2022 - 2023, HS Chemistry, Quarter 1

Big Ideas/Key Concepts:
Note for any standards including both bold and non-bold portions, the bold portions of the standard are the focus for this quarter. Non-bold portions of the standard will be addressed later in the year.

Unit 1: Introduction to Matter & Energy

- Dalton's early model and what evidence he had (laws he used)
- Properties we can measure mass, temperature, pressure, volume, length
- Lavoisier, conceptual understanding of gas laws (excluding ideal)
- Energy at the conceptual level of particles and proportionality with graphs (linear and inverse) to explain gas laws

Unit 2: Introduction to Bonding & Nomenclature

Use properties to introduce bonding and nomenclature; metals and nonmetals; acids and bases; ionic and molecular compounds

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Standards	Student Friendly "I Can" Statements
CHEM1.PS1.11 Develop and compare historical models of the atom (from Democritus to quantum model) and construct arguments to show how scientific knowledge evolves over time, based on experimental evidence, critique, and alternative interpretations. (This standard is also addressed in the next unit.)	I can summarize the atomic models of Democritus and Dalton. I can, like Dalton, use common lab equipment and appropriate units of measurement to collect quantitative data, analyze that data, and effectively communicate the results of the investigation. I can analyze data sets using correct significant figures to determine accuracy and precision. I can explain how experimental evidence required the development of the atomic

CHEM1.<u>**PS1.2**</u> **Demonstrate that atoms, and therefore mass, are conserved during a chemical reaction** by balancing chemical equations.	model. I can interpret a particle model quantitatively and qualitatively in terms of conservation of mass. I can provide evidence for and explain the Law of Definite Proportion, Law of Multiple Proportion, and percent composition.
CHEM1.<u>**PS1.5**</u> **Conduct investigations to explore and characterize the behavior of gases (pressure, volume, temperature), develop models to represent this behavior and construct arguments to explain this behavior. Evaluate the relationship (qualitatively** and quantitatively**) at STP between pressure and volume (Boyle's law), temperature and volume (Charles's law), temperature and pressure (Gay-Lussac law),** and moles and volume (Avogadro's law), **and evaluate and explain these relationships with respect to kinetic-molecular theory. Be able to understand, establish, and predict the relationships between volume, temperature, and pressure using combined gas law** both **qualitatively** and quantitatively.	I can use a particle model to represent the behavior of solids, liquids, gases and phase changes. I can plan and perform an experiment analyzing the connections between pressure, volume, and temperature of a gas. I can evaluate and explain these relationships with respect to kinetic-molecular theory. I can qualitatively apply the gas laws.
CHEM1.<u>**PS3.4**</u> Analyze energy changes to explain and defend the law of conservation of energy.	I can use experimental evidence to explain and defend the law of conservation of energy. I can model the flow of energy.
CHEM1.<u>**PS1.13**</u> Use the periodic table and electronegativity differences of elements to **predict the types of bonds** that are formed between atoms during chemical reactions and **write the names of chemical**	I can relate bond type to patterns of naming ionic and covalent compounds. I can predict the formulas and names of ionic and covalent compounds.

compounds, including polyatomic ions using the IUPAC system	
CHEM1.PS1.12 Explain the origin and organization of the Periodic Table. **Predict chemical and physical properties** of main group elements (reactivity, number of subatomic particles, **ion charge**, ionization energy, atomic radius, and electronegativity) based on **location on the periodic table.** Construct an argument to describe how the quantum mechanical model of the atom (e.g., patterns of valence and inner electrons) defines periodic properties. Use the periodic table to draw Lewis dot structures and show understanding of orbital notations through drawing and interpreting graphical representations (i.e. arrows representing electrons in an orbital).	I can predict ionic charge based on location on the Periodic Table.
CHEM1.PS1.8 Identify acids and bases as a special class of compounds with a specific set of properties.	I can predict the formulas and names of acids and bases.

2022 - 2023, HS Chemistry, Quarter 2

Big Ideas/Key Concepts:

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Unit 3: Chemical Quantities

Chemical quantities leading into reactions – the mole; embed solution chemistry (molarity, but not solubility charts and not intermolecular forces); for honors, optional to calculate the empirical and molecular formulas of a compound, and percent yield of a reaction.

Unit 4: Chemical Reactions: Particles & Energy

Reactions – can embed some energy; for honors, optional to do redox reactions and net ionic.

Unit 5: Stoichiometry

Stoichiometry – can embed some energy

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Standards	Student Friendly "I Can" Statements
CHEM1.<u>**PS1.1**</u> Understand and be prepared to use values specific to chemical processes: the mole, molar mass, molarity, and percent composition.	I can calculate the molar mass of a substance. I can calculate the percent composition of elements in a compound. I can convert between the following quantities of a substance: mass, number of moles, number of particles, and liters at STP. I can calculate the molarity of a solution and use molarity in calculations.

CHEM1.PS1.2 Demonstrate that atoms, and therefore mass, are conserved during a chemical reaction by **balancing chemical equations**. **CHEM 1.PS1.4** Use the reactants in a chemical reaction to predict the products and identify reaction classes (synthesis, decomposition, combustion, single replacement, double replacement).	I can balance a chemical equation. I can classify a chemical reaction as synthesis, decomposition, combustion, single replacement, or double replacement. I can use reactants to predict the products of a chemical reaction. I can use activity series and solubility rules to predict the products of single replacement and double replacement reactions, respectively. I can model the law of conservation of mass using diagrams, calculations, and experiments.
CHEM1.PS3.4 Analyze energy changes to explain and defend the law of conservation of energy. **CHEM1.PS3.3 Distinguish between endothermic and exothermic reactions** by constructing potential energy diagrams and explaining the differences between the two using chemical terms (e.g., activation energy). **Recognize when energy is absorbed or given off depending on the bonds formed and bonds broken.**	I can model the flow of energy during physical changes and chemical reactions. I can explain and model the energy change resulting from breaking or forming bonds. I can label a reaction as endothermic or exothermic based on energy flow.
CHEM1.PS1.3 Perform stoichiometric calculations involving the following relationships: mole-mole; mass-mass; mole-mass; mole-particle; and mass-particle. Show a qualitative understanding of the phenomenon of percent yield, limiting, and excess reagents in a chemical reaction through pictorial and conceptual examples. (states of matter liquid and solid; excluding volume of gases)	I can solve stoichiometry problems. I can model and illustrate the concept of limiting and excess reactants. I can use experimental data to explain a reaction's percent yield. I can plan and carry out a reaction to produce and collect a desired amount of product. I can convert between the following quantities of a substance: mass, number of moles, and number of particles.

2022 - 2023, HS Chemistry, Quarter 3

Big Ideas/Key Concepts:

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Unit 6: Periodic Table & Atomic Structure

Periodic table structure and organization by properties (law of triads; law of octaves; Mendeleev; Mosely); atomic theory (JJ Thomson, Rutherford, nuclear atom, Bohr model with valence electrons and ionization energy data); atomic and ionic radii; EM spectrum concepts – for honors, optional to solve math calculations

Unit 7: Nuclear Chemistry

Nuclear chemistry (subatomic particles; isotopes; radioactive decay); for honors, optional to balance nuclear reactions and solve half-life problems.

Unit 8: Quantum Mechanical Model

Quantum mechanical model (Heisenberg); electron configurations; orbital diagrams; spdf – brings back periodic table and lots of earlier concepts. Convey excitement of merging of theories and models.

Unit 9: Bonding

Bonding and molecular shapes; electronegativity; Lewis structures

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Standards	Student Friendly "I Can" Statements
CHEM1.PS1.11 Develop and compare historical models of the atom (from Democritus to quantum model) **and**	I can draw and explain the Bohr Model of the first 18 elements. I can summarize the experiments, discoveries, and atomic models of Thomson,

construct arguments to show how scientific knowledge evolves over time, based on experimental evidence, critique, and alternative interpretations. ***Quantum will be covered later in Unit 8.***	Rutherford, Bohr. I can explain how experimental evidence required the refinement of the atomic model through the Bohr model. I can use evidence to defend and critique the various models of the atom and its subatomic structure.
CHEM1.PS1.12 Explain the origin and organization of the Periodic Table. Predict chemical and physical properties of main group elements (reactivity, number of subatomic particles, ion charge, ionization energy, atomic radius, and electronegativity) based on location on the periodic table. Construct an argument to describe how the quantum mechanical model of the atom (e.g., patterns of valence and inner electrons) defines periodic properties. Use the periodic table to draw Lewis dot structures and show understanding of orbital notations through drawing and interpreting graphical representations (i.e., arrows representing electrons in an orbital).	I can determine the number of valence electrons in an atom and predict ionic charge. I can explain the logic and origin of the Periodic Table. I can predict chemical and physical properties of main group elements. I can explain the observed periodic trends with respect to ionization energies, ionic radii, and atomic radii.
CHEM1.PS4.1 Using a model, explain why elements emit and absorb characteristic frequencies of light and how this information is used.	I can employ a Bohr model to qualitatively explain atomic absorption and emission. I can explain how emission spectra are characteristic of the elements. I can describe examples of how spectroscopy is used.
CHEM1.PS1.12 Explain the origin and organization of the Periodic Table. Predict chemical and physical properties of main group elements (reactivity, **number of subatomic particles**, ion charge, ionization energy, atomic radius, and electronegativity) based on location	I can determine the number of protons, neutrons, and electrons in an atom. I can determine the atomic number and mass number of isotopes.

on the periodic table. Construct an argument to describe how the quantum mechanical model of the atom (e.g., patterns of valence and inner electrons) defines periodic properties. Use the periodic table to draw Lewis dot structures and show understanding of orbital notations through drawing and interpreting graphical representations (i.e., an arrow representing electrons in an orbital).	
CHEM1. **PS1.10** Compare alpha, beta, and gamma radiation in terms of mass, charge, and penetrating power. Identify examples of applications of different radiation types in everyday life (such as its applications in cancer treatment).	I can compare forms of nuclear radiation in terms of symbol, mass, charge, and penetrating power. I can identify and explain applications of radiation in everyday life.
CHEM1.PS 1.9 Draw models (qualitative models such as pictures or diagrams) to demonstrate understanding of radioactive stability and decay. Understand and differentiate between fission and fusion reactions. Use models (graphs or tables) to explain the concept of half-life and its use in determining the age of materials (such as radiometric dating).	I can model radioactive decay using pictures or diagrams. I can compare fission and fusion reactions. I can use graphs or tables to model half-life.
CHEM1.PS1.11 Develop and compare historical models of the atom (from Democritus to **quantum model)** and construct arguments to show how scientific knowledge evolves over time, based on experimental evidence, critique, and alternative interpretations. **CHEM1.PS1.12** Explain the origin and organization of the Periodic Table. Predict chemical and physical properties of main group elements (reactivity, number of subatomic particles, ion charge, ionization energy,	I can explain the limitations of the Bohr model and evidence that led to the quantum mechanical model. I can describe each atomic orbital (s, p, d, and f) in terms of shape, location, relative energy, and number of possible electrons. I can represent and explain an atom's electronic structure using orbital diagrams and electron configurations including noble gas electron configurations I can draw Lewis dot diagrams.

atomic radius, and electronegativity) based on location on the periodic table. Construct an argument to describe how the quantum mechanical model of the atom (e.g., patterns of valence and inner electrons) defines periodic properties. **Use the periodic table to draw Lewis dot structures and show understanding of orbital notations through drawing and interpreting graphical representations (i.e., arrows representing electrons in an orbital).**	
CHEM1.PS1.13 Use the periodic table and electronegativity differences of elements to predict the types of bonds that are formed between atoms during chemical reactions and write the names of chemical compounds, including polyatomic ions using the IUPAC system **CHEM1.PS1.14** Use Lewis dot structures and electronegativity differences to predict the polarities of simple molecules (linear, bent, trigonal planar, trigonal pyramidal, tetrahedral). Construct an argument to explain how electronegativity affects the polarity of basic chemical molecules.	I can use electronegativity differences or the periodic table to predict bond type. I can analyze potential Lewis structures to choose the best choice with a justification. I can apply and defend VSEPR theory. I can predict the shape and polarity for simple molecules.
CHEM1.PS2.1 Draw, identify, and contrast graphical representations of chemical bonds (ionic, covalent, and metallic) based on chemical formulas. Construct and communicate explanations to show that atoms combine by transferring or sharing electrons.	I can use Bohr diagrams and Lewis dot structures to model bonding. I can identify types of bonds represented by particle diagrams.

CHEM1.PS1.12 Explain the origin and organization of the Periodic Table. Predict chemical and physical properties of main group elements (reactivity, number of subatomic particles, ion charge, ionization energy, atomic radius, and electronegativity) based on location on the periodic table. **Construct an argument to describe how the quantum mechanical model of the atom (e.g., patterns of valence and inner electrons) defines periodic properties**. Use the periodic table to draw Lewis dot structures and show understanding of orbital notations through drawing and interpreting graphical representations (i.e., arrows representing electrons in an orbital).	I can use the quantum mechanical model to explain periodicity.

2022 - 2023, HS Chemistry, Quarter 4

Big Ideas/Key Concepts:
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Unit 10: Intermolecular Forces

Intermolecular forces (IMF) (Hydrogen bonding, London dispersionary, dipole-dipole), with continuation of particle models; for honors, optional to include dipole-induced dipole

Unit 11: Solutions, Acids & Bases

Solutions (colligative properties; particle models based on evidence; ppm); for honors, optional to include solubility rules and curves, percent by mass, molality, acids and bases titrations and dilution

Unit 12: Energy & Temperature

Kinetic molecular theory and energy; temperature; gas laws including Ideal Gas Law with the math; phase diagrams

Unit 13: Thermochemistry

Thermochemistry; calorimetry; heat of reactions; potential energy diagrams; heating curves; $q = mC\Delta T$

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Standards	Student Friendly "I Can" Statements
CHEM1.PS2.2 Understand that intermolecular forces created by the unequal distribution of charge result in varying degrees of attraction between molecules. Compare and contrast the intermolecular forces (hydrogen bonding, dipole-dipole bonding, and London	I can identify, explain, and model the intermolecular forces that exist between molecules. I can use intermolecular forces to compare and contrast physical properties.

dispersion forces) within different types of simple substances (only those following the octet rule) and predict and explain their effect on chemical and physical properties of those substances using models or graphical representations.	
CHEM1.PS1.7 Analyze solutions to identify solutes and solvents, quantitatively analyze concentrations (molarity, percent composition, and ppm), and **perform separation methods such as evaporation, distillation, and/or chromatography and show conceptual understanding of distillation**. **Construct an argument to justify the use of certain separation methods under different conditions.**	I can model how distillation separates mixtures. I can create, execute, and explain a plan to separate a mixture. I can construct an argument to justify using certain separation methods under different conditions.
CHEM1.PS1.7 Analyze solutions to identify solutes and solvents, quantitatively analyze concentrations (molarity, percent composition, and ppm), and perform separation methods such as evaporation, distillation, and/or chromatography and show conceptual understanding of distillation. Construct an argument to justify the use of certain separation methods under different conditions.	I can analyze solutions to identify the solute and solvent. I can prepare a solution of known concentration. I can calculate, analyze, and compare concentrations in terms of molarity, percent composition, and ppm.
CHEM1.PS1.15 Investigate, describe, and mathematically determine the effect of solute concentration on vapor pressure using the solute's van't Hoff factor on freezing point depression and boiling point elevation. *Note: interpret van't Hoff factor graphically not through mathematical calculations.*	I can plan and perform experiments investigating colligative properties I can use experimental evidence to relate concentration and colligative properties.

CHEM1.<u>**PS1.8**</u> Identify acids and bases as a special class of compounds with a specific set of properties.	I can identify acids and bases based on formulas, response to indicators, pH and their behaviors.
CHEM1.<u>**PS2.3**</u> Construct a model to explain the process by which solutes dissolve in solvents and develop an argument to describe how intermolecular forces affect the solubility of different chemical compounds.	I can use forces of attraction to predict and explain solubility. I can model solvation.
CHEM1.<u>**PS2.4**</u> Conduct an investigation to determine how temperature, surface area, and stirring affect the rate of solubility. Construct an argument to explain the relationships observed in experimental data using collision theory.	I can design, conduct, and analyze factors affecting the rate of solvation. I can use collision theory to explain the rate of solvation.
CHEM1.<u>**PS1.5**</u> Conduct investigations to explore and characterize the behavior of gases (pressure, volume, temperature), develop models to represent this behavior and construct arguments to explain this behavior. **Evaluate the relationship** (qualitatively and **quantitatively) at STP between pressure and volume (Boyle's law), temperature and volume (Charles's law), temperature and pressure (Gay-Lussac law), and moles and volume (Avogadro's law),** and evaluate and explain these relationships with respect to kinetic-molecular theory. **Be able to understand, establish, and predict the relationships between volume, temperature, and pressure using combined gas law** both qualitatively and **quantitatively.**	I can relate the properties of a gas to the number of particles in the sample. I can quantitatively apply **all** the gas laws.

CHEM1.<u>PS1.6</u> Use the ideal gas law, PV = nRT, to algebraically evaluate the relationship among the number of moles, volume, pressure, and temperature for ideal gases.	I can solve problems using the ideal gas law. I can carry out and analyze an experiment that applies the ideal gas law.
CHEM1.<u>PS3.2</u> Draw and interpret heating and cooling curves and phase diagrams. Analyze the energy changes involved in calorimetry by using the law of conservation of energy quantitatively (use of $q=mc\Delta T$) and qualitatively.	I can draw and interpret heating and cooling curves. I can draw and interpret phase diagrams. I can relate heat, mass, specific heat capacity, and temperature change. I can solve problems using q = mC**ΔT.** I can use the law of conservation of energy to plan, carry out, analyze, improve, and explain a calorimetry experiment.
CHEM1.<u>PS3.1</u> Contrast the concepts of temperature and heat flow in macroscopic and microscopic terms. Understand that thermal energy is a form of energy and temperature is a measure of average kinetic energy of a molecule.	I can use a particle model to explain heat and temperature. I can describe how heat energy flows in a system.
CHEM1.<u>PS3.3</u> Distinguish between endothermic and exothermic reactions **by constructing potential energy diagrams and explaining the differences between the two using chemical terms (e.g., activation energy).** Recognize when energy is absorbed or given off depending on the bonds formed and bonds broken.	I can draw and interpret potential energy diagrams. I can relate the components of a potential energy diagram to breaking and forming bonds in a chemical reaction.