.3.B6	S4.C.3.1
3	Interactions between any two objects can cause changes in one or both.	How can one explain and predict interactions between objects within systems?	An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. (PS2.A)	Construct an explanation for why an object subjected to multiple pushes and pulls might stay in one place or move. (3-PS2-1)	Systems	3.4.4.C	3.2.4.B1	S4.C.3.1
3	Interactions between any two objects can cause changes in one or both.	How can one explain and predict interactions between objects within systems?	Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (PS2.A)	Through the use of objects, design an investigation and demonstrate that forces can cause changes on an object's speed or direction of motion. (3-PS2-1)	Design Direction Investigation Motion Speed	3.4.4.C	3.2.3.B1	S4.A.2.1 S4.A.2.1.4 S4.A.2.2 S4.A.2.2.1 S4.C.3.1 S4.C3.1.1

3	Interactions between any two objects can cause changes in one or both.	How can one explain and predict interactions between objects within systems?	Patterns of an object's motion in various situations can be observed and measured. (PS2.A)	Take measurements of objects in motion and represent the movement of objects in multiple representations. (3-PS2-1)	Motion Net Zero Pattern Prediction	3.1.4.C 3.1.4.D 3.4.4.C	3.2.3.B1	S4.A.1.3 S4A.4. S4A.1.3.1 S4.C.3.1.3
3	Interactions between any two objects can cause changes in one or both.	How can one explain and predict interactions between objects within systems?	When past motion exhibits a regular pattern, future motion can be predicted from it. (PS2.A)	Investigate the motion of objects to determine observable and measurable patterns to predict future motions. (3-PS2-2)	Force Gravity Net force Pattern Predict	3.4.4.C 3.4.4.D	3.2.3.B1 3.2.4.B1	S4.C.3.1
3	Interactions between any two objects can cause changes in one or both.	How can one explain and predict interactions between objects within systems?	When past motion exhibits a regular pattern, future motion can be predicted from it. (PS2.A)	Provide evidence that a pattern can be used to predict future motion. (3-PS2-2)	Force Pattern	3.4.4.C 3.4.4.D	3.2.3.B1 3.2.4.B1	S4.C.3.1
3	Interactions between any two objects can cause changes in one or both.	How can one explain and predict interactions between objects within systems?	Objects in contact exert forces on each other. (PS2.B)	Design and implement an investigation to demonstrate that objects in contact exert forces on each other. (3-PS2-1)		3.4.4.C	3.2.3.B1	S4.A.2.1 S4.A.2.1.4 S4.A.2.2 S4.A.2.2.1 S4.C.3.1 S4.C3.1.1
3	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	N/A	N/A	N/A	N/A	N/A	N/A
3	Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of matter.	How are waves used to transfer energy and information?	N/A	N/A	N/A	N/A	N/A	N/A

Fourth Grade								
Grade	**Big Idea**	**Essential Questions**	**Concepts**	**Competencies**	**Vocabulary**	**2002 Standards**	**SAS Standards**	**Assessment Anchor Eligible Content**
4	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	N/A	N/A	N/A	N/A	N/A	N/A
4	Interactions between any two objects can cause changes in one or both.	How can one explain and predict interactions between objects within systems?	When objects touch or collide, they push on one another and can change motion or shape. Magnets create a magnetic field that can exert an attracting or repelling force on other objects that can affect motion. (PS2.B) (PS3.C)	Investigate the forces between two or more magnets to identify patterns. (3-PS2-4) (3-PS2-2)	Attract Collision Friction Gravity Magnets Repel	3.4.4 C	3.2.3.B1 3.2.3.B2 3.2.4.B1 3.2.4.B2 3.2.4.B4	S4.C.3.1
4	Interactions between any two objects can cause changes in one or both.	How can one explain and predict interactions between objects within systems?	Magnets create a magnetic field that can exert an attracting or repelling force on other objects that can affect motion. (PS2.B)	Investigate the push-and-pull forces between objects not in contact with one another. (3-PS2-3)	Attract Collision Magnets Repel	3.4.4.C	3.2.3.B1 3.2.3.B2 3.2.4.B1 3.2.4.B2 3.2.4.B4	S4.C.3.1
4	Interactions between any two objects can cause changes in one or both.	How can one explain and predict interactions between objects within systems?	When objects touch or collide, they push on one another and can change motion or shape. Magnets create a magnetic field that can exert an attracting or repelling force on other objects that can affect motion. (PS2.A)	Design and refine solutions to a problem by using magnets to move objects not in contact with one another. (3-PS2-3)	Attract Collision Magnets Repel	3.4.4 C	3.2.3.B1 3.2.3.B2 3.2.4.B1 3.2.4.B2 3.2.3.B6 3.2.4.B4	S4.C.3.1
4	Interactions between any two objects can cause	How can one explain and predict interactions between	Materials that allow electricity to flow are conductors; those	Investigate and describe conductors and insulators.	Conductor Electricity	3.4.4 B	3.2.4.B4	S4,C,1.1.1 S4.C.2.1.3

	changes in one or both.	objects within systems?	that do not are insulators. (PS3.A)	(4-PS3-1)	Insulator			
4	Interactions between any two objects can cause changes in one or both.	How can one explain and predict interactions between objects within systems?	Electrical circuits require a complete loop through which an electrical current can pass. (PS3.A)	Construct serial and parallel circuits and describe the path of electrons in the circuit. (4-PS3-1)	Parallel circuit Serial circuit System	3.4.4 B	3.2.4.B4	S4.C.2.1.3
4	Interactions between any two objects can cause changes in one or both.	How can one explain and predict interactions between objects within systems?	An open circuit is an incomplete electric pathway; a closed circuit is a complete pathway. (PS3.A)	Demonstrate and explain open and closed circuits utilizing switches. (4-PS3-1)	Closed circuit Open circuit Switch System	3.4.4 B	3.2.3.B4 3.2.4.B4	S4.C.2.1.3
4	Interactions between any two objects can cause changes in one or both.	How can one explain and predict interactions between objects within systems?	A core of iron or steel becomes an electromagnet when electricity flows through a coil of insulated wire surrounding it. (PS3.B) (PS2.B)	Construct an electromagnet and plan an investigation to determine how one can make the electromagnet stronger or weaker. (4-PS3-4) (3-PS2-3)	Current Electromagnet System	3.4.4 B	3.2.6.B4 3.2.4.B6 3.2.5.B3 3.2.5.B4	S4.A.2.1.3
4	Interactions between any two objects can cause changes in one or both.	How can one explain and predict interactions between objects within systems?	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. (PS3.B) (PS2.B)	Plan and carry out an investigation to determine factors that affect the strength of electric and magnetic forces. (4-PS3-4) (3-PS2-3)	Current Electromagnetic forces	3.4.7.B	3.2.5.B4 3.4.7.C 3.6.7.C	S4.A.2.1.3
4	Interactions between any two objects can cause changes in one or both.	How can one explain and predict interactions between objects within systems?	A system can appear to be unchanging when processes within the system are going on at opposite but equal rates (e.g., water behind a dam is at a constant height because	Construct an explanation using data why an object subjected to multiple pushes and pulls might stay in one place or move.	Pull Push Systems	3.1.7.A	3.2.4.B1	S4.C.3.1

			water is flowing in at the same rate that water is flowing out).					
4	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	Magnets can exert forces on other magnets or on materials, causing energy transfer between them (e.g., leading to changes in motion) even when the objects are not touching. (PS2.B)	Demonstrate the energy transfer between two objects using a magnet and another object. (3-PS2-3)	Energy Force Magnet Transfer	3.4.4 B 3.4.4 C	3.2.4.B2 3.2.5.B.4	S4.A.1.1 S4.1.3.1 S4.A.2.1.4
4	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	The faster a given object is moving, the more energy it possesses. (PS3.A)	Use evidence to construct an explanation for the relationship between speed, energy and motion. (4-PS3-2)	Energy Motion	3.4.4 B	3.2.3.B2	S4.C.2.1 S4.A.1.1 S4.1.3.1 S4.A.2.1.4
4	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (PS3.A)	Carry out investigations to provide evidence that energy is transferred from place to place by sound, light, heat, electric currents, interacting magnets, and moving or colliding objects. (4-PS3-2)	Collision Electric current Energy Heat Light Magnets Sound Transformation	3.4.4 B 3.4.4 C	3.2.4.B.2 3.2.3.B.2	S4.A.1.1 S4.1.3.1 S4.A.2.1.4
4	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (PS3.A)	Obtain and communicate information for how technology allows humans to concentrate, transport, and store energy for practical use. (4-PS3-4)	Electric current Energy Light Sound	3.4.4 B	3.2.3.B2 3.2.4.B.2	S4.C.2.1 S4.A.1.1 S4.1.3.1 S4.A.2.1.4
4	Interactions of objects or systems of objects can be	How is energy transferred and conserved?	Energy can be moved from place to place by moving	Design and construct a device that converts energy from one form to	Electric current Energy	3.4.4 B	3.2.3.B.2 3.2.4.B.2	S4.C.2.1 S4.A.1.1

	predicted and explained using the concept of energy transfer and conservation.		objects or through sound, light, or electric currents. (PS3.A)	another using given design criteria. (4-PS3-4)	Energy conversion Light Sound		3.2.5.B.2	S4.1.3.1 S4.A.2.1.4
4	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (PS3.B)	Design and test a solution to a problem that utilizes the transfer of electric energy in the solution using given design constraints. (4-PS3-4)	Electric current Energy Light Sound Transfer	3.4.4 B	3.2.3.B2	S4.C.2.1 S4.A.1.1 S4.1.3.1 S4.A.2.1.4
4	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. (ESS3.A)	Develop a model using examples to explain differences between renewable and non-renewable sources of energy. (4-ESS3-1)	Electric current Light Non-renewable energy Renewable energy Sound	3.4.4 B	3.2.3.B2	S4.C.2.1 S4.A.1.1 S4.1.3.1 S4.A.2.1.4
4	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (PS3.B)	Carry out investigations to provide evidence that energy is transferred from place to place by sound, light, heat, electric currents, interacting magnets, and moving or colliding objects. (4-PS3-4)	Collision Electric current Energy transfer Light Magnet Sound	3.4.4 B 3.4.4 C	3.2.4.B.2 3.2.5.B.4	S4.C.3.1 S4.A.1.1 S4.1.3.1 S4.A.2.1.4
4	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (PS3.B)	Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electrical currents. (4-PS3-2)	Electric current Energy transfer Light Sound	3.4.4 B	3.2.3.B2	S4.C.2.1 S4.A.1.1 S4.1.3.1 S4.A.2.1.4

4	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	Energy is present whenever there are moving objects, sound, light, or heat. (PS3.B)	Construct an explanation for the relationship between energy and motion. (4-PS3-2) (4-PS3-3)	Energy Light Sound	3.4.4 B	3.2.3.B2 3.2.4.B6	S4.C.2.1 S4.A.1.1 S4.1.3.1 S4.A.2.1.4
4	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air. As a result, the air gets heated and sound is produced. (PS3.C)	Construct an investigation to demonstrate the relationship between energy and motion. (4-PS3-3)	Collision Energy Energy transfer Heat Force Light Motion Sound	3.4.4 B 3.4.4.C	3.2.3.B2 3.2.4.B6	S4.C.2.1 S4.A.1.1 S4.1.3.1 S4.A.2.1.4
4	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	When objects collide, the contact forces transfer energy so as to change the motion of each object. (PS3.C)	Ask questions and predict outcomes about the changes in energy that occur when objects collide. (4-PS3-3)	Collision Energy Energy transfer Force Motion	3.4.4 B	3.2.4.B2	S4.C.3.1 S4.A.1.1 S4.1.3.1 S4.A.2.1.4
4	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	The expression “produce energy” typically refers to the conversion of stored energy into a desired form for practical use. It is important to be able to concentrate energy so that it is available for use where and when it is needed (e.g., batteries). (PS3.D)	Obtain and communicate information explaining how technology allows humans to concentrate, transport, and store energy for practical use. (4-PS3-4)	Battery Conversion Energy Production Stored Energy	3.4.4 B 3..8.4.A	3.2.12.B5	S4.C.2.1.1 S4.A.1.1 S4.1.3.1 S4.A.2.1.4
4	Waves are a repeating	How are waves used to	Waves are regular patterns of	Identify the patterns of waves by	Energy	3.4.4 B	3.2.4.B5	S4.A.1.1

	pattern of motion that transfers energy from place to place without overall displacement of matter.	transfer energy and information?	motion, and can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; it does not move horizontally. (PS4.A)	observing their motion in water. (4-PS4-1)	Information Motion Waves		3.2.4.B6	S4.1.3.1 S4.A.2.1.4
4	Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of matter.	How are waves used to transfer energy and information?	Waves are regular patterns of motion, and can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; it does not move horizontally. (PS4.A)	Provide evidence that waves transfer energy to objects as a wave passes. (4-PS4-1)	Energy transfer Information Motion Waves	3.4.4 B	3.2.4.B6	S4.A.1.1 S4.1.3.1 S4.A.2.1.4
4	Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of matter.	How are waves used to transfer energy and information?	Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; it does not move in the direction of the wave—observe, for example, a bobbing cork or seabird—except when the water meets the beach. (PS4.A)	Plan data collection methods and make observations to provide evidence that waves transfer energy to objects. (4-PS4-1)	Energy transfer Waves	3.4.4 B	3.2.4.B5 3.2.4.B6	S4.A.1.1 S4.1.3.1 S4.A.2.1.4
4	Waves are a repeating pattern of motion that transfers energy from	How are waves used to transfer energy and information?	Waves of the same type can differ in amplitude (height of the wave) and wavelength	Use a model to describe the amplitude and wavelength of waves. (4-PS4-1)	Amplitude Wavelength Waves	3.1.4.B 3.4.4 B	3.2.4.B5 3.2.4.B6	S4.A.1.1 S4.1.3.1 S4.A.2.1.4

	place to place without overall displacement of matter.		(spacing between wave peaks). (PS4.A)					
4	Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of matter.	How are waves used to transfer energy and information?	Earthquakes cause seismic waves, which are waves of motion in the Earth's crust.(PS4.A)	Describe how similar seismic waves are to other types of waves. (4-PS4-1)	Earthquake Seismic Waves	3.4.4 B	3.2.4.B5 3.2.4.B6	S4.A.1.1 S4.1.3.1 S4.A.2.1.4
4	Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of matter.	How are waves used to transfer energy and information?	An object can be seen when light reflected from its surface enters the eyes. (PS4.B)	Investigate and provide evidence that the color people see depends on the color of the available light sources as well as the properties of the surface of the object reflecting the light. (4-PS4-2)	Reflection Refraction	3.4.4 B	3.2.3.B5 3.2.4.B5	S4.A.1.1 S4.1.3.1 S4.A.2.1.4
4	Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of matter.	How are waves used to transfer energy and information?	The color people see depends on the color of the available light sources as well as the properties of the surface. (PS4.B)	Investigate and provide evidence that the color people see depends on the color of the available light sources as well as the properties of the surface of the object reflecting the light. (4-PS4-2)	Color Reflection	3.4.4 B	3.2.3.B5 3.2.4.B5	S4.A.1.1 S4.1.3.1 S4.A.2.1.4
4	Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of matter.	How are waves used to transfer energy and information?	Digitized information (e.g., the pixels of a picture) can be stored for future recovery or transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—	Obtain and communicate information about modern devices that are used to transmit and receive digital information. (4-PS4-3)	Decode Digitized information Encode Pixels Transmit	3.4.4 B	3.4.4.B1 3.4.4..B3	S4.A.1.1 S4.1.3.1 S4.A.2.1.4

			convert it from digitized form to voice—and vice versa. (PS4.C)					
Fifth Grade								
Grade	**Big Idea**	**Essential Questions**	**Concepts**	**Competencies**	**Vocabulary**	**2002 Standards**	**SAS Standards**	**Assessment Anchor Eligible Content**
5	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	When two or more different substances are mixed, a new substance with different properties may be formed. (PS1.B)	Plan and conduct an investigation to determine whether the mixing of two or more substances results in new substances (e.g., cooking, baking, burning, etc.). (5-PS1-4)	Chemical change vs. physical change Mass Temperature Volume	3.4.7.A 3.2.7.B	3.2.5.A6 3.2.3 A.4	S8.C.1.1.3 S8.A.1.3 S8.A.2.2 S8.A.2.1
5	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. (PS1.A)	Develop a model to describe that matter is made of particles too small to be seen. (5-PS1-1)	Condensation Evaporation Matter Particles	3.4.7.A 3.1.7.B 3.2.7.B	3.2.5.A6	S8.C.1.1.2 S8.A.1.3 S8.A.2.2 S8.A.2.1
5	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	Measurements of a variety of properties can be used to identify materials. (PS1.A)	Make observations and measurements to identify given materials based on their properties. ((5-PS1-3)	Hardness Mass Moh's scale Porosity Properties Solubility Streak tests Volume	3.4.7.A 3.1.7.C 3.2.7.B	3.2.5.A6	S8.C.1.1.2 S8.A.1.3 S8.A.2.2 S8.A.2.1
5	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	The amount of matter is conserved when it changes form. (PS1.A)	Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total mass of matter is conserved.	Conservation of mass	3.4.7.A 3.1.7.B 3.2.7.B	3.2.5.A6	S8.C.1.1.3 S8.A.1.3 S8.A.2.2 S8.A.2.1

				(5-PS1-2)				
5	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	When two or more different substances are mixed, a new substance with different properties may be formed; such occurrences depend on the substances and the temperature. (PS1.B)	Investigate the interaction of two or more substances to provide evidence that when different substances are mixed, one or more new substances with different properties may or may not be formed. (5-PS1-4)	Chemical change Mixtures vs. compounds	3.4.7.A	3.2.6.A4 3.2.7.A4	S8.C.1.1.1 S8.A.1.3 S8.A.2.2 S8.A.2.1 S8.C.1.1.2 S8.C.1.1.3
5	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	No matter what reaction or change in properties occurs, the total mass of the substances does not change. (PS1.B)	Plan and carry out investigations to determine the effect on the total mass of a substance when the substance changes shape, phase, and/or is dissolved. (5-PS1-2)	Chemical change Dissolve Physical changes	3.4.7.A 3.1.7.C 3.2.7.B	3.2.5.A6	S8.C.1.1.3 S8.A.1.3 S8.A.2.2 S8.A.2.1
5	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How can one explain and predict interactions between objects within systems?	*Gravitational force of Earth acting on another object near Earth's surface pulls that object toward the planet's center. (PS2.B) *Earth and Space Science	*Construct and support an argument that the gravitational force exerted by Earth on objects is directed down. (5-PS2-1) *Earth and Space Science	Gravitational force	3.4.7.C 3.4.7.D	3.3.6B1 3.3.7.B1	S8.C.3.1 S8.D.3.1 S8.D.3.1.1 S8.D.3.1.2
5	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	**Energy released from food was once energy from the sun that was captured by plants in the chemical process that forms plant matter. (PS3.D) **Life Science	**Use a model to describe that energy in animal's food was once energy from the sun. (5-PS3-1) **Life Science	Energy flow Flow chart Model Photosynthesis		4.1.7.C	S8.B.3.1.1 S8.B.3.1.2 S8.B.3.1.3 S8.C.2.1 S8.C.2.1.1 S8.C.2.2.1
5	Waves are a repeating pattern of motion that transfers energy from	How are waves used to transfer energy and information?	N/A	N/A	N/A	N/A	N/A	N/A

	place to place without overall displacement of matter.							
Middle School								
Grade	**Big Idea**	**Essential Questions**	**Concepts**	**Competencies**	**Vocabulary**	**2002 Standards**	**SAS Standards**	**Assessment Anchor Eligible Content**
6-8	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	Pure substances are made from a single type of atom or compound; each pure substance has characteristic physical and chemical properties that can be used to identify it.	Plan investigations to generate evidence supporting the claim that one pure substance can be distinguished from another based on given characteristic properties.	Boiling point Characteristic Conductivity Density Flammability Malleability Melting point Odor Properties Pure Substance Reactivity Solubility	3.2.10.B(2) 3.4.7.A (1) 3.4.7.A (2)	3.2.6.A2 3.2.6.A4 3.2.6.A5 3.2.7.A1	S8.C.1.1.1 S8.C.1.1.2 S8.A.1.3 S8.A.2.1 S8.A.2.2
6-8	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions 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.	Given certain conditions (ex. temperature, pressure, space available), select appropriate materials, based on their physical and/or chemical properties, to be used to solve a problem.	Chemical change (e.g., combustion, precipitation) Conditions (e.g., concentration, alloy, pH, pressure, catalysts) Physical change (e.g., phase change/change of state,	3.6.10.C (1) 3.6.10.C (3) 3.4.7.A (3)	3.2.3.A1 3.2.3.A4 3.2.4.A4 3.2.6.A5 3.2.7.A1	S8.A.1.3 S8.A.2.1 S8.A.2.2 S8.C.1.1.2

					solubility)			
6-8	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	The relationships of chemical properties of elements are represented in the repeating patterns within the periodic table.	Using what you know about the repeating pattern of chemical properties and atomic structure within the periodic table, predict the location of an unknown element based on its properties.		3.1.10.B (2) 3.4.10.A (2)	3.2.8.A2	S8.C.1.1.1 S8.A.3.3 S11.C.1.1.4
6-8	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	All substances are made of atoms, which combine with one another in various ways.	Compare and contrast models of simple molecules to those with extended structures.	Atoms Bonding Compounds Elements	3.1.10.B (1) 3.4.10.A (1) 3.4.10.A (6) 3.4.10.A (9)	3.2.7.A2 3.2.10.A2	S8.A.3.2 S8.C.1.1.1
6-8	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	The amount of matter is conserved regardless of what reaction or change in properties occurs, the total mass of the substances involved does not change.	Plan and carry out investigations to determine the effect on the total mass of a substance when the substance changes shape, phase, and/or is dissolved.	Chemical equation Conservation of mass Dissolve Mass Open vs. Closed Phase Change Physical Change Product Reactant System Yields (boiling, melting, freezing, sublimation)	3.4.7.A (4) 3.4.7.D 3.4.10.A (7) 3.2.10.B (2)	3.2.6.A3	S8.C.1.1.3 S8.A.1.3 S8.A.2.1 S8.A.2.2
6-8	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	When two or more different substances are mixed, a new substance with different properties may be formed;	Investigate the interaction of two or more substances to determine whether a new substance is formed when materials are mixed.	Chemical change Compounds Elements Endothermic	3.2.10.B (2) 3.4.7.A (2)	3.2.6.A4 3.2.7.A4	S8.C.1.1.1 S8.C.1.1.3 S8.A.1.3 S8.A.2.1

			such occurrences depend on the substances and conditions (e.g., temperature, pressure, pH, catalysts, etc.).		Exothermic Mixtures Precipitate Products Reactants			S8.A.2.2
6-8	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	In a chemical process, the atoms that make up the original substances (reactants) are regrouped, and these new substances (products) have different properties from those of the reactants.	Develop representations of reactants and products showing how atoms regroup during chemical reactions and have new properties.	Balancing equations Products Reactants Yields	3.1.7.B (2) 3.4.7.A (4)	3.2.7.A4	S8.A.3.2 S8.C.1.1.3
6-8	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	Using water as an example, explain the relationship between the physical properties of a substance and its molecular or atomic structure.	Compare and contrast the properties of water with other substances (freezing point, high specific heat, cohesion).	Cohesion Polarity Specific heat	3.4.10.A (5)	3.2.12.A1	S8.A.3.2 S8.C.1.1.2 S11.C.1.1.2 BIO.A.2.1.1
6-8	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	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.	Construct models comparing the arrangement and motion of molecules within solids, liquids and gases of the same substance.	Gas Liquid Kinetic vs. Potential energy Molecular motion Solid States of matter Temperature Thermal energy	3.1.7.B (2) 3.4.10.A (4)	3.2.6.A1 3.2.10.A3	S8.A.3.2 S8.C.1.1.2 S8.C.3.1.2
6-8	Matter can be understood	How can one explain the	The changes of state that	Interpret a heating curve to	Phase change	3.1.7.C (1)	3.2.4.A5	S8.C.1.1.2

	in terms of the types of atoms present and the interactions both between and within atoms.	structure, properties, and interactions of matter?	occur with variations in temperature or pressure can be described and predicted.	determine the temperature at which a substance is solid, liquid and/or gas.	(boiling, melting, freezing, sublimation) Pressure Temperature	3.4.10.A (4)	3.2.6.A1	S8.C.3.1.2 S8.A.1.1 S8.A.2.2 S8.A.2.1
6-8	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	Some chemical reactions release energy, others absorb energy.	Design, construct and carry out an experiment that either releases or absorbs energy by chemical processes.	Electrical Endothermic Exothermic Colorimetric Photometric	3.2.10.B (2) 3.4.10.B (3)	3.2.7.A3 3.2.8.A3	S8.A.1.3 S8.A.2.1 S8.A.2.2 S8.C.1.1.3 S8.C.2.1.3
6-8	Interactions between any two objects can cause changes in one or both of them. .	How can one explain and predict interactions between objects within systems?	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.	Plan and carry out investigations to illustrate the factors that affect the strength of electric and magnetic forces.	Current Electric charge Electromagnetic Forces Resistance	3.4.10.C (1) 3.2.10.B (2)	3.2.6.B4 3.2.10.B4	S8.A.1.3 S8.A.2.1 S8.A.2.2 S8.C.3.1.1
6-8	Interactions between any two objects can cause changes in one or both of them.	How can one explain and predict interactions between objects within systems?	Gravitational forces are always attractive. There is a gravitational force between all objects. This force is dependent upon mass and distance between the objects.	Develop a simple model using given data that represents the relationship of gravitational interactions (force, mass, distance) and the motion of objects in space.	Gravitation Gravitational forces Law of universal gravity Mass Weight	3.1.7.B (1) 3.4.7.D (4)	3.2.5.B1 3.2.6.B1 3.2.7.B1	S8.A.3.2 S8.C.3.1.1
6-8	Interactions between any two objects can cause changes in one or both of them.	How can one explain and predict interactions between objects within systems?	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,	Communicate qualitative observations and information graphically and mathematically to represent how an object's relative	Acceleration Balanced Displacement Distance	3.1.10.B (3) 3.4.7.C (1)	3.2.6.B1 3.2.5.B1 3.2.7.B1	S8.A.1.1 S8.C.3.1.1

			its motion will change.	position, velocity, and direction of motion are affected by forces acting on the object.	Force Motion graphs Net Force Newton's 1st Law Newton's 2nd Law Position Reference frame Speed Unbalanced Velocity			
6-8	Interactions between any two objects can cause changes in one or both of them.	How can one explain and predict interactions between objects within systems?	A pair of interacting objects apply equal and opposite forces on one another.	Design a qualitative solution to a problem involving the motion of colliding objects. (e.g. pool table, model car collision).	Acceleration Force Force pairs Mass Newton's 3rd Law	3.4.12.C (6)	3.2.5.B1 3.2.6.B1 3.2.7.B1	S8.C.3.1.1 S8.A.2.1 S8.A.2.2
6-8	Interactions between any two objects can cause changes in one or both of them.	How can one explain and predict interactions between objects within systems?	Explain that the mechanical advantages produced by simple machines helps to do work (physics) by either overcoming a force or changing the direction of the applied force.	Given a scenario involving simple machines, qualitatively compare the mechanical advantage of each. Based on this analysis, argue which machine is best for the task.	Distance Force Mechanical advantage Simple machines Work	3.4.4.C (11) 3.4.7.C (3) 3.4.10.C (2)		S8.A.1.1 S8.C.3.1.3
6-8	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	Energy is transferred from hotter regions or objects and into colder ones by the processes of conduction, convection, and radiation.	Use and/or construct models to communicate the means by which thermal energy is transferred during conduction, convection, and radiation.	Conduction Convection energy Insulator Radiation Transfer Thermal energy	3.4.4.B (1) 3.4.4.B (2) 3.4.4.B (5) 3.2.10.B (4) 3.6.10.C (5) 3.6.10.C (6) 3.6.10.C (7)	3.2.7.B3 3.2.6.B3 3.2.6.B6	S8.A.3.2 S8.C.2.1.2
6-8	Interactions of objects or	How is energy transferred and	Whenever a transformation of	Compare, evaluate, and design a	Energy transfer	3.4.7.B (3)	3.2.5.B3	S8.A.2.1

	systems of objects can be predicted and explained using the concept of energy transfer and conservation.	conserved?	energy occurs, some of the energy in the system appears as thermal energy.	device that improves thermal energy transfer, and defend the selection of materials chosen to construct the device.	Thermal energy Law of conservation of energy	3.6.10.C (5) 3.6.10.C (6) 3.6.10.C (7)	3.2.7.B6	S8.A.2.2 S8.C.2.1.3
6-8	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	The term “heat” as used in everyday language refers both to thermal motion (the motion of atoms or molecules within a substance) and electromagnetic radiation (particularly infrared and light).	Demonstrate different methods of heat transfer used in technological systems. Cite advantages and disadvantages of each method.	Atoms Conduction Convection Electromagnetic Radiation Heat Kinetic Molecules Potential Substance Temperature Thermal energy	3.4.10.B (4) 3.6.10.C (7)	3.2.5.B3 3.2.6.B3 3.2.8.B3	S8.A.3.1 S8.C.2.1.2
6-8	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	Temperature is a measure of the average kinetic energy of particles of matter.	Generate and defend a model that explains the Kinetic Theory.	Kinetic energy Temperature System Potential energy Total energy	3.4.10.B (3) 3.1.10.B (1)	3.2.8.B3	S8.A.3.2 S8.C.3.1.2
6-8	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	The amount of energy transfer needed to change the temperature of a sample depends on the nature of the matter, the size of the sample, and the environment.	Develop and conduct an experiment to rank the specific heat of various materials by comparing their rate of change in temperature.	Conduction Heat transfer Specific heat	3.2.10.B (2) 3.4.12.B (4)	3.2.6.B3 3.2.7.B3 3.2.7.B6	S8.A.1.3 S8.A.2.1 S8.A.2.2 S8.C.2.1.2
6-8	Waves are a repeating pattern of motion that transfers energy from	How are waves used to transfer energy and information?	A wave has a repeating pattern with a specific wavelength, frequency, and	Use a drawing or physical representation of wave properties to explain amplitude, frequency, and	Amplitude Compressions Crest	3.4.7.C (5) 3.1.7.D (1)	3.2.7.B5	S8.A.1.1

	place to place without overall displacement of matter.		amplitude.	wavelength of different waves in the electromagnetic spectrum.	Frequency Trough Rarefactions Wave Wave length			
6-8	Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of matter.	How are waves used to transfer energy and information?	A sound wave needs a medium through which it is transmitted.	Through the use of models, explain the transmission of sound waves through different mediums.	Longitudinal Medium Sound Wave Vacuum	3.2.10.B (2) 3.4.7.C (5)	3.2.5.B5	S8.A.3.2
6-8	Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of matter.	How are waves used to transfer energy and information?	When light shines on an object, it is reflected, absorbed, or transmitted through the object.	Construct explanations of how waves are reflected, absorbed or transmitted through an object.	Absorption Color Frequency Light Reflection Transmission	3.4.7.C (4) 3.4.7.C (5)	3.2.7.B5	S8.A.1.1
6-8	Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of matter.	How are waves used to transfer energy and information?	Many modern communication devices use digitized signals (sent as wave pulses) as a more reliable way to encode and transmit information.	Apply scientific knowledge to explain the application of waves in common communication designs.	Decode Encode Transmit Wave pulse	3.4.7.B (3) 3.4.7.C (5)	3.2.7.B5 3.2.8.B6	S8.A.1.3 S8.A.2.1 S8.A.2.2
High School								
Grade	**Big Idea**	**Essential Questions**	**Concepts**	**Competencies**	**Vocabulary**	**2002 Standards**	**SAS Standards**	**Assessment Anchor Eligible Content**
9-12	Matter can be understood in terms of the types of atoms present and the interactions both between	How can one explain the structure, properties, and interactions of matter?	Stable forms of matter are those in which the electric potential energy is minimized.	Construct models showing that stable forms of matter are those with minimum electrical field energy.	Coulomb's Law Geometries and orbital shapes	3.2.10B 3.4.10C	3.2.C.A1 3.2.C.A5 3.2.12.A2	CHEM.A.1.1.1 CHEM.A.2.2.4

	and within atoms.				Lewis dot structures Molecular Octet rule			
9-12	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	A stable molecule has lower energy, by an amount known as the binding energy, than the same set of atoms separated; this energy must be provided to break the bond.	Construct models showing that energy is needed to break bonds and overcome intermolecular forces and that energy is released when bonds form (Enthalpy, Lattice energy are beyond the Eligible Content).	Activation Binding Energy Bond Energy Endothermic Energy Enthalpy Exothermic Lattice energy Physical properties	3.2.10B 3.4.10A	3.2.1.C.A2 3.2.C.A1 3.2.10.A4 3.4.10.A	CHEM.A.1.1.4
9-12	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. The periodic table orders elements in increasing number of protons and places those with similar chemical properties in columns.	Use the atomic model and the periodic table to predict and explain trends in properties of elements.	Atomic radius Charge Chemical Configuration Effective nuclear charge Electron affinity Electronegativity Electrons Elements Energy Ionization Neutrons Nucleus Orbital diagram Particles Physical properties Protons Reactivity	3.1.10C 3.4.10A	3.2.10.A1 3.2.C.A1 3.2.C.A2	CHEM.A.2.1 CHEM.A.2.3

					Shielding effect Subatomic			
9-12	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, and surrounding electrons.	Develop a model showing the likely position of electrons as determined by the quantized energy levels of atoms.	Bohr Configuration Dalton Electronic Emission Energy levels Excited state Ground state Orbitals Quantized Sublevels Rutherford Spectra Thomson	3.4.1.10A	3.2.10.A1 3.2.C.A1 3.2.C.A2 3.2.10.A5 3.2.12.A2	CHEM.A.2.2 CHEM.A.2.2.1 CHEM.A.2.2.2 CHEM.A.2.2.3 CHEM.A.2.2.4
9-12	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	The solubility of solutions depends on their properties and other factors. e.g., dissolving, dissociating	Develop explanations and/or mathematical expressions comparing solutions made from ionic and covalent solutes and how various factors affect the solubility of these solutions	Colligative Heterogeneous Homogeneous “Like dissolves like” Molarity Percent by mass Percent by volume Polarity Properties Solubility Solute Solvent	3.4.12.A	3.2.C.A1 3.2.C.A2 3.2.C.A4 3.2.10.A2 3.2.10.A4 3.2.10.A5 3.2.12.A1	CHEM.A.1.2 CHEM.A.1.2.1 CHEM.A.1.2.2 CHEM.A.1.2.3 CHEM.A.1.2.4 CHEM.A.1.2.5
9 -12	Matter can be understood in terms of the types of atoms present and the interactions both between	How can one explain the structure, properties, and interactions of matter?	The fact that atoms are conserved, together with knowledge of chemical properties of the elements	Analyze and interpret data sets, using the mole concept, to mathematically determine amounts of representative particles in	Density Dimensional analysis Excess	3.4.12.A 3.1.12.D	3.2.C.A2 3.2.C.A4 3.2.10.A5	CHEM. B.1.1 CHEM.B.1.1.1 CHEM.B.1.2.1

	and within atoms.		involved, can be used to describe and predict chemical reactions and calculate quantities of reactants and products.	macroscopic, measureable quantities.	reactants Limiting reactants Molar mass Mole Percent yield Proportion/ratios Stoichiometric relationships			
9 -12	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	The mole, as a fundamental unit, is used to represent a specific quantity of atomic particles such as atoms, ions, formula units, and molecules.	Analyze and interpret data to apply the laws of definite proportions and multiple proportions, to determine empirical and molecular formulas of compounds, percent composition and mass of elements in a compound.	Avogadro's number Empirical Formula Law of definite proportions Law of multiple proportions Molar mass Molar volume Molecular Percent composition Ratio	3.4.10.A	3.2.C.A1 3.2.C.A2 3.2.C.A4 3.2.10.A5	CHEM.B.1.2 CHEM.B.1.2.3
9 -12	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	The kinetic molecular theory and Gas Laws are used to explain and predict the behavior of gases.	Utilize mathematical relationships to predict changes in the number of particles (moles), the temperature, the pressure, and the volume in a gaseous system (i.e., Boyle's Law, Charles' Law, Avogadro's Law, Dalton's Law of partial pressures, the combined gas law, and the ideal gas law).	Avogadro's law Boyle's law Charles's law Combined gas law Dalton's law of density Partial pressures Gay-Lussac's law Ideal Gas Law Molar mass Molar volume Pressure	3.4.10.A	3.2.10.A3 3.2.C.A3	CHEM.B.2.2.1 CHEM.B.2.2.2

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9-12	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	Properties of chemical compounds are related to electrostatic interaction between particles.	Use Lewis Structures and VSEPR to predict and explain charge distribution across a particle (atom, ion, molecule or formula unit)	Atoms Covalent bond Electronegativity scale Ions Ionic Bond Lattice / crystal structure Metallic Bonding Molecules Polarity VSEPR/shape	3.1.10B	3.2.10.A1 3.2.C.A5	CHEM.B.1.4 CHEM.B.1.4.1
9-12	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. Properties of chemical compounds are related to electrostatic interaction between particles.	Analyze and interpret data obtained from measuring the bulk properties of various substances to explain the relative strength of the interactions among particles in the substance.	Boiling point Bonding Dispersion Forces Freezing point Hydrogen Intermolecular “Like dissolves like” London Van der Waals Melting point Polarity Surface tension Vapor pressure	3.4.1.12.a 3.4.12.a	3.2.C.A1 3.2.C.A2 3.2.C.A4 3.2.10.A 3.2.10.A1 3.2.10.A4 3.2.10.A5 3.2.12.A1	CHEM.A.1.1 CHEM.A.1.2 CHEM.A.1.2.1 CHEM.A.1.2.2 CHEM.A.1.2.3 CHEM.A.1.2.4 CHEM.A.1.2.5
9-12	Matter can be understood in terms of the types of atoms present and the interactions both between	How can one explain the structure, properties, and interactions of matter?	Chemical processes, their rates, and energy changes can be understood in terms of the arrangement and energy	Use models to understand the effect of concentration, temperature, and surface area on frequency of collisions and subsequently rate.	Activation Bond energy Collision theory Energy	3.4.10A 3.4.12A	S11.C.1.1 3.2.C.A4	

	and within atoms.		of colliding particles and the subsequent rearrangements of atoms.	Describe the function of catalysts.	Reaction rate			
9-12	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.	Develop and use models to explain that atoms (and therefore mass) are conserved during a chemical reaction. Models can include computer models, ball and stick models, and drawings.	Balance Chemical properties Combustion Decomposition Double replacement Mole ratio Net ionic equations Physical properties Products Reactants Single replacement Synthesis redox (reduction and oxidation)	3.4.10A 3.4.12A 3.1.10B	3.2.10.A2 3.2.C.A2 3.2.10.A4 3.2.C.A4 3.2.C.B3	
9-12	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	In many situations, a dynamic and condition-dependent balance between the rates of a forward and the reverse reaction determines the concentration of reaction components.	Develop a model for chemical systems to support/predict changes in reaction conditions limited to simple equilibrium reactions.	Equilibrium Percent yield Le Chatelier's overlap Le Chatelier's principle	3.4.10A 3.4.12A	3.2.10.A4 3.2.C.A2 3.2.C.A4	
9-12	Matter can be understood in terms of the types of atoms present and the	How can one explain the structure, properties, and interactions of matter?	In many situations, a dynamic and condition-dependent balance between the rates of	Use system models (computers or drawings) to construct molecular-level explanations to predict the	Reaction Reverse	3.4.10A 3.1.10B	3.2.10.A4 3.2.C.A4 3.2.12.A5	

	interactions both between and within atoms.		a forward and the reverse reaction determines the concentration of reaction components.	behavior of systems where a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present.				
9-12	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	Nuclear processes, including fusion, fission, and radioactive decays involve changes in unstable nuclei The total number of neutrons plus protons does not change in any nuclear process.	Construct models to explain changes in nuclei during the processes of fission, fusion, and radioactive decay and the subatomic interactions that determine nuclear stability.	Alpha radiation Beta radiation Gamma radiation Nuclear fission Nuclear fusion Radioactivity Stable nuclei Unstable nuclei	3.4.12.A	3.2.12.A2 3.2.C.A3	
9-12	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the maximum ages of rocks and other materials from the isotope ratios present.	Analyze and interpret data sets to determine the maximum age of samples (rocks, organic material) using the mathematical model of radioactive decay.	Decay Half-Life Isotopes Radioactive	3.4.12.A	3.2.12.A2	
	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.	How can one explain the structure, properties, and interactions of matter?	Acids and bases are identified by their characteristics and interactions. pH scale is a log scale that reflects the concentration of protons in a solution.	Using models, differentiate between acid and bases and acid-base systems. Determine neutralization point of a reaction. Determine pH of a solution. Show understanding of log scale.	Acid Arrhenius Base Bronsted Lowry pH pH scale Proton Titration	3.4.12A	3.2.12.A	

9-12	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms	How can one explain the structure, properties, and interactions of matter?		Apply a systematic set of rules (IUPAC) for naming compounds and writing chemical formulas (e.g., binary covalent, binary ionic, ionic compounds containing polyatomic ions)	Nomenclature IUPAC	3.2.C.A2 3.2.C.A4 3.4.12A		
9-12	Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms	How can one explain the structure, properties, and interactions of matter?		Utilize significant figures to communicate the precision in a quantitative observation Accuracy discussion: Calculate error and percent error given experimental data and the accepted value.	Accuracy Error Figures Percent error Precision Significant	3.2.C.A3		
9-12	Interactions between any two objects can cause changes in one or both of them.	How can one explain and predict interactions between objects within systems?	The motion of an object is determined by the interactions between the object and any other objects in the system.	Construct an explanation for the motion of an object based on the interactions that occur between the object and other objects in the system.	Force System Velocity	3.4.10C	3.2.P.B1 3.2.P.B6 3.2.12.B6	
9-12	Interactions between any two objects can cause changes in one or both of them.	How can one explain and predict interactions between objects within systems?	Newton's Second Law provides a mathematical model that describes the relationship between the net force on an object, the mass of the object, and the acceleration of the object.	Plan and carry out investigations to show how the mathematical relationship of Newton's Second Law of motion accurately predicts the relationship between the net force on objects, their mass, and the resulting change in motion.	Acceleration Mass Net Force	3.2.10B 3.4.10C	3.2.P.B1 3.2.P.B6 3.2.12.B6	
9-12	Interactions between any two objects can cause changes in one or both of them.	How can one explain and predict interactions between objects within systems?	Newton's Law of Universal Gravitation provides a mathematical model that describes and predicts the effects of gravitational forces acting between masses.	Use mathematical representations of Newton's Law of Gravitation to describe and predict the gravitational forces between objects.	Gravitational forces Mathematical representation Newton's Law of Gravitation	3.4.10D	3.2.P.B1 3.2.P.B6 3.2.12.B6	

9-12	Interactions between any two objects can cause changes in one or both of them.	How can one explain and predict interactions between objects within systems?	Coulomb's Law provides a mathematical model that describes and predicts the effect of electrostatic forces acting between electrically charged objects.	Use mathematical representations of Coulomb's Law to describe and predict the electrostatic forces between objects.	Electrostatic force	3.4.10C	3.2.12.B4	
9-12	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	The energy an object has within a system depends on the object's motion and interactions with other objects in that system.	Construct an explanation for the energy of an object has in a system based on the object's motion and the object's interaction with other objects in the system.	Kinetic energy Mechanical energy Potential energy	3.4.10B	3.2.P.B2	
9-12	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	Any change in an object's energy is the result of interactions with other objects in a system or a transfer of energy between systems, changing in the total energy of the systems involved.	Develop and use a model to explain how an object's energy is transferred or transformed as objects interact within a system.	Energy transfer Model System	3.4.10B	3.2.P.B2 3.2.12.B6	
9-12	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	Any energy gain or loss in a system will result in a corresponding energy loss or gain in another system.	Identify problems and suggest design solutions to optimize the energy transfer between objects or systems of objects.	Design Energy transfer Solution System	3.2.12D 3.4.10B	3.2.P.B2 3.2.12.B6	
9-12	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	Mathematical expressions for the kinetic and potential energy of objects allow for the concept of the conservation of energy to be used to describe and predict the behavior of	Construct mathematical models to show how energy is transformed and transferred within a system.	Mathematical model Transfer Transform	3.4.10B	3.2.P.B2 3.2.12.B6	

			objects in a system.					
9-12	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	Mathematical expressions for the kinetic and potential energy of objects allow for the concept of the conservation of energy to be used to describe and predict the behavior of objects in a system.	Plan and carry out an investigation to provide evidence that energy is conserved in a system.	Conservation of energy Evidence Investigation	3.2.10B 3.4.10B	3.2.P.B2 3.2.12.B6	
9-12	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	The transfer of energy through interactions of objects or systems of objects cause a change in the momentum of objects or systems of objects.	Generate and analyze data to support the claim that the total momentum of a closed system of objects is conserved.	Elastic collision Impulse Inelastic collision Momentum	3.2.10B 3.4.10B	3.2.P.B2	
9-12	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	For any system of interacting objects, the total momentum within the system changes due to transfer of momentum or energy into or out of the system.	Use mathematical representations to support the claim that the total momentum of a system of objects is conserved through the transfer of momentum between objects when there is no net force on the system.	Claims Mathematical representation Momentum Net force System	3.4.10B	3.2.P.B2 3.2.12B2 3.2.12.B6	
9-12	Interactions of objects or systems of objects can be predicted and explained using the concept of energy transfer and conservation.	How is energy transferred and conserved?	For any system of interacting objects, the total momentum within the system changes due to transfer of momentum or energy into or out of the system.	Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.	Macroscopic object	3.2.12D 3.4.10B	3.2.P.B2 3.2.12B2 3.2.12.B6	
9-12	Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of	How are waves used to transfer energy and information?	The speed of a wave in any medium is the product of the wave's frequency and wavelength.	Analyze and interpret data to support the claim that the speed of a wave in a medium is the product of the wave's frequency and the wave's wavelength.	Medium Frequency Wave Wavelength	3.4.12C	3.2.P.B5	

	matter.							
9-12	Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of matter.	How are waves used to transfer energy and information?	Wave transmission, reflection, refraction, and/or absorption occurs when waves travel between two different mediums.	Construct explanations for the transmission, reflection, refraction and/or absorption of waves as they pass from one medium to another medium.	Absorption Reflection Refraction Transmission	3.4.12C	3.2.P.B5	
9-12	Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of matter.	How are waves used to transfer energy and information?	Wave transmission, reflection, refraction, and/or absorption occurs when waves travel between two different mediums.	Develop a claim and reasoning supported by evidence that describes the behavior of a wave as it passes from one medium to another medium.		3.4.12C	3.2.P.B5	
9-12	Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of matter.	How are waves used to transfer energy and information?	Objects have natural frequencies and when they are forced to vibrate at a natural frequency they resonate with large vibrations.	Construct an explanation for the application of resonance in everyday phenomena (e.g., waves in a stretched string, speech, the design of all musical instruments).	Resonance	3.4.10C		
9-12	Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of matter.	How are waves used to transfer energy and information?	As waves pass through each other they create new waves with characteristics that are derived from the characteristics of the original waves.	Investigate the patterns created when waves of different frequencies combine, and explain how these patterns are used to encode and transmit information	Constructive interference Destructive interference Encode Superposition	3.4.12C		
9-12	Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of matter.	How are waves used to transfer energy and information?	Electromagnetic waves are particle-like photons that travel through a vacuum at the speed of light and have an energy that is directly proportional to the frequency of the wave.	Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.	Electromagnetic wave Particle model Photon Wave model	3.4.12C 3.4.12D	3.2.P.B5	

9-12	Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of matter.	How are waves used to transfer energy and information?	Electromagnetic waves are particle-like photons that travel through a vacuum at the speed of light and have an energy that is directly proportional to the frequency of the wave.	Generate and analyze data to support the claim that the energy of an electromagnetic wave is directly proportional to the frequency of the wave.	Electromagnetic wave Frequency Proportional	3.2.10B 3.4.12C	3.2.P.B5	
~~**9-12**~~	Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of matter.	How are waves used to transfer energy and information?	Several useful technologies digitize information by producing, transmitting, and capturing pulses of electromagnetic waves.	Construct explanations for why the wavelength of an electromagnetic waves determines its use for certain applications.	Electromagnetic wave Pulses Wavelength	3.4.12C 3.4.12D 3.6.12B	3.2.P.B5 3.2.12.B5	
9-12	Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of matter.	How are waves used to transfer energy and information?	Several useful technologies digitize information by producing, transmitting, and capturing pulses of electromagnetic waves.	Obtain, evaluate, and communicate information regarding the advantages of using a digital transmission and storage of information.	Digital transmission Storage	3.4.10D 3.6.10B 3.7.10B	3.2.P.B5 3.2.12.B5	
9-12	Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of matter.	How are waves used to transfer energy and information?	Several useful technologies digitize information by producing, transmitting, and capturing pulses of electromagnetic waves.	Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.	Matter Technical information Wave behavior Wave interactions	3.4.12D 3.6.10B 3.7.10B	3.2.P.B5 3.2.12.B5	