Vertical Alignment – 8th Grade, Physical Science, Chemistry, & Physics

8th Grade	Physical Science	Chemistry	Physics
S8P1. Students will examine the scientific view of the nature of matter. a. Distinguish between atoms and molecules. b. Describe the difference between pure substances (elements and compounds) and mixtures. c. Describe the movement of particles in solids, liquids, gases, and plasmas states. d. Distinguish between physical and chemical properties of matter as physical (i.e., density, melting point, boiling point) or chemical (i.e., reactivity, combustibility). e. Distinguish between changes in matter as physical (i.e., physical change) or chemical (development of a gas, formation of precipitate, and change in color). f. Recognize that there are more than 100 elements and some have similar properties as shown on the Periodic Table of Elements. g. Identify and demonstrate the Law of Conservation of Matter.	**SPS1. Students will investigate our current understanding of the atom.** a. Examine the structure of the atom in terms of • proton, electron, and neutron locations. • atomic mass and atomic number. • atoms with different numbers of neutrons (isotopes). • explain the relationship of the proton number to the element's identity. b. Compare and contrast ionic and covalent bonds in terms of electron movement.	**SC3 Students will use the modern atomic theory to explain the characteristics of atoms.** a. Discriminate between the relative size, charge, and position of protons, neutrons, and electrons in the atom. b. Use the orbital configuration of neutral atoms to explain its effect on the atom's chemical properties. c. Explain the relationship of the proton number to the element's identity. d. Explain the relationship of isotopes to the relative abundance of atoms of a particular element. e. Compare and contrast types of chemical bonds (i.e. ionic, covalent). f. Relate light emission and the movement of electrons to element identification.	
	SPS2. Students will explore the nature of matter, its classifications, and its system for naming types of matter. a. Calculate density when given a means to determine a substance's mass and volume. b. Predict formulas for stable binary ionic compounds based on balance of charges. c. Use IUPAC nomenclature for transition between chemical names and chemical formulas of • binary ionic compounds	**SC1 Students will analyze the nature of matter and its classifications.** a. Relate the role of nuclear fusion in producing essentially all elements heavier than helium. b. Identify substances based on chemical and physical properties. c. Predict formulas for stable ionic compounds (binary and tertiary) based on balance of charges. d. Use IUPAC nomenclature for both chemical names and formulas: • Ionic compounds (Binary and	

	(containing representative elements). • binary covalent compounds (i.e. carbon dioxide, carbon tetrachloride). d. Demonstrate the Law of Conservation of Matter in a chemical reaction. e. Apply the Law of Conservation of Matter by balancing the following types of chemical equations: • Synthesis • Decomposition • Single Replacement Double Replacement	tertiary) • Covalent compounds (Binary and tertiary) • Acidic compounds (Binary and tertiary) **SC2 Students will relate how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions.** a. Identify and balance the following types of chemical equations: • Synthesis • Decomposition • Single Replacement • Double Replacement • Combustion b. Experimentally determine indicators of a chemical reaction specifically precipitation, gas evolution, water production, and changes in energy to the system. c. Apply concepts of the mole and Avogadro's number to conceptualize and calculate • Empirical/molecular formulas, • Mass, moles and molecules relationships, • Molar volumes of gases. d. Identify and solve different types of stoichiometry problems, specifically relating mass to moles and mass to mass. e. Demonstrate the conceptual principle of limiting reactants. f. Explain the role of equilibrium in chemical reactions.	

	SPS3. Students will distinguish the characteristics and components of radioactivity. a. Differentiate among alpha and beta particles and gamma radiation. b. Differentiate between fission and fusion. c. Explain the process half-life as related to radioactive decay. d. Describe nuclear energy, its practical application as an alternative energy source, and its potential problems.		**SP2. Students will evaluate the significance of energy in understanding the structure of matter and the universe.** a. Relate the energy produced through fission and fusion by stars as a driving force in the universe. b. Explain how the instability of radioactive isotopes results in spontaneous nuclear reactions.
	SPS4. Students will investigate the arrangement of the Periodic Table. a. Determine the trends of the following: • Number of valence electrons • Types of ions formed by representative elements • Location of metals, nonmetals, and metalloids • Phases at room temperature b. Use the Periodic Table to predict the above properties for representative elements.	**SC4. Students will use the organization of the Periodic Table to predict properties of elements.** a. Use the Periodic Table to predict periodic trends including atomic radii, ionic radii, ionization energy, and electronegativity of various elements. b. Compare and contrast trends in the chemical and physical properties of elements and their placement on the Periodic Table.	
	SPS5. Students will compare and contrast the phases of matter as they relate to atomic and molecular motion. a. Compare and contrast the atomic/molecular motion of solids, liquids, gases and plasmas. b. Relate temperature, pressure, and volume of gases to the behavior of gases.	**SC6. Students will understand the effects motion of atoms and molecules in chemical and physical processes.** a. Compare and contrast atomic/molecular motion in solids, liquids, gases, and plasmas. b. Collect data and calculate the amount of heat given off or taken in by chemical or physical processes. c. Analyzing (both conceptually and quantitatively) flow of energy during	

		change of state (phase). Teacher Note: The use of Gas Laws to achieve this standard is permissible, but not mandated.	
	SPS6. Students will investigate the properties of solutions. a. Describe solutions in terms of • solute/solvent • conductivity • concentration b. Observe factors affecting the rate a solute dissolves in a specific solvent. c. Demonstrate that solubility is related to temperature by constructing a solubility curve. d. Compare and contrast the components and properties of acids and bases. e. Determine whether common household substances are acidic, basic, or neutral.	**SC7. Students will characterize the properties that describe solutions and the nature of acids and bases.** a. Explain the process of dissolving in terms of solute/solvent interactions: • Observe factors that effect the rate at which a solute dissolves in a specific solvent, • Express concentrations as molarities, • Prepare and properly label solutions of specified molar concentration, • Relate molality to colligative properties. b. Compare, contrast, and evaluate the nature of acids and bases: • Arrhenius, Bronsted-Lowry Acid/Bases • Strong vs. weak acids/bases in terms of percent dissociation • Hydronium ion concentration • pH • Acid-Base neutralization	
S8P2. Students will be familiar with the forms and transformations of energy. a. Explain energy transformation in terms of the Law of Conservation of Energy. b. Explain the relationship between potential and kinetic energy. c. Compare and contrast the different forms of energy (heat, light, electricity, mechanical motion, sound) and their characteristics.	**SPS7. Students will relate transformations and flow of energy within a system.** a. Identify energy transformations within a system (e.g. lighting of a match). b. Investigate molecular motion as it relates to thermal energy changes in terms of conduction, convection, and radiation. c. Determine the heat capacity of a substance using mass, specific heat,		**SP3. Students will evaluate the forms and transformations of energy.** a. Analyze, evaluate, and apply the principle of conservation of energy and measure the components of work-energy theorem by • describing total energy in a closed system. • identifying different types of potential energy. • calculating kinetic energy given

d. Describe how heat can be transferred through matter by the collisions of atoms (conduction) or through space (radiation). In a liquid or gas, currents will facilitate the transfer of heat (convection).	and temperature. d. Explain the flow of energy in phase changes through the use of a phase diagram.		mass and velocity. • relating transformations between potential and kinetic energy. b. Explain the relationship between matter and energy. c. Measure and calculate the vector nature of momentum. d. Compare and contrast elastic and inelastic collisions. e. Demonstrate the factors required to produce a change in momentum. f. Analyze the relationship between temperature, internal energy, and work done in a physical system. g. Analyze and measure power.
S8P3. Students will investigate relationship between force, mass, and the motion of objects. a. Determine the relationship between velocity and acceleration. b. Demonstrate the effect of balanced and unbalanced forces on an object in terms of gravity, inertia, and friction. c. Demonstrate the effect of simple machines (lever, inclined plane, pulley, wedge, screw, and wheel and axle) on work.	**SPS8. Students will determine relationships among force, mass, and motion.** a. Calculate velocity and acceleration. b. Apply Newton's three laws to everyday situations by explaining the following: • Inertia • Relationship between force, mass and acceleration • Equal and opposite forces c. Relate falling objects to gravitational force d. Explain the difference in mass and weight. e. Calculate amounts of work and mechanical advantage using simple machines.		**SP1. Students will analyze the relationships between force, mass, gravity, and the motion of objects.** a. Calculate average velocity, instantaneous velocity, and acceleration in a given frame of reference. b. Compare and contrast scalar and vector quantities. c. Compare graphically and algebraically the relationships among position, velocity, acceleration, and time. d. Measure and calculate the magnitude of frictional forces and Newton's three Laws of Motion. e. Measure and calculate the magnitude of gravitational forces. f. Measure and calculate two-dimensional motion (projectile and circular) by using component vectors. g. Measure and calculate centripetal force.

			h. Determine the conditions required to maintain a body in a state of static equilibrium.
S8P4. Students will explore the wave nature of sound and electromagnetic radiation. a. Identify the characteristics of electromagnetic and mechanical waves. b. Describe how the behavior of light waves is manipulated causing reflection, refraction diffraction, and absorption. c. Explain how the human eye sees objects and colors in terms of wavelengths. d. Describe how the behavior of waves is affected by medium (such as air, water, solids). e. Relate the properties of sound to everyday experiences. f. Diagram the parts of the wave and explain how the parts are affected by changes in amplitude and pitch.	**SPS9. Students will investigate the properties of waves.** a. Recognize that all waves transfer energy. b. Relate frequency and wavelength to the energy of different types of electromagnetic waves and mechanical waves. c. Compare and contrast the characteristics of electromagnetic and mechanical (sound) waves. d. Investigate the phenomena of reflection, refraction, interference, and diffraction. e. Relate the speed of sound to different mediums. f. Explain the Doppler Effect in terms of everyday interactions.		**SP4. Students will analyze the properties and applications of waves.** a. Explain the processes that results in the production and energy transfer of electromagnetic waves. b. Experimentally determine the behavior of waves in various media in terms of reflection, refraction, and diffraction of waves. c. Explain the relationship between the phenomena of interference and the principle of superposition. d. Demonstrate the transfer of energy through different mediums by mechanical waves. e. Determine the location and nature of images formed by the reflection or refraction of light.
S8P5. Students will recognize characteristics of gravity, electricity, and magnetism as major kinds of forces acting in nature. a. Recognize that every object exerts gravitational force on every other object and that the force exerted depends on how much mass the objects have and how far apart they are. b. Demonstrate the advantages and disadvantages of series and parallel circuits and how they transfer energy. c. Investigate and explain that electric	**SPS10. Students will investigate the properties of electricity and magnetism.** a. Investigate static electricity in terms of • friction • induction • conduction b. Explain the flow of electrons in terms of • alternating and direct current. • the relationship among voltage, resistance and current.		**SP5. Students will evaluate relationships between electrical and magnetic forces.** a. Describe the transformation of mechanical energy into electrical energy and the transmission of electrical energy. b. Determine the relationship among potential difference, current, and resistance in a direct current circuit. c. Determine equivalent resistances in series and parallel circuits. d. Determine the relationship between moving electric charges and magnetic

currents and magnets can exert force on each other.	• simple series and parallel circuits. c. Investigate applications of magnetism and/or its relationship to the movement of electrical charge as it relates to • electromagnets • simple motors • permanent magnets		fields.
		SC5. Students will understand that the rate at which a chemical reaction occurs can be affected by changing concentration, temperature, or pressure and the addition of a catalyst. a. Demonstrate the effects of changing concentration, temperature, and pressure on chemical reactions. b. Investigate the effects of a catalyst on chemical reactions and apply it to everyday examples. c. Explain the role of activation energy and degree of randomness in chemical reactions.	
			SP6. The student will describe the corrections to Newtonian physics given by quantum mechanics and relativity when matter is very small, moving fast compared to the speed of light, or very large. a. Explain matter as a particle and as a wave. b. Describe the Uncertainty Principle. c. Explain the differences in time, space, and mass measurements by two observers when one is in a frame of reference moving at constant velocity parallel to one of the coordinate axes

			of the other observer's frame of reference if the constant velocity is greater than one tenth the speed of light. d. Describe the gravitational field surrounding a large mass and its effect on a ray of light.