Course/Grade Level: Chemistry Curriculum (10th Grade)

CH.1 Unifying Concepts: The following three items are incorporated within each individual unit as applicable.

Students will…

CH.1.1 ▲ understand technology is the application of scientific knowledge for functional purposes. (HS.5.1.1)

Additional Specificity:

a. Recognize technology is driven by the need to meet human needs and solve human problems.
b. Recognize engineering is the practical application of science to commerce or industry.
c. Recognize medicine is a practical application of science to human health.
d. Recognize all technological advances contain a potential for both gains and risks for society.

CH.1.2 ▲ understand natural resources from the lithosphere and ecosystems are required to sustain human populations. (HS.6.3.1)

Additional Specificity:

a. Recognize these processes of ecosystems include maintenance of the atmosphere, generation of soils, control of the hydrologic cycle, and recycling of nutrients. Humans are altering many of these processes, and the changes may be detrimental, beneficial, or both to ecosystem function.
b. Realize natural systems can reuse waste, but this capacity is limited. Recycling and environmentally sound decisions improve the quality of human life.

CH.1.3 develop an understanding that science is a human endeavor that uses models to describe and explain the physical universe. (HS.7.1)

CH.1.4 develop an understanding of the nature of scientific knowledge. (HS.7.2)

CH.1.5 understand science from historical perspectives. (HS.7.3)

CH.2 Students will develop science as inquiry.

Students will…

CH.2.1 ▲ actively engage in investigations, including developing questions, gathering and analyzing data, and designing and conducting research. (HS.1.1.2)

Additional Specificity: *Conduct scientific investigations including, when appropriate by:*

a. Formulating a testable hypothesis.
b. Identifying and testing variables (independent, dependent, and variables to be kept constant).
c. Using methods for gathering data this is observable, measurable, and replicable.
d. Analyzing and evaluating the results in order to clarify the questions and hypothesis, and to refine methods for further

CH.2.2 ▲ actively engage in using technological tools and mathematics in their own scientific investigations. (HS.1.1.3)

Additional Specificity:

a. Use a variety of technologies, such as hand tools, measuring instruments, calculators, and computers as an integral component of scientific investigations.
b. Use common mathematical functions to analyze and describe data. These would include the use of scientific notation, the SI units of measure, and proper rounding techniques for the recording of data.
c. Use statistical and graphing data analysis techniques.
d. Recognize that the accuracy and precision of the data, and therefore the quality of the investigation, depends on the instruments used.
e Use equipment properly and safely.

CH.3 Students will understand chemists kinetic and potential energy to explain the physical and chemical properties of matter on earth that may exist in any of these three states: solids, liquids and gases.

Students will…

CH.3.1 ▲ recognize that elements and molecules may exist as gases, liquids, or solids. Ionic compounds most commonly exist as solids. (HS.2A.2.1)

CH.3.2 ▲ comprehend that intermolecular attraction (attraction between molecules) determines the state of the molecule. (HS.2A.2.1)

Additional Specificity:

a. Examples of intermolecular attraction include hydrogen bonding, permanent dipole interaction, and induced dipole interaction.
b. Gases have the weakest and solids have the greatest intermolecular attraction.
c. The hydrogen bond is an intermolecular attraction responsible for the properties of water and many biological molecules.

CH.4 Students will analyze atomic structure.

Students will…

CH.4.1 ▲ understand atoms, the fundamental organizational unit of matter, are composed of subatomic particles. Chemists are primarily interested in protons, electrons, and neutrons found in the atom. (HS.2A.1.1)

Additional Specificity:

a. Identify atoms by the number of protons in the nucleus (the atomic number). The protons have a positive charge and a mass of 1 amu. Protons and neutrons are found in the small, dense, nucleus.
b. Recognize neutrons have a neutral charge and a mass of 1 amu.
c. Recognize electrons have a negative charge and are found outside the nucleus in an electron cloud. The mass of an electron is approximately 2,000 times smaller that a proton. The electrons determine the size and chemical properties of the atom.
d. Recognize the number of electrons is equal to the number of protons in a neutral atom. Ions have a different number of electrons than protons.

CH.4.2 understand isotopes are atoms with the same atomic number (same number of protons) but different numbers of neutrons. The nuclei of some atoms are radioactive isotopes that spontaneously decay, releasing radioactive energy. (HS.2A.1.2)

Additional Specificity:

a. Generalize the periodic tables reflects the average mass of the isotopes.
b. Identify examples of released radioactivity are alpha, beta, and gamma radiation.
c. Use the half-life of the isotope to calculate amounts of isotope present after a designated amount of time.
d. Balance a nuclear equation by using the sum of the atomic numbers and the sum of the mass numbers which must be equal on both sides of the equation.

CH.5 Students will understand the periodic table lists elements according to increasing atomic number. This table organizes physical and chemical trends by groups, periods, and sub-categories.

Students will…

CH.5.1 ▲ identify that elements in the same group have the same number of valence electrons and can be used to predict similar physical and chemical properties. Elements are grouped by similar ground state valence electron configurations. (HS.2A.2.2)

CH.5.2 ▲ conclude that as periods increase, the principle energy levels of the outermost (valence) electrons increase. (HS.2A.2.2)

Additional Specificity:

Electrons changing from one energy level to another may result in the emission or absorption of various forms of electromagnetic radiation, including a range of colors that form visible light. When there is color, there are electrons changing energy levels.

CH.5.3 ▲ identify sub-categories within the periodic table as metals, non-metals, metalloids, transition elements, intertransition elements and the s, p, d, and f blocks. (HS.2A.2.2)

Additional Specificity: *Nonmetals have a different physical and chemical properties than metals.*

a. For example, nonmetals have lower melting points, lower density, and are poorer conductors of electricity and heat.
b. Chemical properties depend on the subshell of the valence electrons which are different for metals and non-metals.

CH.6 Students will understand chemical bonds result when valence electrons are transferred or shared between atoms. Breaking a chemical bond requires energy. Formation of a chemical bond releases energy. Ionic compounds result from atoms transferring electrons. Molecular compounds result from atoms sharing electrons.
Students will…

CH.6.1 ▲ construct valence electron configurations which determine whether an atom gains, loses, or shares electrons to achieve a more stable electron configuration similar to the noble gases. (HS.2A.2.3)

CH.6.2 ▲ identify that positively charged ions are called cations, and negatively charged ions are called anions. (HS.2A.2.3)

Additional Specificity:
a. Cations are attracted to anions (opposite charges attract).
b. Most cations are metals; most anions are nonmetals.
c. In stable ionic compounds, the sum of the charges is zero.

CH.6.3 ▲ identify that covalent bonds form when two or more atoms share one or more pairs of electrons to achieve a more stable electron configuration.

Additional Specificity:
a. The two classifications of covalent bonds are nonpolar and polar.
b. The greater the eletronegativity difference between atoms involved in the bond, the more polar the bond.

CH.6.4 ▲ recognize that the energy required to break ionic bonds is greater that the energy required to break covalent bonds. (HS.2A.2.3)

Additional Specificity:
Heat exchange during a chemical reaction is often easily noticed: a reaction that absorbs heat will feel colder; a reaction that releases heat will feel warmer.

CH.6.5 ▲ define metallic bonding as free forming a negative sea of electrons surrounding the positive metal ions. (HS.2A.2.3)

CH.7 Students will understand a chemical reaction occurs when one or more substances (reactants) reacts to form a different chemical substance(s) (products). There are different types of chemical reactions all of which demonstrate the Law of Conservation of Matter and Energy.

Students will…

CH.7.1 ▲ identify that chemical reactions are written as balanced chemical equations. In ordinary chemical reactions, the number and kind of atoms must be conserved. (HS.2A.3.1)

CH.7.2 ▲ classify chemical reactions as synthesis, decomposition, combustion, single or double replacement. (HS.2A.3.1)

CH.7.3 ▲ recognize that two or more of the following may often identify chemical reactions: physical property change, effervescence, mass change, precipitation, light emission, and heat exchange. (HS.2A.3.1)

CH.7.4 ▲ recognize that the rate (speed) of a chemical reaction depends on such parameters as temperature, concentration, catalysts, inhibitors, surface area, and reaction type. (HS.2A.3.1)

CH.8 Students will perform stoichiometric calculations.

Students will…

CH.8.1 understand how to perform mathematical calculations regarding the Law of Conservation of Matter, i.e. through stoichiometric relationships. (HS.2A.3.2)

Additional Specificity:

Recognize reaction stoichiometry involves understanding the use of coefficients (moles) to balance equations and solve for a variety of relationships using the molar mass of the substances. Examples of these types of relationships include mole/mole, mole/mass, mole/volume, mass/volume, mass/mass, etc.

CH.8.2 recognize solutions have a variety of combinations of solute and solvent, and that there are many factors affecting the properties of the solutions.

Additional Specificity:

a. Calculate the concentrations of solutions, which are measured in molarity defined as the number of moles of solute per liter of solution.
b. Identify factors affecting the solubility and the rate of solution.
c. Recognize how concentration affects the colligative properties (vapor pressure reduction, boiling point elevation, freezing point depression, osmotic pressure).

CH.9 Students will understand the differences and reactions between acids, bases, and salts. Perform calculations to determine the concentration of ions in solutions.

Students will…

CH.9.1 identify that acids react with bases to produce water and salt. (HS.2A.3.2)

CH.9.2 recognize that pH is a logarithmic function of hydronium ion concentration. As the pH decreases, the hydronium ion concentration increase. pOH and hydroxide concentrations are found in a similar way.

CH.9.3 determine the concentration of an unknown acid or base by experimental titration and use of $M_{acid} \times V_{acid} = M_{base} \times V_{base}$.

CH.9.4 calculate using the dilution formula (M1 X V1 = M2 x V2), the concentration of a solution after diluting it with water.

CH.10 Students will recognize electrochemical cells operate as a result of oxidation/reduction reactions. Balancing oxidation/reduction reactions occurs by balancing the electrons being transferred.

Students will…

CH.10.1 assign oxidation numbers to elements within compounds as well as uncombined elements.

CH.10.2 define the oxidation and reduction processes in terms of the gain or loss of electrons and the change in oxidation number on the individual elements.

CH.10.3 write and balance half reactions and identify the oxidation and reduction processes. The half reactions will then be used to balance the overall equation.

CH.10.4 recognize that electrochemical cells (voltaic and electrolytic cells) function as a result of oxidation/reduction reactions.

CH.11 **▲ Students will understand carbon atoms can bond to each other in chains, rings, and branching networks to form a variety of molecular structures including relatively large molecules essential to life. Diamonds, a three-dimensional branching of carbon atoms and quartz, a repeated three-dimensional branching of silicon dioxide molecules, are further examples of network solids. Unique properties of network solids include hardness, high melting points, poor conductors - indicative of covalent bonding and stable geometry. (HS.2A.2.3.e)**

Students will…

CH.11.1 identify hydrocarbon compounds and draw structures using the IUPAC naming system.

CH.11.2 write molecular formulas for alkanes, alkenes and alkynes using the general formulas.

CH.11.3 draw structures of isomers for alkanes with less than ten carbons.