Davison Community Schools
ADVISORY CURRICULUM COUNCIL
Phase II
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Transition Physical Science 9

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:

Chapter 1-2

- **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?**

Supplemental Material: Reading Essentials 1-1

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

Essential Understanding:

- **Standard measurement units, such as centimeters and second, are exact quantities used to compare measurements.**
- **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.**

Curriculum Standards- DOK noted where applicable with Standards

P1.1 Scientific Inquiry

Science is a way of understanding nature. Scientific research may begin by generating new scientific questions that can be answered through replicable scientific investigations that are logically developed and conducted systematically. Scientific conclusions and explanations result from careful analysis of empirical evidence and the use of logical reasoning. Some questions in science are addressed through indirect rather than direct observation, evaluating the consistency of new evidence with results predicted by models of natural processes. Results from investigations are communicated in reports that are scrutinized through a peer review process.

P1.1A Generate new questions that can be investigated in the laboratory or field.

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.

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).
P1.1D Identify patterns in data and relate them to theoretical models.
P1.1E Describe a reason for a given conclusion using evidence from an investigation.
P1.2 Scientific Reflection and Social Implications
The integrity of the scientific process depends on scientists and citizens understanding and respecting the "Nature of Science." Openness to new ideas, skepticism, and honesty are attributes required for good scientific practice. Scientists must use logical reasoning during investigation design, analysis, conclusion, and communication. Science can produce critical insights on societal problems from a personal and local scale to a global scale. Science both aids in the development of technology and provides tools for assessing the costs, risks, and benefits of technological systems. Scientific conclusions and arguments play a role in personal choice and public policy decisions. New technology and scientific discoveries have had a major influence in shaping human history. Science and technology continue to offer diverse and significant career opportunities.
P1.2A Critique whether or not specific questions can be answered through scientific investigations.
P1.2B Identify and critique arguments about personal or societal issues based on scientific evidence.
P1.2C Develop an understanding of a scientific concept by accessing information from multiple sources. Evaluate the scientific accuracy and significance of the information.
P1.2D Evaluate scientific explanations in a peer review process or discussion format.
P1.2E Evaluate the future career and occupational prospects of science fields.

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	**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

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 - 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	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.

Phase II Curriculum

Unit 2: Motion

Essential Questions:	**Essential Understanding:**
● **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?** ● **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.**	● **Graphs are visual representations of numerical data.** ● **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.2.2A Distinguish between the variables of distance, displacement, speed, velocity, and acceleration. (DOK 1)
Clarification Notes: Use of the terms vector and scalar should be applied to distinguish between the vector quantities of displacement, velocity and acceleration and the scalar quantities of distance and speed. These vector quantities have direction associated with them in addition to magnitude.

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)
P3.4A 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. ● 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 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:**
● 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? ● 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. ● What is Newton's Third Law of Motion? ● What are action and reaction forces?	● **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.

P3.1A Identify the force(s) acting between objects in "direct contact" or at a distance.

P3.2C Calculate the net force acting on an object.

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).

P3.4A Predict the change in motion of an object acted on by several forces.

P3.4C Solve problems involving force, mass, and acceleration in linear motion (Newton's second law).

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).

P3.6B Predict how the gravitational force between objects changes when the distance between them changes.

P3.6C Explain how your weight on Earth could be different from your weight on another planet.

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
Vocab: - 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	● I can: ● - Identify the force(s) acting between objects in "direct contact" or at a distance. ● - Identify the magnitude and direction of

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: $F= G(m_1m_2)/d$

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.
- - 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.

Phase II Curriculum

Unit 4: Energy and Work

Essential Questions:	**Essential Understanding:**
● What is the difference between kinetic and potential energy? ● Describe the different forms of potential energy. ● Describe how energy can be transformed from one form to another. ● How is mechanical energy related to kinetic and potential energy? ● What is the law of conservation of energy.	**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** ● **Describe different forms of potential energy** ● **Describe how energy can be transformed from one form to another** ● **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

P4.1A Account for and represent energy into and out of systems using energy transfer diagrams.

P4.2B Name devices that transform specific types of energy into other types (e.g., a device that transforms electricity into motion).

P4.3A Identify the form of energy in given situations (e.g., moving objects, stretched springs, rocks on cliffs, energy in food).

P4.3B Describe the transformation between potential and kinetic energy in simple mechanical systems (e.g., pendulums, roller coasters, ski lifts).

P4.10B)Identify common household devices that transform electrical energy to other forms of energy, and describe the type of energy transformation.

P3.2B Compare work done in different situations.

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 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. - Name devices that transform specific types of energy into other types - Explain how energy is conserved in common systems - Identify the form of energy in given situations

Phase II Curriculum

Unit 5: Thermal Energy

Essential Questions:	**Essential Understanding:**
● What is temperature? ● 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?	● 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 ● There are three ways thermal energy is transferred: conduction, convection, radiation ●

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.

C3.3A Describe how heat is conducted in a solid.

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.

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 - 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	I can: ● Define temperature in terms of kinetic energy ● 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

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: $Q = m(T_f - T_i)C$	• 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: Waves and Sound

Essential Questions:	**Essential Understanding:**
(Waves) ● How do waves transfer energy? ● What are mechanical waves? ● How do transverse waves differ from longitudinal waves? ● How are wavelength and period related? ● What is the relationship between frequency and wavelength? *(Sound)* ● How does sound travel through different mediums? ● What affects the speed of sound? ● How are amplitude, intensity, and loudness related? ● How is sound intensity measured? ● What is the relationship between frequency and pitch?	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. 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.
P4.4B Identify everyday examples of transverse and compression (longitudinal) waves.
P4.4C Compare and contrast transverse and compression (longitudinal) waves in terms of wavelength, amplitude, and frequency.
P4.5D Explain how waves propagate from vibrating sources and why the intensity decreases with the square of the distance from a point source.
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.
P4.6D Explain why we see a distant event before we hear it (e.g., lightning before thunder, exploding fireworks before the boom).

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	**I can:** - 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,

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. Equations: wave speed: $v = f\lambda$	amplitude, and frequency. - Demonstrate that frequency and wavelength of a wave are inversely proportional in a given medium. - 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. - Recognize how amplitude, intensity and loudness are related

Phase II Curriculum
Unit 7: 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? ● 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? ● What technologies use radio and micro waves for communication? *(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? ● Why does a prism separate white light into different colors? ● How do you see color? *(Mirrors, Lenses)* ● How do different types of mirrors form images? ● What are real images and virtual images? ● What are some examples of plane, convex, concave mirrors? ● 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 can transfer energy through matter and space ● 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 Visible light are electromagnetic waves that can be detected by the human eye. ● 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 Mirrors and lenses form images by causing light rays to change direction ● 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.	**I can:** *(Electromagnetic Waves)* - 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. *(Light)* - 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

Spectrum: a range of some value. 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 the difference between regular and diffuse reflection - Define the index of refraction of a material - Explain why a prism separates white light into different colors - Explain how you see color *(Mirrors, Lenses)* - 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 8 : Classification and Phases of Matter / Kinetic Molecular Theory

Essential Questions:	**Essential Understanding:**
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?	Matter can be classified by what it is made of, by its physical properties, and by its chemical properties ● 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. Many physical properties of matter can be described by the motion of its particles ● Solids, liquids, and gases differ by the amount of thermal energy their particles have.

Curriculum Standards- DOK noted where applicable with Standards

C2.2 Molecules in Motion Molecules that compose matter are in constant motion (translational, rotational, vibrational). Energy may be transferred from one object to another during collisions between molecules.

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.

C2.2B Describe the various states of matter in terms of the motion and arrangement of the molecules (atoms) making up the substance.

C3.3 Heating Impacts Heating increases the kinetic (translational, rotational, and vibrational) energy of the atoms composing elements and the molecules or ions composing compounds. As the kinetic (translational) energy of the atoms, molecules, or ions increases, the temperature of the matter increases. Heating a sample of a crystalline solid increases the kinetic (vibrational) energy of the atoms, molecules, or ions. When the kinetic (vibrational) energy becomes great enough, the crystalline structure breaks down, and the solid melts.

C3.3A Describe how heat is conducted in a solid.

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.

P4.p1A For a substance that can exist in all three phases, describe the relative motion of the particles in each of the phases.

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.

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.

P4.p2 Elements, Compounds, and Mixtures Elements are a class of substances composed of a single kind of atom. Compounds are composed of two or more different elements chemically combined. Mixtures are composed of two or more different elements and/or compounds physically combined. Each element and compound has physical and chemical properties, such as boiling point, density, color, and conductivity, which are independent of the amount of the sample.

P4.p2A Distinguish between an element, compound, or mixture based on drawings or formulae.

P4.p2C Separate mixtures based on the differences in physical properties of the individual components.

P4.p2D Recognize that the properties of a compound differ from those of its individual elements.

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.

C4.3B Recognize that solids have a more ordered, regular arrangement of their particles than liquids and that liquids are more ordered than gases.

C5.2B Distinguish between chemical and physical changes in terms of the properties of the reactants and products.

C5.2C Draw pictures to distinguish the relationships between atoms in physical and chemical changes.

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.

LEARNING TARGETS

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	**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

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. 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	- 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: - Describe particle movement in the four states of matter - Define the different states of matter in terms of particle motion and strength of attractive forces

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 9 : 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?	The properties of an element are determined by the composition of its atoms. ● 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

C4.8 Atomic Structure Electrons, protons, and neutrons are parts of the atom and have measurable properties, including mass and, in the case of protons and electrons, charge. The nuclei of atoms are composed of protons and neutrons. A kind of force that is only evident at nuclear distances holds the particles of the nucleus together against the electrical repulsion between the protons.

C4.8A Identify the location, relative mass, and charge for electrons, protons, and neutrons.

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.

C4.8C Recognize that protons repel each other and that a strong force needs to be present to keep the nucleus intact.

C4.8D Give the number of electrons and protons present if the fluoride ion has a -1 charge.

C4.9 Periodic Table In the periodic table, elements are arranged in order of increasing number of protons (called the atomic number). Vertical groups in the periodic table (families) have similar physical and chemical

properties due to the same outer electron structures.

C4.9A Identify elements with similar chemical and physical properties using the periodic table.

C4.10 Neutral Atoms, Ions, and Isotopes A neutral atom of any element will contain the same number of protons and electrons. Ions are charged particles with an unequal number of protons and electrons. Isotopes are atoms ,of the same element with different numbers of neutrons and essentially the same chemical and physical properties.

C4.10A List the number of protons, neutrons, and electrons for any given ion or isotope.

C4.10B Recognize that an element always contains the same number of protons.

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
Vocab: 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	**I can…** - Identify the names and symbols of common elements - 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 - Identify different groups on the periodic table - Define valence electron and relate it to an atom's stability

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.	

Phase II Curriculum

Unit 12: Elements and Their Properties

Essential Questions: ***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?	**Essential Understanding:** Elements can be classified into three main types - metals, nonmetals, and metalloids. ● 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

C4.9 Periodic Table In the periodic table, elements are arranged in order of increasing number of protons (called the atomic number). Vertical groups in the periodic table (families) have similar physical and chemical properties due to the same outer electron structures.
C4.9A Identify elements with similar chemical and physical properties using the periodic table.

LEARNING TARGETS

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

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 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.	- 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 - Understand the importance synthetic elements

Phase II Curriculum

Unit 13: Chemical Bonds

Essential Questions:	**Essential Understanding:**
● How does a compound differ from its component elements? ● What does a chemical formula represent? ● How do electron dot diagrams help predict chemical bonding? ● 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? ● How are oxidation numbers determined? ● How are formulas for ionic and covalent compounds written? ● How are ionic and covalent compounds named?	Just over 110 elements combine with chemical bonds to form nearly an infinite number of compounds ● 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

C5.5 Chemical Bonds — Trends An atom's electron configuration, particularly of the outermost electrons, determines how the atom can interact with other atoms. The interactions between atoms that hold them together in molecules or between oppositely charged ions are called chemical bonds.
C5.5A Predict if the bonding between two atoms of different elements will be primarily ionic or covalent.
C5.4B Predict the formula for binary compounds of main group elements.
C5.5x Chemical Bonds Chemical bonds can be classified as ionic, covalent, and metallic. The properties of a compound depend on the types of bonds holding the atoms together.
C5.5c Draw Lewis structures for simple compounds.
C5.5d Compare the relative melting point, electrical and thermal conductivity and hardness for ionic, metallic, and covalent compounds.
C5.5e Relate the melting point, hardness, and electrical and thermal conductivity of a substance to its structure.
C4.2 Nomenclature All compounds have unique names that are determined systematically.
C4.2A Name simple binary compounds using their formulae.
C4.2B Given the name, write the formula of simple binary compounds.
C4.2x Nomenclature All molecular and ionic compounds have unique names that are determined systematically.
C4.2c Given a formula, name the compound.
C4.2d Given the name, write the formula of ionic and molecular compounds.
C4.2e Given the formula for a simple hydrocarbon, draw and name the isomers.
C4.8D **(2)**Give the number of electrons and protons present if the fluoride ion has a -1 charge.
C5.5A **(2)**Predict if the bonding between two atoms of different elements will be primarily ionic or covalent.
C5.5B **(1,3)**Predict the formula for binary compounds of main group elements.

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 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.	I can… - Describe how a compound differs from its component elements - 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:**
● What are the reactants and products in a chemical reaction? ● Is mass conserved in a chemical reaction? ● Why are chemical reaction important? ● How do you balance a chemical equation? ● 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? ● 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

C5.2 Chemical Changes Chemical changes can occur when two substances, elements, or compounds interact and produce one or more different substances whose physical and chemical properties are different from the interacting substances. When substances undergo chemical change, the number of atoms in the reactants is the same as the number of atoms in the products. This can be shown through simple balancing of chemical equations. Mass is conserved when substances undergo chemical change. The total mass of the interacting substances (reactants) is the same as the total mass of the substances produced (products).
C5.2A Balance simple chemical equations applying the conservation of matter.
C5.2B Distinguish between chemical and physical changes in terms of the properties of the reactants and products.
C5.2C Draw pictures to distinguish the relationships between atoms in physical and chemical changes.
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.
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.
C3.4B Explain why chemical reactions will either release or absorb energy

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