Chemistry K-12 Vertical Alignment

Topic	Kinder §112.2	1st §112.3	2nd §112.4	3rd §112.5	4th §112.6	5th §112.7	6th §112.26	7th §112.27	8th §112.28	Biology §112.42	IPC §112.44	Chemistry §112.43	Physics §112.45	Earth Systems §112.49	Environmental Science §112.50	Aquatic Science §112.47	Astronomy §112.48
Physical & Chemical Properties	K.6.A The student is expected to identify and record observable physical properties of objects, including shape, color, texture, and material, and generate ways to classify objects.	1.6.A classify objects by observable physical properties, including, shape, color, and texture, and attributes such as larger and smaller and heavier and lighter;	2.6.A classify matter by observable physical properties, including texture, flexibility, and relative temperature, and identify whether a material is a solid or liquid;	3.6.A measure, test, and record physical properties of matter, including temperature, mass, magnetism, and the ability to sink or float in water; 3.6.B describe and classify samples of matter as solids, liquids, and gases and demonstrate that solids have a definite shape and that liquids and gases take the shape of their container;	4.6.A classify and describe matter using observable physical properties, including temperature, mass, magnetism, relative density (the ability to sink or float in water), and physical state (solid, liquid, gas);	5.6.A compare and contrast matter based on measurable, testable, or observable physical properties, including mass, magnetism, relative density (sinking and floating using water as a reference point), physical state (solid, liquid, gas), volume, solubility in water, and the ability to conduct or insulate thermal energy and electric energy;	6.6.C identify elements on the periodic table as metals, nonmetals, metalloids , and rare Earth elements based on their physical properties and importance to modern life; 6.6.D compare the density of substances relative to various fluids; and 6.6.A compare solids, liquids, and gases in terms of their structure, shape, volume, and kinetic energy of atoms and molecules;		8.6.C describe the properties of cohesion, adhesion, and surface tension in water and relate to observable phenomena such as the formation of droplets, transport in plants, and insects walking on water; 8.6.D compare and contrast the properties of acids and bases, including pH relative to water; and		IPC.7.B use patterns within the Periodic Table to predict the relative physical and chemical properties of elements; IPC.7.C explain how physical and chemical properties of substances are related to their usage in everyday life such as in sunscreen, cookware, industrial applications, and fuels;	Chem.5.A explain the development of the Periodic Table over time using evidence such as chemical and physical properties; Chem.5.B predict the properties of elements in chemical families, including alkali metals, alkaline earth metals, halogens, noble gases, and transition metals, based on valence electrons patterns using the Periodic Table; and (Concept moved from 8.5B) Chem.12.B define acids and bases and distinguish between Arrhenius and Bronsted-Lowry definitions; Chem.12.C differentiate between strong and weak acids and bases; Chem.12.E define pH and calculate the pH of a solution using the hydrogen ion concentration.				Aqua.5.A The student understands how the properties of water build the foundation of aquatic ecosystems. Aqua.5.B identify how aquatic ecosystems are affected by water's properties of adhesion, cohesion, surface tension, heat capacity, and thermal conductivity; Aqua.5.C explain how the density of water is critical for organisms in cold environments. Aqua.8.B collect and analyze pH, salinity, temperature, mineral content, nitrogen compounds, dissolved oxygen, Aqua.11.A examine basic principles of fluid dynamics, including hydrostatic pressure, density as a result of salinity, Aqua.11.C explain how fluid dynamics causes upwelling and lake turnover;	
Physical & Chemical Changes		1.6.B explain and predict changes in materials caused by heating and cooling; and 1.8.A investigate and describe applications of heat in everyday life such as cooking food or using a clothes dryer; 1.8.B describe how some changes caused by heat may be reversed such as melting butter and other changes cannot be reversed such as cooking an egg or baking a cake.	2.6.B conduct a descriptive investigation to explain how physical properties can be changed through processes such as cutting, folding, sanding, melting, or freezing; and	3.6.C predict, observe, and record changes in the state of matter caused by heating or cooling in a variety of substances such as ice becoming liquid water, condensation forming on the outside of a glass, or liquid water being heated to the point of becoming water vapor (gas); and			6.6.E identify the formation of a new substance by using the evidence of a possible chemical change, including production of a gas, change in thermal energy, production of a precipitate, and color change.	7.6.C distinguish between physical and chemical changes in matter;	8.6.B use the periodic table to identify the atoms involved in chemical reactions;		IPC.8.A investigate how changes in properties are indicative of chemical reactions such as hydrochloric acid with a metal, oxidation of metal, combustion, and neutralizing an acid with a base;	Chem.12.D predict products in acid-base reactions that form water; Chem.9.B differentiate among acid-base reactions, precipitation reactions, and oxidation-reduction reactions; Chem.13.C classify processes as exothermic or endothermic and represent energy changes that occur in chemical reactions using thermochemical equations or graphical analysis;					
Materials Science		1.6.C demonstrate and explain that a whole object is a system made of organized parts such as a toy that can be taken apart and put back together.	2.6.C demonstrate that small units such as building blocks can be combined or reassembled to form new objects for different purposes and explain the materials chosen based on their physical properties.	3.6.D demonstrate that materials can be combined based on their physical properties to create or modify objects such as building a tower or adding clay to sand to make a stronger brick and justify the selection of materials based on their physical properties.													
Types of Mixtures					4.6.B investigate and compare a variety of mixtures, including solutions that are composed of liquids in liquids and solids in liquids; and 4.6.C demonstrate that matter is conserved when mixtures such as soil and water or oil and water are formed.	5.6.B demonstrate and explain that some mixtures maintain physical properties of their substances such as iron filings and sand or sand and water; 5.6.C compare the properties of substances before and after they are combined into a solution and demonstrate that matter is conserved in solutions; and	6.6.B investigate the physical properties of matter to distinguish between pure substances, homogeneous mixtures (solutions), and heterogeneous mixtures;	7.6.D describe aqueous solutions in terms of solute and solvent, concentration, and dilution; and 7.6.E investigate and model how temperature, surface area, and agitation affect the rate of dissolution of solid solutes in aqueous solutions.	8.6.A explain by modeling how matter is classified as elements, compounds, homogeneous mixtures, or heterogeneous mixtures;		IPC.7.F plan and conduct an investigation to provide evidence that the rate of reaction or dissolving is affected by multiple factors such as particle size, stirring, temperature, and concentration.	Chem.11.B distinguish among types of solutions, including electrolytes and nonelectrolytes and unsaturated, saturated, and supersaturated solutions; Chem.11.A describe the unique role of water in solutions in terms of polarity; Chem.11E calculate the concentration of solutions in units of molarity; and Chem.11.F calculate the dilutions of solutions using molarity.				Aqua.7.C identify variables that affect the solubility of carbon dioxide and oxygen in water;	

											Chem.11.C investigate how solid and gas solubilities are influenced by temperature using solubility curves and how rates of dissolution are influenced by temperature, agitation, and surface area; Chem.11.D investigate the general rules regarding solubility and predict the solubility of the products of a double replacement reaction;					
Atomic Theory & the Periodic Table						5.6.D illustrate how matter is made up of particles that are too small to be seen such as air in a balloon.		7.6.A compare and contrast elements and compounds in terms of atoms and molecules, chemical symbols, and chemical formulas; 7.6.B use the periodic table to identify the atoms and the number of each kind within a chemical formula;			IPC.7.A model basic atomic structure and relate an element's atomic structure to its bonding, reactivity, and placement on the Periodic Table;	Chem.6.A construct models using Dalton's Postulates, Thomson's discovery of electron properties, Rutherford's nuclear atom, Bohr's nuclear atom, and Heisenberg's Uncertainty Principle to show the development of modern atomic theory over time; Chem.6.B describe the structure of atoms and ions, including the masses, electrical charges, and locations of protons and neutrons in the nucleus and electrons in the electron cloud; Chem.6.D calculate average atomic mass of an element using isotopic composition; and Chem.6.E construct models to express the arrangement of electrons in atoms of representative elements using electron configurations and Lewis dot structures. Chem.5.C analyze and interpret elemental data, including atomic radius, atomic mass, electronegativity, ionization energy, and reactivity to identify periodic trends. Chem.7.A construct an argument to support how periodic trends such as electronegativity can predict bonding between elements;					
Element Bonding												Chem.12.A name and write the chemical formulas for acids and bases using IUPAC nomenclature rules; Chem.7.B name and write the chemical formulas for ionic and covalent compounds using International Union of Pure and Applied Chemistry (IUPAC) nomenclature rules; Chem.7.C classify and draw electron dot structures for molecules with linear, bent, trigonal planar, trigonal pyramidal, and tetrahedral molecular geometries as explained by Valence Shell Electron Pair Repulsion (VSEPR) theory; and Chem.7.D analyze the properties of ionic, covalent, and metallic substances in terms of intramolecular and intermolecular forces. Chem.8.D differentiate between empirical and molecular formulas.					
												Chem.8.A define mole and apply the concept of molar mass to convert between moles and grams;					

Stoichiometry												Chem.8.B calculate the number of atoms or molecules in a sample of material using Avogadro's number; Chem.9.C perform stoichiometric calculations, including determination of mass relationships, gas volume relationships, and percent yield; Chem.8.C calculate percent composition of compounds; Chem.9.D describe the concept of limiting reactants in a balanced chemical equation.					
Conservation of Mass									8.6.E investigate how mass is conserved in chemical reactions and relate conservation of mass to the rearrangement of atoms using chemical equations, including photosynthesis.		IPC.8.B develop and use models to balance chemical equations and support the claim that atoms, and therefore mass, are conserved during a chemical reaction;	Chem.9.A interpret, write, and balance chemical equations, including synthesis, decomposition, single replacement, double replacement, and combustion reactions using the law of conservation of mass;					
Gas Laws												Chem.10.B describe and calculate the relationships among volume, pressure, number of moles, and temperature for an ideal gas; Chem.10.C define and apply Dalton's law of partial pressure.					
Nuclear											IPC.8.C research and communicate the uses, advantages, and disadvantages of nuclear reactions in current technologies; and	Chem.14.C give examples of applications of nuclear phenomena such as nuclear stability, radiation therapy, diagnostic imaging, solar cells, and nuclear power. Chem.14.A describe the characteristics of alpha, beta, and gamma radioactive decay processes in terms of balanced nuclear equations; Chem.14.B compare fission and fusion reactions;					
Key	SE containing blue text aligns with more than one topic. The black text is relevant to the topic in that row.																