Davison Community Schools
ADVISORY CURRICULUM COUNCIL
Phase II
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Physical Science 9 (DHS, DAE)

Course Essential Questions (from Phase I report):
How does matter and energy interact and affect the world we live in?

Phase II Curriculum
Unit 1: Scientific Method, Measurement, and Data Analysis

Essential Questions:

The Methods of Science
- What steps do scientists often use to solve problems?
- Why do scientists use variables?
- What is the difference between scientific law and scientific theory?

Standards of Measurement
- What is a standard of measurement?
- What multiple of ten does each SI prefix represent?
- What are the SI units for length, volume, mass, density, time, and temperature?
- How can related SI units be converted?

Communicating with Graphs
- What are the three types of graphs, and how are they used?
- How are dependent and independent variables expressed in a graph?
- How can you analyze data using the various types of graphs?

Technology
- What are the different types of technology?
- What is the importance of science in technology?

Essential Understanding:
- Science is a method of learning and communicating information about the natural world.
- Science methods form a creative and dynamic inquiry process that is validated by peer review and argumentation.
- Scientific investigations don't always proceed with identical steps but do contain similar methods.
- Standard measurement units, such as centimeters and second, are exact quantities used to compare measurements.
- Graphs are visual representations of numerical data.
- The results of science provide technologies that improve everyday life.

Curriculum Standards- DOK noted where applicable with Standards

P1.1A Generate new questions that can be investigated in the laboratory or field. (DOK 3)
P1.1B Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the challenges of controlling variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions. (DOK 3)
P1.1C Conduct scientific investigations using appropriate tools and techniques (e.g., selecting an instrument that measures the desired quantity length, volume, weight, time interval, temperature with the appropriate level of precision). (DOK 2)
P1.1D Identify patterns in data and relate them to theoretical models. (DOK 2)
P1.1E Describe a reason for a given conclusion using evidence from an investigation. (DOK 3)

P1.2A Critique whether or not specific questions can be answered through scientific investigations. (DOK 3)
P1.2B Identify and critique arguments about personal or societal issues based on scientific evidence. (DOK 3)
P1.2C Develop an understanding of a scientific concept by accessing information from multiple sources. Evaluate the scientific accuracy and significance of the information. (DOK 3)
P1.2D Evaluate scientific explanations in a peer review process or discussion format. (DOK 3)
P1.2E Evaluate the future career and occupational prospects of science fields. (DOK 2)

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
Vocab: - scientific method - organized set of investigation procedures that can include stating a problem, forming a hypothesis, researching and gathering information, testing a hypothesis, analyzing data, and drawing conclusions - hypothesis - educated guess using what you know and what you observe - experiment - organized procedure for testing a hypothesis; tests the effects of one thing on another under controlled conditions - variable - factor that can cause a change in the results of an experiment - dependent variable - factor that changes as a result of changes in other variables - independent variable - factor that, as it changes, affects the measure of another variable - constant - in an experiment, a variable that does not change when other variables change - control - standard used for comparison of test results in an experiment - bias - occurs when a scientist's expectations change how the results of an experiment are viewed - model - can be used to represent an idea, object, or event that is too big, too small, too complex, or too dangerous to observe or test directly. - theory- explanation of things or events that is based on knowledge gained from many observations and investigations - scientific law - statement about what happens in nature that seems to be true all the time; does not explain why or how something happens - technology- application of science to help people - standard - exact, agreed upon quantity used for comparison - SI - International System of Units - the improved, universally accepted version of the metric system that is based on multiples of ten and includes the meter (m), liter (L), and kilogram (kg) - volume - amount of space occupied by an object - mass - amount of matter in an object	I can: - Generate new questions that can be investigated in the laboratory or field. - Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error - Understand the challenges of controlling variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions. - Conduct scientific investigations using appropriate tools and techniques (e.g., selecting an instrument that measures the desired quantity length, volume, weight, time interval, temperature with the appropriate level of precision). - Identify patterns in data and relate them to theoretical models. - Describe a reason for a given conclusion using evidence from an investigation. - Critique whether or not specific questions can be answered through scientific investigations. - Identify and critique arguments about personal or societal issues based on scientific evidence. - Develop an understanding of a scientific concept by accessing information from multiple sources. - Evaluate the scientific accuracy and significance of the information. - Evaluate scientific explanations in a peer review process or discussion format. - Evaluate the future career and occupational prospects of science fields.

- density- mass per unit volume of a material - graph - visual display of information or data that can provide a quick way to communicate a lot of information and allow scientists to observe patterns - accuracy - the quality or state of being correct or precise. - precision - the quality, condition, or fact of being exact and accurate. Equations: Density D = m/v Graphs Line, Bar, and Pie	

Phase II Curriculum

Unit 2: Motion

Essential Questions:

Describing Motion

- Describe and represent various types of motion
- Describe the relationships between position and time using mathematical statements, graphs, and motion maps
- Identify different interactions that exist between objects using the concept of force.

Acceleration

- How acceleration, time, and velocity are related?
- Explain how positive and negative acceleration affect motion.
- How do you calculate the acceleration of an object?

Motion and Forces

- Explain how force and motion are related.
- Describe what inertia is and how it is related to Newton's first law of motion.
- Identify the forces and motion that are present during a car crash.

Essential Understanding:

- The motion of an object can be described by its position and velocity as functions of time and by its average speed and average acceleration during intervals of time.
- An object's position can be measured and graphed as a function of time. An object's speed can be calculated and graphed as a function of time.
- The change of speed and/or direction (acceleration) of an object is proportional to the net force and inversely proportional to the mass of the object. The acceleration and net force are always in the same direction.
- Forces have magnitude and direction. The net force on an object is the sum of all the forces acting on the object. Objects change their speed and/or direction only when a net force is applied. If the net force on an object is zero, there is no change in motion (Newton's First Law).
- There are four basic forces (gravitational, electromagnetic, strong, and weak nuclear) that differ greatly in magnitude and range.
- Between any two charged particles, electric force is vastly greater than the gravitational force.
- Most observable forces (e.g., those exerted by a coiled spring or friction) may be traced to electric forces acting between atoms and molecules.

Curriculum Standards- DOK noted where applicable with Standards

P 2.1D Describe and analyze the motion that a position-time graph represents, given the graph. (DOK 2)
P 2.1A Calculate the average speed of an object using the change of position and elapsed time. (DOK 1)
P 2.1C Create line graphs using measured values of position and elapsed time. (DOK 2)
P 2.2C Describe and analyze the motion that a velocity-time graph represents, given the graph. (DOK 2)
P 2.2B Use the change of speed and elapsed time to calculate the average acceleration for linear motion. (DOK 1)
P 3.4B Identify forces acting on objects moving with constant velocity (e.g., cars on a highway). (DOK 1)
P3.1A Identify the force(s) acting between objects in "direct contact" or at a distance. (DOK 1)
P3.2A Identify the magnitude and direction of everyday forces (e.g., wind, tension in ropes, pushes and pulls, weight). (DOK 1)
P3.4A Predict the change in motion of an object acted on by several forces. (DOK 2)

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
Vocab: - distance - how far an object moves - displacement - distance and direction of an object's change in position from the starting point - speed - distance and object travels per unit of time - average speed - total distance an object travels divided by the total time it takes to travel that distance - instantaneous speed - speed of an object at a given point in time; is constant for an object moving with constant speed, and changes with time for an object that is slowing down or speeding up - velocity - speed and direction of a moving object - acceleration - rate of change of velocity; can be calculated by dividing the change in velocity by the time it takes the change to occur - rotation - the action of rotating around an axis or center - revolution - move in a circle on a central axis - periodic motion - a recurrent motion in which the intervals of time required to complete each cycle are equal Equations: speed: $s = d/t$ velocity: $v = d/t$ acceleration: $a = (v_f - v_i)/t$ Graphs: distance vs. time velocity vs. time	● Calculate the change in position of an object. ● Calculate the average velocity of an object using change in position and elapsed time. ● Calculate the average speed of an object using distance traveled and elapsed time. ● Explain the difference between average speed and average velocity. ● Create line graphs using measured values of position and elapsed time. ● Describe the motion of an object that a position-time graph represents, given the graph. ● Given a position-time graph, analyze the motion of an object in terms of position, velocity, and acceleration. ● Define what is meant by a vector and scalar quantity. ● Identify distance, displacement, speed, velocity and acceleration as either vector or scalar quantity. ● Compare and contrast distance and displacement. ● Use change of velocity and elapsed time to calculate average acceleration for the linear motion of an object. ● Describe the motion of an object that a velocity-time graph represents, given the graph. ● Given the velocity-time graph, analyze the motion of an object in terms of displacement, velocity, and acceleration. ● Identify the force(s) acting between objects in "direct contact". ● Identify the force(s) acting between objects at a distance. ● Identify the magnitude of everyday forces. ● Identify the direction of everyday forces. ● Predict the change in motion of an object acted on by several forces. ● Identify forces acting on objects moving with constant velocity

Phase II Curriculum

Unit 3: Forces

Essential Questions:	**Essential Understanding:**
Newton's Second Law ● What is Newton's Second Law of Motion? ● Apply Newton's Second Law of Motion. ● What are the three different types of friction. ● How does air resistance affect falling objects? **Gravity** ● What is a gravitational force? ● What is the difference between mass and weight? ● Why do thrown objects follow a curved path? ● What is the difference between circular motion and straight line motion. **Newton's Third Law** ● What is Newton's Third Law of Motion? ● What are action and reaction forces? ● How do you calculate momentum? ● When is momentum conserved?	● Newton's Laws of Motion connect the change in an objects motion with the forces acting on it. ● The acceleration of an object equals the net force divided by the mass. ● Gravity is an attractive force that any two objects with mass exert on each other. ● Forces between two objects are always exerted in pairs.

Curriculum Standards- DOK noted where applicable with Standards

P2.1E Describe and classify various motions in a plane as one dimensional, two dimensional, circular, or periodic. (DOK 2)
P2.1F Distinguish between rotation and revolution and describe and contrast the two speeds of an object like the Earth. (DOK 2)
P3.1A Identify the force(s) acting between objects in "direct contact" or at a distance. (DOK 1)
P3.2A Identify the magnitude and direction of everyday forces (e.g., wind, tension in ropes, pushes and pulls, weight). (DOK 1)
P3.2C Calculate the net force acting on an object. (DOK 1)
P3.3A Identify the action and reaction force from examples of forces in everyday situations (e.g., book on a table, walking across the floor, pushing open a door). (DOK 1)
P3.4A Predict the change in motion of an object acted on by several forces. (DOK21)
P3.4C Solve problems involving force, mass, and acceleration in linear motion (Newton's second law). (DOK 1)
P3.4D Identify the force(s) acting on objects moving with uniform circular motion (e.g., a car on a circular track, satellites in orbit). (DOK 1)
P3.6A Explain earth-moon interactions (orbital motion) in terms of forces. (DOK 1)
P3.6B Predict how the gravitational force between objects changes when the distance between them changes. (DOK 1)
P3.6C Explain how your weight on Earth could be different from your weight on another planet. (DOK 1)

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
<u>Vocab:</u>	● I can:

- Newton's First Law - states that a body at rest will remain at rest, and a body in motion will remain in motion with a constant velocity, unless acted upon by a force (law of inertia)
- Newton's Second Law - states that the acceleration of an object is in the same direction as the net force on the object, and that the acceleration equals the net force divided by the mass
- Newton's Third Law - states that when one object exerts a force on a second object, the second object exerts a force on the first object that is equal in strength but opposite in direction
- friction - force that opposes the sliding motion between two touching surfaces
- static friction - frictional force that prevents two surfaces from sliding past each other
- sliding friction - frictional force that opposes the motion of two surfaces sliding past each other
- air resistance - force that opposes the motion of objects that move through the air
- force - a push or pull exerted on an object
- net force - sum of the forces that are acting on an object
- gravity - attractive force between two objects that depend on the masses of the objects and the distance between them
- weight - gravitational force exerted on an object
- centripetal acceleration - acceleration of an object toward the center of a curved or circular path
- centripetal force - a net force that is directed toward the center of a curved or circular path
- horizontal - parallel to the plane of the horizon
- vertical - an upright structure
- momentum - property of a moving object that equals its mass times its velocity
- velocity - the speed and direction of a moving object
- Newton - SI unit for force

Equations:

acceleration: $a = F_{net}/m$

weight: $w = gm$

momentum: $p = mv$

universal gravity: $F= G(m_1m_2)/d$

- - Identify the force(s) acting between objects in "direct contact" or at a distance.
- - Identify the magnitude and direction of everyday forces.
- - Calculate the net force acting on an object.
- - Identify the action and reaction force from examples of forces in everyday situations.
- - Predict the change in motion of an object acted on by several forces.
- - Identify forces acting on objects moving with constant velocity.
- - Solve problems involving force, mass, and acceleration in linear motion.
- - Identify the force(s) acting on objects moving with uniform circular motion.
- - Apply conservation of momentum to solve simple collision problems.
- - Explain earth-moon interactions (orbital motion) in terms of forces.
- - Predict how the gravitational force between objects changes when the distance between them changes.
- - Explain how your weight on Earth could be different from your weight on another planet.
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Phase II Curriculum

Unit 4: Energy and Work

Essential Questions:	**Essential Understanding:**
The Nature of Energy ● What is the difference between kinetic and potential energy? ● How do you calculate kinetic energy? ● What are some different forms of potential energy? ● How do you calculate gravitational potential energy? **Conservation of Energy** ● Describe how energy can be transformed from one form to another. ● How is mechanical energy related to kinetic and potential energy? ● Why is mechanical energy not always conserved ● What is the law of conservation of energy? **Work and Power** ● How are power and energy related? ● What is work? ● How do you calculate work? ● How do you calculate power?	Energy: ● Every change that occurs requires energy ● There are different forms of energy, including potential energy and kinetic energy ● Energy cannot be created or destroyed, but only can change from one form to another ● Distinguish between kinetic and potential energy ● Calculate kinetic energy ● Describe different forms of potential energy ● Describe how energy can be transformed from one form to another ● Explain how the mechanical energy of a system is the sum of the kinetic and potential energy ● Law of Conservation of Energy Work: ● Work is done when a force causes something to move. ● Explain the meaning of work ● Describe how work and energy are related ● Calculate work ● Calculate power.

Curriculum Standards- DOK noted where applicable with Standards

P3.2B Compare work done in different situations. (DOK 2)
P4.1A Account for and represent energy into and out of systems using energy transfer diagrams. (DOK 2)
P4.2A Account for and represent energy transfer and transformation in complex processes (interactions). (DOK 2)
P4.2B Name devices that transform specific types of energy into other types (e.g., a device that transforms electricity into motion). (DOK 1)
P4.2C Explain how energy is conserved in common systems (e.g., light incident on a transparent material, light incident on a leaf, mechanical energy in a collision). (DOK 1)
P4.2D Explain why all the stored energy in gasoline does not transform to mechanical energy of a vehicle. (DOK 1)
P4.3A Identify the form of energy in given situations (e.g., moving objects, stretched springs, rocks on cliffs, energy in food). (DOK 1)
P4.3B Describe the transformation between potential and kinetic energy in simple mechanical systems (e.g., pendulums, roller coasters, ski lifts). (DOK 1)
P4.3C Explain why all mechanical systems require an external energy source to maintain their motion. (DOK 1)
P4.5A Identify everyday examples of energy transfer by waves and their sources. (DOK 1)
P4.10B Identify common household devices that transform electrical energy to other forms of energy, and describe the type of energy transformation. (DOK 1)

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
Vocab: - kinetic energy - energy a moving object has because of its motion; depends on the mass and speed of the object - joule - SI unit for energy - potential energy - stored energy of an object - elastic potential energy - energy stored when an object is compressed or stretched - chemical potential energy - energy stored in chemical bonds - gravitational potential energy - energy stored by objects due to their position above Earth's surface; depends on the distance above Earth's surface and the objects mass - mechanical energy - sum of the potential and kinetic energy of a system - law of conservation of energy - states that energy can never be created nor destroyed - energy - power derived from the utilization of physical or chemical resources - work - transfer of energy that occurs when a force makes an object move; measured in joules (J) - power - amount of work done, or the amount of energy transferred, divided by the time required to do the work or transfer the energy; measured in watts (W) Equations: kinetic energy: $KE = \frac{1}{2} mv^2$ gravitational energy: $GPE = mgh$ work: $W = Fd$ power: $P = W/t$ and $P = E/t$	I can: - Account for and represent energy into and out of systems using energy transfer diagrams. - Explain instances of energy transfer by waves and objects in everyday activities - Explain why work has a more precise scientific meaning than the meaning of work in everyday language. - Calculate the amount of work done on an object that is moved from one position to another. - Using the formula for work, derive a formula for change in potential energy of an object lifted a distance h. - Account for and represent energy transfer and transformation in complex processes. - Name devices that transform specific types of energy into other types - Explain how energy is conserved in common systems - Explain why all the stored energy in gasoline does not transform to mechanical energy of a vehicle. - Identify the form of energy in given situations - Describe the transformation between potential and kinetic energy in simple mechanical systems - Explain why all mechanical systems require an external energy source to maintain their motion. - Rank the amount of kinetic energy from highest to lowest of everyday examples of moving objects. - Calculate the changes in kinetic and potential energy in simple mechanical systems using the formulas for kinetic energy and potential energy. - Calculate the impact speed of an object dropped from a specific height or the maximum height reached by an object, given the initial vertical velocity.

Phase II Curriculum

Unit 5: Thermal Energy

Essential Questions:	**Essential Understanding:**
Temperature and Heat ● What is temperature? ● How are thermal energy and temperature related? ● What is the difference between thermal energy and heat? **Transferring Thermal Energy** ● How do you calculate changed in thermal energy? ● What are conduction, convection, and radiation? ● How do thermal conductors differ from thermal insulators? ● How are thermal insulators used to control the transfer of thermal energy? **Using Heat** ● What are some common types of heating systems? ● What are the first and second laws of thermodynamics?	● Thermal energy flows from an area of higher temperature to an area of lower temperature ● Atoms and molecules that make up matter are in continual random motion ● Explain how thermal energy depends on temperature ● Explain how thermal energy and energy are related ● There are three ways thermal energy is transferred: conduction, convection, radiation ● Thermal energy can be made useful by controlling its production and movement ● Describe common types of heating systems

Curriculum Standards- DOK noted where applicable with Standards

P4.1B Explain instances of energy transfer by waves and objects in everyday activities (e.g., why the ground gets warm during the day, how you hear a distant sound, why it hurts when you are hit by a baseball). (DOK 1)
P4.2D Explain why all the stored energy in gasoline does not transform to mechanical energy of a vehicle. (DOK 1)
P4.3C Explain why all mechanical systems require an external energy source to maintain their motion. (DOK 1)
P4.12C Explain how stars, including our Sun, produce huge amounts of energy (e.g., visible, infrared, or ultraviolet light). (DOK 1)
C2.2A Describe conduction in terms of molecules bumping into each other to transfer energy. Explain why there is better conduction in solids and liquids than gases. (DOK 2)
C3.3A Describe how heat is conducted in a solid. (DOK 1)
C3.3B Describe melting on a molecular level. (DOK 1)
C5.4A Compare the energy required to raise the temperature of one gram of aluminum and one gram of water the same number of degrees. (DOK 2)

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
Vocab: - temperature - measure of the average kinetic energy of all the particles in an object	I can: ● Define temperature in terms of kinetic energy

- thermal energy - sum of the kinetic and potential energy of the particles in an object; is transferred by conduction, convection, and radiation - heat - thermal energy that flows from a warmer material to a cooler material - specific heat - amount of thermal energy needed to raise the temperature of 1 kg of an object 1 degree Celsius - convection - transfer of thermal energy in a fluid by the movement of warmer and cooler fluid from one place to another - conduction - transfer of thermal energy by collisions between particles in matter at a higher temperature and particles in matter at a lower temperature - radiation - transfer of thermal energy by electromagnetic waves - insulator - material in which heat flows slowly - thermodynamics - study of the relationship between thermal energy, heat, and work - first law of thermodynamics - states that the increase in thermal energy of a system equals the work done on the system plus the heat added to the system - second law of thermodynamics - states that it is impossible for heat to flow from a cool object to a warmer object unless work is done Equations: Change in Thermal Energy: $Q = m(T_f - T_i)C$	● Explain how thermal energy depends on temperature ● Explain how thermal energy and heat are related ● Calculate the change in thermal energy ● Understand the concept of specific heat ● Compare and contrast the transfer of thermal energy by conduction, convection, and radiation ● Explain how insulators are used to control the transfer of thermal energy ● Describe the first and second law of thermodynamics ● Describe how heat is conducted in a solid. ● Describe melting on a molecular level.

Phase II Curriculum

Unit 6: Electricity

Essential Questions:	**Essential Understanding:**
Electric Charge ● How can an object become electrically charged? **Electric Current** ● When and how does a voltage difference produce an electric current? ● How do batteries produce a voltage difference in a circuit? **Electric Power** ● How can you calculate electric power? ● How do series circuits differ from parallel circuits?	● The flow of electric charges in a circuit is a source of electrical energy. ● Like electrical charges attract each other and unlike charges repel ● Electrical energy can be converted into other forms of energy in a circuit ● A voltage difference causes electrons to flow in a circuit.

Curriculum Standards- DOK noted where applicable with Standards

P1.2E Evaluate the future career and occupational prospects of science fields. (DOK 2)
P3.7A Predict how the electric force between charged objects varies when the distance between them and/or the magnitude of charges change. (DOK 1)
P3.7B Explain why acquiring a large excess static charge (e.g., pulling off a wool cap, touching a Van de Graff generator, combing) affects your hair. (DOK 1)
P4.10A Describe the energy transformations when electrical energy is produced and transferred to homes and businesses. (DOK 1)
P4.10B Identify common household devices that transform electrical energy to other forms of energy, and describe the type of energy transformation. (DOK 1)
P4.10C Given diagrams of many different possible connections of electric circuit elements, identify complete circuits, open circuits, and short circuits and explain the reasons for the classification. (DOK 2)
P4.10D Discriminate between voltage, resistance, and current as they apply to an electric circuit. (DOK21)

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
Vocab: magnetism - the properties and interactions of magnets. magnetic field - surrounds a magnet and exerts a force on other magnets and objects made of magnetic material. magnetic pole - region on a magnet where the magnetic force exerted by a magnet is strongest; like poles repel and opposite poles attract. electric field - surrounds any charged particle and	I can: - Describe the energy transformations when electrical energy is produced and transferred to homes and businesses. - Identify common household devices that transform electrical energy to other forms of energy, and describe the type of energy transformation. - Given diagrams of many different possible connections of electric circuit elements, identify complete circuits, open circuits, and short circuits

exerts a force on other charged particle. static electricity- the accumulation of excess electric charge on an object. law of conservation of charge - states that charge can be transferred from one object to another but cannot be created or destroyed. conductor - material, such as copper wire, in which electrons can move easily. insulator - material in which electrons are not able to move easily. charging by contact - process of transferring charge between objects by touching or rubbing. charging by induction - process of rearranging electrons on a neutral object by bringing a charged object near to it. Equations: current: I = V/R electrical power P = IV electrical energy E = Pt	and explain the reasons for the classification. - Discriminate between voltage, resistance, and current as they apply to an electric circuit.

Phase II Curriculum

Unit 7: Waves and Sound

Essential Questions:

The Nature of Waves

- How do waves transfer energy?
- What are mechanical waves?
- How do transverse waves differ from longitudinal waves?

Wave Properties

- How are wavelength and period related?
- What is the relationship between frequency and wavelength?
- How do you calculate the speed of a wave?

The Behavior of Waves

- What is the law of reflection?
- Why do waves change direction when they travel from one material to another?
- How are refraction and diffraction similar and different?
- What happens when waves interfere with each other?

The Nature of Sound

- How does sound travel through different mediums?
- What affects the speed of sound?
- How does your ear enable you to hear?

Properties of Sound

- How are amplitude, intensity, and loudness related?
- How is sound intensity measured?
- What is the relationship between frequency and pitch?
- What is the Doppler Effect?

Essential Understanding:

- Waves transfer energy from place to place without transferring matter.
- Waves move through matter as energy is transferred from particle to particle.
- Wave properties depend on the vibrations of the wave source and the material in which the wave moves.
- Waves can change direction when they interact with matter.
- Sound waves are compressional waves produced by something that vibrates.
- Sound waves are compressional wave that can only travel through matter
- The loudness of a sound depends on its intensity and its pitch depends on its frequency
- Sound waves are used to locate objects from images, and to treat medical problems

Curriculum Standards- DOK noted where applicable with Standards

P1.2E Evaluate the future career and occupational prospects of science fields.(DOK 2)
P4.4A Describe specific mechanical waves (e.g., on a demonstration spring, on the ocean) in terms of wavelength, amplitude, frequency, and speed. (DOK 1)
P4.4B Identify everyday examples of transverse and compression (longitudinal) waves.(DOK 1)
P4.4C Compare and contrast transverse and compression (longitudinal) waves in terms of wavelength, amplitude, and frequency. (DOK 2)
P4.5A Identify everyday examples of energy transfer by waves and their sources. (DOK 1)
P4.5B Explain why an object (e.g., fishing bobber) does not move forward as a wave passes under it.(DOK 1)
P4.5C Provide evidence to support the claim that sound is energy transferred by a wave, not energy transferred by particles. (DOK 2)
P4.5D Explain how waves propagate from vibrating sources and why the intensity decreases with the square of the distance from a point source.(DOK 2)

P4.5E Explain why everyone in a classroom can hear one person speaking, but why an amplification system is often used in the rear of a large concert auditorium. (DOK 1)
P4.6B Explain why radio waves can travel through space, but sound waves cannot.(DOK 1)
P4.6D Explain why we see a distant event before we hear it (e.g., lightning before thunder, exploding fireworks before the boom). (DOK 1)
P4.8A Draw ray diagrams to indicate how light reflects off objects or refracts into transparent media.(DOK 1)
P4.8B Predict the path of reflected light from flat, curved, or rough surfaces (e.g., flat and curved mirrors, painted walls, paper). (DOK 1)
P4.9A Identify the principle involved when you see a transparent object (e.g., straw, a piece of glass) in a clear liquid. (DOK 1)

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
Vocab: wave - a repeating disturbance or movement that transfers energy through matter or space. medium - matter in which a wave travels transverse wave compressional wave - a wave for which the matter in the medium moves back and forth along the direction that the wave travels. crest - the highest point on a transverse wave. trough - the lowest point on a transverse wave. rarefaction - the least dense region of a compressional wave. wavelength - distance between one point on a wave and the nearest point just like it. frequency - the number of wavelengths that pass a fixed point each second; is expressed in hertz (HZ). period - the amount of time it takes one wavelength to pass a fixed point; is expressed in seconds. amplitude - a measure of the energy carried by the wave. refraction - the bending of a wave as it changes speed in moving from one medium to another. diffraction - the bending of a wave around an obstacle; can also occur when waves pass through a narrow opening. interference - occurs when two or more waves overlap and combine to form a new wave. standing wave - a wave pattern that forms when waves of equal wavelength and amplitude, but traveling in opposite directions, continuously interfere with each other, has points called nodes that do not move. resonance - the process by which an object is made to vibrate by absorbing energy at its natural frequency. hertz - the measure of frequency.	I can: - Account for and represent energy into and out of systems using energy transfer diagrams. - Explain instances of energy transfer by waves and objects in everyday activities. - Describe specific mechanical waves. - Identify everyday examples of transverse and compression (longitudinal) waves. - Compare and contrast transverse and compression (longitudinal) waves in terms of wavelength, amplitude, and frequency. - Demonstrate that frequency and wavelength of a wave are inversely proportional in a given medium. - Identify everyday examples of energy transfer by waves and their sources. - Explain why an object (e.g., fishing bobber) does not move forward as a wave passes under it. - Provide evidence to support the claim that sound is energy transferred by a wave, not energy transferred by particles. - Explain how waves propagate from vibrating sources and why the intensity decreases with the square of the distance from a point source. - Explain why everyone in a classroom can hear one person speaking, but why an amplification system is often used in the rear of a large concert auditorium. - Describe how two wave pulses propagated from opposite ends of a demonstration spring interact as they meet. - List and analyze everyday examples that demonstrate the interference characteristics of waves. - Explain how sounds travels through different mediums - Identify what influences the speed of sound - Recognize how amplitude, intensity and loudness are related

Equations: wave speed: $v = f\lambda$	

Phase II Curriculum
Unit 8: Electromagnetic Waves, Light, Lenses, and Mirrors

Essential Questions:	**Essential Understanding:**
Electromagnetic Waves ● How does a vibrating electric charge produce an electromagnetic wave? ● What properties describe electromagnetic waves? ● How do electromagnetic waves transfer energy? **The Electromagnetic Spectrum** ● What are the main divisions of the electromagnetic spectrum? ● What are the properties of each type of electromagnetic wave? ● What are some common uses of each type of electromagnetic wave? **The Behavior of Light** ● How are transparent, translucent and opaque materials different? ● What is the difference between regular and diffuse reflection? ● What is the index of refraction of a material? **Light and Color** ● Why does a prism separate white light into different colors? ● How do you see color? **Mirrors** ● How do different types of mirrors form images? ● What are real images and virtual images? ● What are some examples of plane, convex, concave mirrors? **Lenses** ● In what ways do convex lenses and concave lenses bend light rays? ● What types of images do convex lenses and concave lenses form?	● Electromagnetic waves are transverse waves that can be produced by vibrating electric charges ● Each type of electromagnetic wave has a certain range of frequencies and wavelengths ● Signals and information can be transmitted using radio waves. ● All objects/materials radiate electromagnetic waves ● Light waves change direction when they are reflected or change speed ● Light waves of different wavelengths or combinations of wavelengths cause the human eye to detect different colors ● Light rays can change direction when they are reflected by a mirror ● Light rays are bent when they pass through a lens

Curriculum Standards- DOK noted where applicable with Standards

P1.2E Evaluate the future career and occupational prospects of science fields.(DOK 2)
P4.4A Describe specific mechanical waves (e.g., on a demonstration spring, on the ocean) in terms of wavelength, amplitude, frequency, and speed. (DOK 1)
P4.6A Identify the different regions on the electromagnetic spectrum and compare them in terms of wavelength,

frequency, and energy. (DOK 2)
P4.6B Explain why radio waves can travel through space, but sound waves cannot.(DOK 1)
P4.6C Explain why there is a time delay between the time we send a radio message to astronauts on the moon and when they receive it. (DOK 1)
P4.6D Explain why we see a distant event before we hear it (e.g., lightning before thunder, exploding fireworks before the boom). (DOK 1)
P4.8A Draw ray diagrams to indicate how light reflects off objects or refracts into transparent media.(DOK 1)
P4.8B Predict the path of reflected light from fl at, curved, or rough surfaces (e.g., fl at and curved mirrors, painted walls, paper). (DOK 1)
P4.9A Identify the principle involved when you see a transparent object (e.g., straw, a piece of glass) in a clear liquid. (DOK 1)
P4.9B Explain how various materials reflect, absorb, or transmit light in different ways. (DOK 1)
P4.9C Explain why the image of the Sun appears reddish at sunrise and sunset.(DOK 1)

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
Vocab: Electromagnetic wave: waves create by vibrating electric charges, can travel through a vacuum or through matter, and have a wide variety of frequencies and wavelengths Photon: particle that electromagnetic waves sometimes behave like; has energy that increases as the frequency of the electromagnetic wave increases. Radiant energy: energy carried by an electromagnetic wave. Radio wave: electromagnetic waves with wavelengths longer than about 1mm, used for communication Microwave: radio waves with wavelengths between 1m and 1mm. Infrared wave: electromagnetic waves that have a wavelength about 1mm and 750 billionths of a meter. Visible light: electromagnetic waves with wavelengths of 750 to 400 billionths of a meter that can be detected by human eyes. Ultraviolet light: electromagnetic waves with wavelengths between about 400 billionths and 10 billionths of a meter. X ray: electromagnetic waves with wavelengths between about 10 billionths of a meter and 10 trillionths of a meter, that are often used for medical imaging. Gamma ray: electromagnetic wave with no mass and no charge that travels at the speed of light and is usually emitted with alpha or beta particles from a decaying atomic nucleus; has a wavelength less that about ten trillionths. Spectrum: a range of some value.	I can: - Explain how vibrating charges produce electromagnetic waves - Describe and compare the properties of electromagnetic waves - Identify the different regions on the electromagnetic spectrum and compare them in terms of wavelength, frequency, and energy. - Explain why radio waves can travel through space, but sound waves cannot. - Explain why there is a delay between the time we send a radio message to astronauts on the moon and when they receive it. - Describe how electric and magnetic fields form electromagnetic waves - Identify uses for different types of electromagnetic waves - Explain why we see a distant event before we hear it. - Draw ray diagrams to indicate how light reflects off objects or refracts into transparent media. - Predict the path of reflected light from flat, curved, or rough surfaces. - Identify the principle involved when you see a transparent object . - Explain how various materials reflect, absorb, or transmit light in different ways. - Explain why the image of the Sun appears reddish at sunrise and sunset. - Describe evidence that supports the dual wave - particle nature of light. - Describe how light interacts with matter - Explain the difference between regular and diffuse reflection - Define the index of refraction of a material

Index of refraction: property of a material indicating how much light slows down when traveling in the material. Opaque: material that absorbs or reflects all light and does not transmit any light. Translucent: material that transmits some light but but not enough to see objects clearly through. Transparent: material that transmits almost all the light striking it so that objects can be clearly seen through it. Mirage: image of a distant object produced by the refraction of light through air layers of different densities. Concave lens: a lens that is thicker at the edges than in the middle; causes light rays to diverge and forms reduced, upright, virtual images; and is used in combination with other lenses. Concave mirror: a reflective surface that curves inward and can magnify objects or create beams of light. Convex lens: a lens that is thicker in the middle than at the edges and can form real or virtual images. Convex mirror: a reflective surface that curves outward and forms a reduced, upright, virtual image. Plane mirror: flat, smooth mirror that reflects light to form upright, virtual images. Virtual image: an image formed by diverging light rays that is perceived by the brain, even though no actual light rays pass through the place where the image seems to be located. Real image: an image formed by light rays that converge to pass through the place where the image is located. Optical axis: imaginary straight line that is perpendicular to the center of a concave mirror or convex lens. Focal length: distance from the center of a lens or mirror to the focal point. Focal point: the point on the optical axis of a concave mirror or convex lens where light rays, that are initially parallel to the optical axis, pass through after they strike the mirror or lens.	- Explain why a prism separates white light into different colors - Explain how you see color - Describe how an image is formed in three types of mirrors - Explain the difference between real and virtual images - Identify examples and uses of plane, concave, and convex mirrors - Describe the shapes of convex and concave lenses

Phase II Curriculum
Unit 9: Classification and Phases of Matter / Kinetic Molecular Theory

Essential Questions:

Composition of Matter

- What are substances and mixtures?
- Identify elements and compounds.
- Compare and contrast solutions, colloids, and suspensions.

Properties of Matter

- Can you identify substances using physical properties?
- What is the difference between physical and chemical changes?
- Identify chemical changes.
- How does the law of conservation of mass apply to chemical changes?

Kinetic Theory

- What is the kinetic theory of matter?
- Describe particle movement in the four states of matter.
- What happens to particle behavior at the melting and boiling points?

Essential Understanding:

- Matter can be either a pure substance (an element or compound) or a mixture (either homogeneous or heterogeneous).
- A physical property can be observed without changing the identity of the substance.
- A chemical property describes whether it can undergo a chemical change.
- Solids, liquids, and gases differ by the amount of thermal energy their particles have.

Curriculum Standards- DOK noted where applicable with Standards

C2.2A Describe conduction in terms of molecules bumping into each other to transfer energy. Explain why there is better conduction in solids and liquids than gases. (DOK 2)
C2.2B Describe the various states of matter in terms of the motion and arrangement of the molecules (atoms) making up the substance. (DOK 1)
C3.3A Describe how heat is conducted in a solid. (DOK 1)
C3.3B Describe melting on a molecular level. (DOK 1)
C4.3A Recognize that substances that are solid at room temperature have stronger attractive forces than liquids at room temperature, which have stronger attractive forces than gases at room temperature. (DOK 1)
C4.3B Recognize that solids have a more ordered, regular arrangement of their particles than liquids and that liquids are more ordered than gases. (DOK 1)
C5.2B Distinguish between chemical and physical changes in terms of the properties of the reactants and products. (DOK 2)
C5.2C Draw pictures to distinguish the relationships between atoms in physical and chemical changes. (DOK 2)
C5.4B Measure, plot, and interpret the graph of the temperature versus time of an ice-water mixture, under slow heating, through melting and boiling. (DOK 2)
P4.p1 Kinetic Molecular Theory Properties of solids, liquids, and gases are explained by a model of matter that is composed of tiny particles in motion. (DOK 1)
P4.p1A For a substance that can exist in all three phases, describe the relative motion of the particles in each of the phases. (DOK 1)
P4.p1B For a substance that can exist in all three phases, make a drawing that shows the arrangement and relative spacing of the particles in each of the phases. (DOK 2)
P4.p1C For a simple compound, present a drawing that shows the number of particles in the system does not change as a result of a phase change. (DOK 2)
P4.p2A Distinguish between an element, compound, or mixture based on drawings or formulae. (DOK 2)
P4.p2B Identify a pure substance (element or compound) based on unique chemical and physical properties.

(DOK 2)
P4.p2C Separate mixtures based on the differences in physical properties of the individual components. (DOK 2)
P4.p2D Recognize that the properties of a compound differ from those of its individual elements. (DOK 1)

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
Vocab: Substance: element or compound that cannot be broken down into simpler components and maintain the properties of the original substance. Element: substance with atoms that are all alike. Compound: substance formed from two or more elements in which the exact combination and proportion of elements is always the same. Heterogeneous mixture: mixture, such as mixed nuts or a dry soap mix, in which different materials are unevenly distributed and are easily identified. Homogeneous mixture: solid, liquid, or gas that contains two or more substances blended evenly throughout. Solution: homogeneous mixture Colloid: heterogeneous mixture whose particles never settle. Tyndall effect: scattering of a light beam as it passes through a colloid. Suspension: heterogeneous mixture containing a liquid in which visible particles settle Property: a characteristic of a substance Physical property: any characteristic of a material, such as size or shape, that you can observe or attempt to observe without changing the identity of the material. Chemical property: any characteristic of a substance, such as flammability, that indicates whether it can undergo a certain chemical change. Physical change: any change in size, shape, or state of matter in which the identity of the substance remains the same. Chemical change: change of one substance into a new substance Distillation: process that can separate two substances in a mixture by evaporating a liquid and recondensing its vapor Law of conservation of mass: states that the mass of all substances present before a chemical change equals the mass of all the substances remaining after the change. State of matter: the physical phase, solid, liquid, gas, plasma, that material may be found.	I can… Classification of Matter: - Define substances and mixtures - Identify elements and compounds - Differentiate between heterogeneous and homogeneous mixtures - Compare and contrast solutions, colloids, and suspensions - Identify substances using physical properties - Compare and contrast physical and chemical changes - Identify physical and chemical changes - Determine how the law of conservation of mass applies to chemical changes Kinetic Theory: - Explain the kinetic theory of matter - Describe particle movement in the four states of matter - Explain particle motion at the melting and boiling points - Explain the relationship between heat, temperature, and kinetic energy - Define the different states of matter in terms of particle motion and strength of attractive forces - Diagram the spatial representation of atoms in all states of matter - Measure, plot, and interpret the graph of the temperature versus time of an ice-water mixture, under slow heating, through melting and boiling. - Identify and define phase changes and relate them to energy (heat added or taken away)

Kinetic energy: energy a moving object has because of its motion; depends on the mass and speed of the object. Kinetic theory: explanation of the behavior of molecules in matter; state that all matter is made of constantly moving particles that collide without losing energy Melting point: temperature at which a solid begins to liquefy. Heat of fusion: amount of energy required to change a substance from the solid phase to the liquid phase. Boiling point: temperature at which the pressure of the vapor in the liquid is equal to the external pressure acting on the surface of the liquid. Heat of vaporization: amount of energy required to change a substance from the liquid phase to the gas phase Diffusion: spreading of particles throughout a given volume until they are uniformly distributed. Plasma: matter consisting of positively and negatively charged particles. Thermal expansion: increase in the size of a substance when the temperature is increased. Deposition: phase change in which a gas changes into a solid Sublimation: phase change in which a solid changes into a gas. Graphs: Phase Change Diagram (temp vs. time)	

Phase II Curriculum
Unit 10: Properties of Atoms and the Periodic Table

Essential Questions:	**Essential Understanding:**
Structure of the Atom ● What are the names and symbols of some common elements? ● What are quarks? ● Describe the electron cloud model of the atom. ● How are electrons arranged in an atom? ***Masses of Atoms*** ● How do you determine the atomic mass and mass number of an atom? ● What are the components of isotopes? ● How do you calculate the average atomic mass of an element? ***The Periodic Table*** ● How is the periodic table organized? ● Explain how to use the periodic table to obtain information. ● What is the difference between metals, nonmetals, and metalloids?	● Protons and neutrons are located in an atom's nucleus, and electrons are located in an electron cloud surrounding the nucleus ● All atoms of the same element have the same number of protons but can have different numbers of neutrons ● Atoms of elements that are in the same group on the periodic table contain the same number of outer energy electrons

Curriculum Standards- DOK noted where applicable with Standards

C4.8A Identify the location, relative mass, and charge for electrons, protons, and neutrons. (DOK 1)
C4.8B Describe the atom as mostly empty space with an extremely small, dense nucleus consisting of the protons and neutrons and an electron cloud surrounding the nucleus. (DOK 1)
C4.8C Recognize that protons repel each other and that a strong force needs to be present to keep the nucleus intact. (DOK 1)
C4.8D Give the number of electrons and protons present if the fluoride ion has a -1 charge. (DOK 1)
C4.9A Identify elements with similar chemical and physical properties using the periodic table. (DOK 1)
C4.10A List the number of protons, neutrons, and electrons for any given ion or isotope. (DOK 1)
C4.10B Recognize that an element always contains the same number of protons. (DOK 1)

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**

Vocab:	I can…
Atom: the smallest particles of an element that still retains the properties of the element. Nucleus: positively charged center of an atom that contains protons and neutrons and is surrounded by a cloud of electrons. Proton: particle, composed of quarks, inside the nucleus of an atom that has a charge of 1+. Neutron: neutral particle, composed of quarks, inside the nucleus of an atom. Electron: particles surrounding the center of an atom that have a charge of 1-. Quark: particles of matter that make up protons and neutrons. Electron cloud: area around the nucleus of an atom where the atom's electrons are most likely to be found. Atomic number: number of protons in an atom's nucleus. Mass number: sum of the number of protons and neutrons in an atom's nucleus. Isotope: atoms of the same element that have different number of neutrons. Average atomic mass: weighted-average mass of the mixture of an element's isotopes. Periodic table: organized list of all known elements that are arranged by increasing atomic number and by changes in chemical and physical properties. Group: vertical column in the periodic table. Electron dot diagram: uses the symbol for an element and dots representing the number of electrons in the element's outer energy level. Period: horizontal row in the periodic table. Valence electron: electrons found in the outer energy level of an atom.	- Identify the names and symbols of common elements - Identify quarks as subatomic particles in matter - Describe the electron cloud model of the atom - Explain how electrons are arranged in an atom - Compute the atomic mass and mass number of an atom - Identify the components of isotopes - Interpret the average atomic mass of an element - Explain the composition of the periodic table - Use the periodic table to obtain information - Explain what the terms metal, nonmetal, and metalloid mean - Define valence electron and relate it to an atom's stability

Phase II Curriculum

Unit 11: Radioactivity and Nuclear Reactions

Essential Questions:

Radioactivity

- What force holds the atomic nucleus together?
- What is radioactivity?
- How are the properties of radioactive and stable nuclei different?
- Explain how radioactivity was first discovered.

Nuclear Decay

- What are alpha, beta, and gamma particles?
- How do you determine the half-life of a radioactive material?
- How is nuclear fission different than nuclear fusion?
- Describe the process of radioactive dating.

Detecting Radioactivity

- How do cloud and bubble chambers detect radioactivity?
- Explain how an electroscope can be used to detect radiation.
- How does a Geiger counter measure nuclear radiation?

Essential Understanding:

- The repulsive electrical force between protons causes some nuclei to be unstable
- Unstable nuclei can emit particles and energy while they decay
- Nuclear radiation produces charged particles in matter that can be detected
- Nuclear fission splits nuclei apart and nuclear fusion joins nuclei together

Curriculum Standards- DOK noted where applicable with Standards

C2.5a Determine the age of materials using the ratio of stable and unstable isotopes of a particular type. (DOK 1)
C2.r5b Illustrate how elements can change in nuclear reactions using balanced equations. (DOK 2)
C2.r5c Describe the potential energy changes as two protons approach each other. (DOK 2)
C2.r5d Describe how and where all the elements on earth were formed. (DOK 2)
C3.5a Explain why matter is not conserved in nuclear reactions. (DOK 2)
C4.8A Identify the location, relative mass, and charge for electrons, protons, and neutrons. (DOK 1)
C4.8B Describe the atom as mostly empty space with an extremely small, dense nucleus consisting of the protons and neutrons and an electron cloud surrounding the nucleus. (DOK 1)
C4.8C Recognize that protons repel each other and that a strong force needs to be present to keep the nucleus intact. (DOK 1)
C4.8D Give the number of electrons and protons present if the fluoride ion has a -1 charge. (DOK 1)
P4.12A Describe peaceful technological applications of nuclear fission and radioactive decay. (DOK 1)
P4.12C Explain how stars, including our Sun, produce huge amounts of energy (e.g., visible, infrared, or ultraviolet light). (DOK 2)

C4.10A List the number of protons, neutrons, and electrons for any given ion or isotope. (DOK 1)
C4.10B Recognize that an element always contains the same number of protons. (DOK 1)

LEARNING TARGETS

Knowledge/Content I Know …	Skills/Processes I Can …
Vocab: **Strong force:** Causes protons and neutrons to be attracted to each other. **Radioactivity:** The process of nuclear decay. **Alpha particle:** Made of two protons and two neutrons. **Transmutation:** The process of changing one element to another through nuclear decay. **Beta particle:** When an electron is ejected from the nucleus. **Gamma ray:** An electromagnetic wave that is ejected from the nucleus. **Half-life:** The amount of time it takes for half the nuclei in a sample of the isotope to decay. **Cloud chamber:** Uses water or ethanol vapor to detect alpha or beta particle radiation. **Bubble chamber:** Uses a superheated liquid to detect alpha or beta particle radiation. **Geiger counter:** A device that measures the amount of radiation by producing a clicking sound. **Nuclear fission:** The process by which a large nucleus splits releasing energy. **Chain reaction:** A series of repeated fission reactions caused by the release of neutrons in each reaction. **Critical mass:** The amount of material required so that each fission reaction produces approximately one more fission reaction. **Nuclear fusion:** The process by which two smaller nuclei combine releasing energy. **Tracer:** A radioisotope used to find or keep track of molecules in an organism.	I can… - Describe the structure of an atom and its nucleus - Explain what radioactivity is - Contrast properties of radioactive and stable nuclei - Discuss the discovery of radioactive nuclei - Compare and contrast alpha, beta, and gamma radiation - Define the half-life of a radioactive material - Describe the process of radioactive dating - Describe how radioactivity can be detected in cloud and bubble chambers - Explain how an electroscope can be used to detect radiation - Explain how a Geiger counter can measure nuclear radiation - Explain nuclear fission and how it can begin a chain reaction - Discuss how nuclear fusion occurs in the SUn - Describe how radioactive tracers can be used to diagnose medical problems - Discuss how nuclear reactions can help treat cancer

Phase II Curriculum

Unit 12: Elements and Their Properties

Essential Questions:	**Essential Understanding:**
Metals ● What are the properties of a typical metal? ● Where are the alkali metals and alkaline earth metals found? ● How are the three groups of transition elements different? ***Nonmetals*** ● How would you classify hydrogen? ● Compare and contrast properties of the halogens. ● Describe properties and uses of the noble gases. ***Mixed Groups*** ● Distinguish among metals, nonmetals, and metalloids. ● What are allotropes? ● In what ways can the crystal structure of carbon be different? ● What are synthetic elements and why are they important?	● Metals are located on the left side of the periodic table and are generally shiny, good conductors, malleable, and ductile ● Nonmetals are located on the right side of the periodic table and are generally are dull, poor conductors, and brittle ● Some groups on the periodic table contain metalloids (elements that share some properties of both metals and nonmetals)

Curriculum Standards- DOK noted where applicable with Standards
C4.9A Identify elements with similar chemical and physical properties using the periodic table. (DOK 1)

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
Vocab: **Metal:** Elements found on the left side of the periodic table. **Malleable:** Ability of a metal to be shaped or hammered into sheets. **Ductile:** Ability of a metal to be drawn into wires. **Metallic bonding:** Bonding that occurs between metal ions. **Radioactive element:** One in which the nucleus breaks down and gives off particles and energy. **Transition element:** Elements found in groups 3-12. **Nonmetal:** Elements found on the right side of the	I can… - Describe the properties of a typical metal - Identify the alkali metals and alkaline earth metals - Differentiate among three groups of transition elements - Recognize hydrogen as a nonmetal - Compare and contrast properties of the halogens - Describe properties and uses of the noble gases - Distinguish among metals, nonmetals and metalloids - Describe the nature of allotropes - Recognize the significance of differences in crystal structure in carbon

periodic table. **Diatomic molecule:** Consists of two atoms and elements in a covalent bond. **Salt:** Occurs when a halogen gains an electron from a metal. **Sublimation:** The process of a solid changing directly to a vapor without forming a liquid. **Metalloid:** Elements that have both metallic and nonmetallic properties. **Allotrope:** Different forms of the same element. **Semiconductor:** Elements that conduct electricity under certain conditions. **Transuranium element:** Elements that have more 92 protons.	- Understand the importance synthetic elements

Phase II Curriculum

Unit 13: Chemical Bonds

Essential Questions:	**Essential Understanding:**
Stability in Bonding ● How does a compound differ from its component elements? ● What does a chemical formula represent? ● How do electron dot diagrams help predict chemical bonding? **Types of Bonds** ● Why does chemical bonding occur? ● What are ionic bonds and covalent bonds? ● Which particles are produced by different types of bonding? ● How do nonpolar and polar covalent bonds compare? **Writing Formulas and Naming Compounds** ● How are oxidation numbers determined? ● How are formulas for ionic and covalent compounds written? ● How are ionic and covalent compounds named?	● When atoms form compounds, each atom is more stable in the compound than it was by itself ● Atoms form ionic bonds by transferring electrons and form covalent bonds by sharing electrons ● The oxidation numbers of the ions in ionic compounds determine the formula of the compounds

Curriculum Standards- DOK noted where applicable with Standards

C4.2A Name simple binary compounds using their formulae. (DOK 1)
C4.2B Given the name, write the formula of simple binary compounds. (DOK 1)
C4.2c Given a formula, name the compound. (DOK 1)
C4.2d Given the name, write the formula of ionic and molecular compounds. (DOK 1)
C4.2e Given the formula for a simple hydrocarbon, draw and name the isomers. (DOK 1)
C4.8D Give the number of electrons and protons present if the fluoride ion has a -1 charge. (DOK 1)
C5.5A Predict if the bonding between two atoms of different elements will be primarily ionic or covalent (DOK 2).
C5.4B Predict the formula for binary compounds of main group elements. (DOK 2)
C5.5c Draw Lewis structures for simple compounds. (DOK 1)
C5.5d Compare the relative melting point, electrical and thermal conductivity and hardness for ionic, metallic, and covalent compounds. (DOK 2)
C5.5e Relate the melting point, hardness, and electrical and thermal conductivity of a substance to its structure. (DOK 2)

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
Vocab: **Chemical formula:** Tells what elements a compound contains and the exact number of the atoms of each	I can… - Describe how a compound differs from its component elements

element in a unit of that compound. **Chemical bond:** The force that holds atoms together in a compound. **Ion:** A charged particle that has either more or fewer electrons than protons. **Ionic bond:** A bond that exists between oppositely charged ions. **Covalent bond:** A bond that exists between atoms that share electrons. **Molecule:** A neutral particle that forms as a result of electron sharing. **Polar molecule:** A molecule that has a slightly positive and slightly negative end. **Nonpolar molecule:** A molecule in which electrons are shared equally in bonds. **Binary compound:** A compound consisting of two elements. **Oxidation number:** Tells you how many electrons an atom has gained, lost , or shared to become stable. **Polyatomic ion:** A positively or negatively charged, covalently bonded group of atoms. **Hydrate:** A compound that has water chemically attached to its ions and written into its chemical formula.	- Explain what a chemical formula represents - Explain that the electric forces between oppositely charges electrons and protons are essential to forming compounds - State a reason why chemical bonding occurs - Describe ionic bonds and covalent bonds - Identify the particles produced by ionic bonding and by covalent bonding - DIstinguish between a nonpolar covalent bond and a polar covalent bond - Explain how to determine oxidation numbers - Write formulas and names for ionic compounds - Write formulas and names for covalent compounds

Phase II Curriculum

Unit 14: Chemical Reactions

Essential Questions:	**Essential Understanding:**
Chemical Changes ● What are the reactants and products in a chemical reaction? ● Is mass conserved in a chemical reaction? ● Why are chemical reactions important? **Chemical Equations** ● How do you balance a chemical equation? **Classifying Chemical Reactions** ● What are the five general types of chemical reactions? ● How can you predict if a metal will replace another in a compound? ● What do the terms oxidation and reduction mean? **Chemical Reactions and Energy** ● How can the source of energy changes in chemical reactions be identified? ● How do exergonic and endergonic reactions compare? ● Is energy conserved during a chemical reaction? ● How do chemists express the rates of chemical reactions? ● How do catalysts and inhibitors affect reaction rates?	A chemical reaction involves changing one or more substances into a different substance or substances. ● The rearrangement of atoms in a chemical change is described by a chemical equation ● A balanced chemical equation contains the same number and types of atoms in the reactants as in the products ● Reactions can be classified based on how atoms are rearranged ● Exergonic reactions release energy and endergonic reactions absorb energy

Curriculum Standards- DOK noted where applicable with Standards

C5.2A Balance simple chemical equations applying the conservation of matter. (DOK 2)
C5.2B Distinguish between chemical and physical changes in terms of the properties of the reactants and products. (DOK 2)
C5.2C Draw pictures to distinguish the relationships between atoms in physical and chemical changes. (DOK 2)
C5.2x Balancing Equations A balanced chemical equation will allow one to predict the amount of product formed.
C5.2d Calculate the mass of a particular compound formed from the masses of starting materials. (DOK 1)
C3.4 Endothermic and Exothermic Reactions Chemical interactions either release energy to the environment (exothermic) or absorb energy from the environment (endothermic).
C3.4A Use the terms endothermic and exothermic correctly to describe chemical reactions in the laboratory. (DOK 1)
C3.4B Explain why chemical reactions will either release or absorb energy. (DOK 2)

LEARNING TARGETS

Knowledge/Content I Know …	Skills/Processes I Can …
Vocab: **Chemical reaction:** A change in which one or more substances are converted into new substance. **Reactant:** The substances that react. **Product:** New substances that are produced. **Chemical equation:** A way to describe a chemical reaction using chemical formulas and other symbols. **Coefficient:** Represent the number of units of each substance taking part in a reaction. **Balanced chemical equation:** Has the same number of atoms of each element on both sides of the equation. **Subscript:** Indicates the number of atoms. **Combustion reaction:** Occurs when a substance reacts with oxygen to produce energy in the form of heat and light. **Synthesis reaction:** Occurs when two or more substances combine to form another substance. **Decomposition reaction:** Occurs when one substance breaks down, or decomposes, into two or more substances. **Single-displacement reaction:** Occurs when one element replaces another element in a compound. **Double-displacement reaction:** Occurs when the positive ion of one compound replaces the positive ion of the other to form two new compounds. **Precipitate:** An insoluble compound that comes out of solution during this type of reaction. **Oxidation:** When a substances loses electrons. **Reduction:** When a substance gains electrons. **Exergonic reaction:** Chemical reactions that release energy. **Exothermic reaction:** When energy is given off primarily in the form of heat. **Endergonic reaction:** When a chemical reaction requires more energy to break bonds than are released. **Endothermic reaction:** When energy is needed in the form of thermal energy. **Catalyst:** A substance that speeds up chemical reactions. **Inhibitor:** A substance that slows down a chemical reaction.	I can… - Identify the reactants and products in a chemical reaction - Determine how a chemical reaction satisfies the law of conservation of mass - Determine how chemists express chemical changes using equations - Identify what is meant by a balanced chemical equation - Determine how to write a balanced chemical equation - Identify the five general types of chemical reactions - Define the terms oxidation and reduction - Identify redox reactions - Predict which metals will replace other metals in compounds - Identify the source of energy changes in chemical reactions - Compare and contrast exergonic and endergonic reactions - Examine the effects of catalysts and inhibitors on the speed of chemical reactions

Phase II Curriculum

Unit 15: Solutions

Essential Questions:	**Essential Understanding:**
How Solutions Form ● How do substances dissolve in a liquid? ● How do solid solutions and gas solutions form? ● What factors affect the rates at which solids dissolve in liquids? **Solubility and Concentration** ● How are the concentrations of solutions expressed? ● What is solubility? ● What are saturated, unsaturated, and supersaturated solutions? ● How do pressure and temperature affect the solubility of gases? **Particles in Solution** ● Why do some solutions conduct electricity? ● What are two ways that some solutes form ions in solution? ● How do solutes affect the freezing and boiling points of solvents? **Dissolving Without Water** ● What solutes do not dissolve well in water? ● How does polarity affect solubility? ● How does soap work?	A solution is a homogenous mixture of a solvent and solute. ● A solution forms when particles of solute become evenly mixed among particles of solvent. ● Solubility is the maximum amount of solute that can dissolve and concentration is the amount of solute actually dissolved in a given amount of solute ● Dissolved particles can both lower the freezing point and raise the boiling point of a solution ● Nonpolar solvents can dissolve many nonpolar solutes

Curriculum Standards- DOK noted where applicable with Standards

C4.7x Solutions The physical properties of a solution are determined by the concentration of solute.
C4.7a Investigate the difference in the boiling point or freezing point of pure water and a salt solution. (DOK 2)
C4.7b Compare the density of pure water to that of a sugar solution. (DOK 2)

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
<u>Vocab:</u> **Solution:** A mixture that has the same composition, color, density, and even taste throughout. **Solute:** The substance being dissolved in a solution. **Solvent:** The substance doing the dissolving in a solution.	I can… - Determine how things dissolve - Examine the factors that affect the rates at which solids and gases dissolve in liquids - Define the concept of solubility - Identify how to express the concentration of solutions

Polar: Molecules that have slightly positive and negative ends. **Solubility:** The maximum amount of a solute that can be dissolved in a given amount of solvent at a given temperature. **Saturated solution:** A solution that contains all the solute it can hold at a given temperature. **Unsaturated solution:** Any solution that can dissolve more solute at a given temperature. **Supersaturated solution:** A solution that contains more solute than a saturated solution at the same temperature. **Ion:** A charged particle. **Electrolyte:** Substances that form ions in water that conduct electricity. **Nonelectrolyte:** Substances that form no ions in water and cannot conduct electricity. **Ionization:** Process of forming ions from molecules. **Dissociation:** Process by which an ionic solid separates into its positive and negative ions. **Nonpolar:** Materials that have no separate positive and negative areas.	- List and define three types of solutions - Describe the effects of pressure and temperature on the solubility of gases - Examine how some solutes break apart in water solutions to form positively and negatively charged particles - Determine how some solutions conduct electricity - Describe how antifreeze - Identify several kinds of solutes that do not dissolve well in water - Explain how solvents work in terms of polarity - Determine how to choose the right solvent for the job

Phase II Curriculum
Unit 16: Acids, Bases, Salts, and Other Organic Compounds

Essential Questions:

Acids and Bases

- What defines an acid or base?
- How are common acids and bases used?
- How do acids and bases form ions in solution?

Strength of Acids and Bases

- What determines the strength of an acid or base?
- How effectively do different acids and bases conduct electricity?
- What is the difference between strength and concentration?

Salts

- What is a neutralization reaction?
- What is a salt, and how does it form?
- What is the purpose of the indicator in a titration?
- How do soaps and detergents differ?

Simple Organic Compounds

- What is the difference between organic and inorganic compounds?
- Why can carbon form so many different compounds?

Other Organic Compounds

- What is the difference between a saturated and unsaturated hydrocarbon?
- What are isomers and how do their properties vary?
- What is a substituted hydrocarbon?
- What are the properties and uses of some common substituted hydrocarbons?
- What are aromatic compounds?

Petroleum

- How are organic compounds obtained from petroleum?
- How do organic compounds combine to form polymers?
- What are some uses of polymers?

Biological Compounds

- How are the structures of proteins, carbohydrates, lipids, and nucleic acids similar? How are they different?
- What types of polymers are found in the basic food groups?
- What is the function of DNA?

Essential Understanding:

- Acids produce hydronium ions in water
- Bases produce hydroxide ions in water
- Acid strength describes the ease with which an acid dissociates into ions.
- Acid concentration describes the amount of acid dissolved in water
- An acid and a base react to form a salt and water
- Hydrocarbons are compounds made only of carbon and hydrogen atoms
- Substituted hydrocarbons contain other elements besides carbon and hydrogen
- Petroleum is the source of carbon compounds used to make plastics, fossil fuels, and many other products
- Proteins, nucleic acids, carbohydrates, and lipids are polymers made by plants and animals.

Curriculum Standards- DOK noted where applicable with Standards
C5.7A Recognize formulas for common inorganic acids, carboxylic acids, and bases formed from families I and II. (DOK 1) C5.7B Predict products of an acid-base neutralization. (DOK 2) C5.7C Describe tests that can be used to distinguish an acid from a base. (DOK 1) C5.7D Classify various solutions as acidic or basic, given their pH. (DOK 1) C5.7E Explain why lakes with limestone or calcium carbonate experience less adverse effects from acid rain than lakes with granite beds. (DOK 2) C5.8A Draw structural formulas for up to ten carbon chains of simple hydrocarbons.(DOK 1) C5.8B Draw isomers for simple hydrocarbons. (DOK 1) C5.8C Recognize that proteins, starches, and other large biological molecules are polymers. (DOK 1)
LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
Vocab: ***A*cid**: A substance that produces hydrogen ions in a water solution. **Hydronium ion**: Produced when H+ ions interact with water molecules to form H3O+ ions. **Indicator**: An organic compound that changes color in the presence of an acid or base. **Base**: A substance that produces hydroxide ions in a water solution. **Electrolyte**: a solution that contains ions and conducts electricity. **Strong acid**: An acid where nearly all the acid molecules dissociate into ions when in water. **Weak acid**: An acid where only a small fraction of the molecules dissociate into ions when in water. **Strong base**: A base in which ions dissociate completely in solution. **Weak base**: A base in which ions do not dissociate completely in solution. **pH**: A measure of the concentration of H+ ions in a solution. **Buffer**: Help to minimize the effects of additional acids or bases **Neutralization**: The reaction of an acid with a base to form a salt and water. **Salt**: A compound formed when the negative ions from an acid combine with the positive ions from a base. **Titration:** A process used to determine the concentration of an acidic or basic solution. **Soaps**: organic salts. **Organic compound**: Compounds containing the element carbon. **Hydrocarbon**: A compound made of only carbon and	I can… *(Acids, Bases, Salts)* - Compare and contrast acids and bases and identify the characteristics they have - Examine some formulas and uses of common acids and bases - Determine how the process of ionization and dissociation apply to acids and bases - Determine what is responsible for the strength of an acid or base - Compare and contrast strength and concentration - Examine the relationship between pH and acid or base strength - Examine electrical conductivity - Identify a neutralization reaction - Determine what a salt is and how salts form - Compare and contrast soaps and detergents - Examine how esters are made and what they are used for *(Organic Compounds)* - Identify the difference between organic and inorganic compounds - Examine the structure of some organic compounds - Differentiate between saturated and unsaturated hydrocarbons - Identify isomers of organic compounds - Define aromatic compounds - Identify the nature of alcohols and acids - Identify organic compounds you used daily in life - Explain how carbon compounds are obtained from petroleum - Determine how carbon compounds can form long chains - Define the terms polymerization and

hydrogens atoms. **Saturated hydrocarbon**: Hydrocarbons containing only single-bonded carbon atoms. **Isomer**: Compounds that have identical chemical formulas but different molecular structures and shapes. **Unsaturated hydrocarbon**: Hydrocarbons that contain at least one double or triple bond. **Aromatic compound**: A compound that contains a benzene structure having a ring with six carbons. **Substituted hydrocarbon**: Hydrocarbons that have had different atoms or groups of atoms added to change the properties of the compound. **Alcohol**: Forms when -OH group replaces one or more hydrogen atoms in a hydrocarbon.. structural formula, **Polymer**: Long molecular chains made of monomers. **Monomer**: A small molecule that forms a link in a polymer chain. **Polyethylene**: Made by combining ethylene with itself repeatedly. **Depolymerization**: A process that uses heat or chemicals to break the long polymer chain into its monomer fragments. **Protein**: Large organic polymer formed from organic monomers call amino acids. **Nucleic acid**: Organic polymers that control the activities and reproduction of cells. **Deoxyribonucleic acid (DNA)**: Found in cells where it codes and stores genetic information. **Carbohydrate**: Compounds containing carbon, hydrogen, and oxygen, that have twice as many hydrogen atoms as oxygen atoms. **Lipid**: Organic compounds such as fats, oils, and related compounds.	depolymerization - Compare and contrast proteins, nucleic acids, carbohydrates, and lipids - Identify the structure of polymers found in basic food groups - Identify the structure of large biological polymers