Chemistry Standards

Unit Title: Introduction to Chemistry and Scientific Investigations	**Duration:** 5 weeks

Objectives:

- TLW understand how to apply significant figures, metric units and mathematical equations to solve contextual problems and apply these concepts to scientific investigations.
- TLW understand the concepts of chemical and physical changes and properties and distinguish between them

Standards:

C5.2B: Distinguish between chemical and physical changes in terms of the properties of the reactants and products.
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.
C1.1A: Generate new questions that can be investigated in the laboratory or field.
C1.1B: 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.
C1.1C: 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).
C1.1f: Predict what would happen if the variables, methods, or timing of an investigation were changed.

Literacy Activities:

- Close reading of high level, complex text
- Entrance and exit slips
- Teacher/Student Think/Read Aloud
- Complex, Contextual Problem Solving
- Pair & share, group work
- Using the Internet for accurate information acquisition

Skills:

- using significant figures
- using the metric system and unit conversion
- solving complex contextual problems
- use the Internet to acquire accurate information including data, formulas and instructions
- properly using scientific instruments
- within the context of lab work, students will be able to follow directions, collect accurate data, use spreadsheets to report accurate results and calculate and identify sources of errors.

Vocabulary:

chemical change density expected value formula	observed value percent error physical change	scientific experiment significant figures subscript

Unit Title: Gas Laws	**Duration:** 3 weeks

Objectives:
TLW apply the kinetic molecular theory to describe and explain physical and chemical properties of matter and phase changes.
TLW use kinetic molecular theory to describe and explain the behavior of gases.
TLW apply the gas laws to solve complex, contextual gas law problems.

Standards:
C5.2f: Predict volumes of product gases using initial volumes of gases at the same temperature and pressure.
C5.4d: Explain why freezing is an exothermic change of state.
C3.3B: Describe melting on a molecular level.
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.
C2.2c: Explain changes in pressure, volume, and temperature for gases using the kinetic molecular model.
C2.2d: Explain convection and the difference in transfer of thermal energy for solids, liquids, and gases using evidence that molecules are in constant motion.
C2.2e: Compare the entropy of solids, liquids, and gases.
C2.2f: Compare the average kinetic energy of the molecules in a metal object and a wood object at room temperature.
C4.4a: Explain why at room temperature different compounds can exist in different phases.
C4.5a: Provide macroscopic examples, atomic and molecular explanations, and mathematical representations (graphs and equations) for the pressure-volume relationship in gases.
C4.5b: Provide macroscopic examples, atomic and molecular explanations, and mathematical representations (graphs and equations) for the pressure-temperature relationship in gases.
C4.5c: Provide macroscopic examples, atomic and molecular explanations, and mathematical representations (graphs and equations) for the temperature-volume relationship in gases.
P4.p1A : 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 phase

Literacy Activities:
- Close reading of high level, complex text
- Entrance and exit slips
- Teacher/Student Think/Read Aloud
- Complex, Contextual Problem Solving
- Pair & share, Group work
- Using the Internet for accurate information acquisition

Skills:
- solve complex, contextual gas law problems
- understand the difference between boiling and evaporation
- understand the energy changes associated with phase changes
- understand the difference between heat and temperature
- understand the relationship between molecular motion and temperature

Vocabulary:

atoms	fusion	rotational motion
atmosphere	heat	STP
boiling point	intermolecular	sublimation
condensation	kinetic molecular theory	thermal contraction
crystallization	kinetic energy	thermal expansion
deposition	Kelvin temperature scale	translational motion
evaporation	molecules	vapor pressure
freezing point	pascal	vibrational motion

Unit Title: Compound Prediction	**Duration:** 2 week

Objective:
TLW predict bonding between two atoms of different elements, ions or polyatomic ions

Standards:
C5.5A: Predict if the bonding between two atoms of different elements will be primarily ionic or covalent.
5.5B: Predict the formula for binary compounds of main group elements.
5.7A: Recognize formulas for common inorganic acids, carboxylic acids, and bases formed from families I and II.

Literacy Activities:
- Close reading of high level, complex text
- Entrance and exit slips
- Teacher/Student Think/Read Aloud
- Complex, Contextual Problem Solving
- Pair & share, Group work
- Using the Internet for accurate information acquisition

Skills:
- understand why ions form
- understand why ions have a certain charge
- predict oxidation numbers of elements based on the periodic table
- predict how two atoms, ions or polyatomic ions form compounds

Vocabulary:

anion bond cation	compound element ion	oxidation number polyatomic ion stability

Unit Title: Nomenclature	**Duration:** 3 weeks

Objective:
TLW name inorganic compounds as well as write the molecular formula from the name

Standards:
C5.5B: Predict the formula for binary compounds of main group elements.
C5.7A: Recognize formulas for common inorganic acids, carboxylic acids, and bases formed from families I and II.
C4.2A: Name simple binary compounds using their formulae
C4.2B: Given the name, write the formula of simple binary compounds.
C4.2c: Given a formula, name the compound.
C4.2d: Given the name, write the formula of ionic and molecular compounds.

Literacy Activities:
- Close reading of high level, complex text
- Entrance and exit slips
- Teacher/Student Think/Read Aloud
- Complex, Contextual Problem Solving
- Pair & share, Group work
- Using the Internet for accurate information acquisition

Skills:
- Name binary compounds, ternary compounds and acids in both the old and Stock format

Vocabulary:

acid binary	Stock	ternary

Unit Title: Pre-stoichiometry	**Duration:** 1.5 week

Objectives:
TLW use stoichiometric methods to determine the relationships between atoms and molecules in elements and compounds.

Standards:
C4.1a: Calculate the percent by weight of each element in a compound based on the compound formula.
C4.6a: Calculate the number of moles of any compound or element given the mass of the substance.
C4.6b: Calculate the number of particles of any compound or element given the mass of the substance.
C5.2g: Calculate the number of atoms present in a given mass of element.

Literacy Activities:
- Close reading of high level, complex text
- Entrance and exit slips
- Teacher/Student Think/Read Aloud
- Complex, Contextual Problem Solving
- Pair & share, Group work
- Using the Internet for accurate information acquisition

Skills:
- understand and use the concept of percent composition
- determine from the periodic table the atomic mass of elements and formula mass or molecular mass of various compounds.
- use dimensional analysis to convert between mass, volume of gases and number of species.

Vocabulary:

atomic mass avogadro's number coefficient	empirical formula dimensional analysis mole	molecular formula percent composition subscript

Unit Title: Stoichiometry	**Duration:** 4.5 weeks

Objective:
TLW use stoichiometric methods to determine relationships between atoms and molecules in elements, compounds and chemical reactions.
TLW predict the products from the reactants

Standards:
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.
C5.2d: Calculate the mass of a particular compound formed from the masses of starting materials.
C5.2e: Identify the limiting reagent when given the masses of more than one reactant.
C5.6b: Predict single replacement reactions.

Literacy Activities:
- Close reading of high level, complex text
- Entrance and exit slips
- Teacher/Student Think/Read Aloud
- Complex, Contextual Problem Solving
- Pair & share, Group work
- Using the Internet for accurate information acquisition

Skills:
- balance chemical reactions
- given reactants, calculate the expected products produced as well as the reactants in excess
- calculate percent yield
- predict products from reactants based on known patterns

Vocabulary:

combination decomposition double replacement percent yield products reactants single replacement theoretical yield		

Unit Title: Limiting Reactants	**Duration:** 2 week

Objective:
TLW solve stoichiometric limiting reactant problems

Standards:
C1.1C : 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).
C1.1D: Identify patterns in data and relate them to theoretical models.
C1.1h: Design and conduct a systematic scientific investigation that tests a hypothesis. Draw conclusions from data presented in charts or tables.
C5.2e: Identify the limiting reagent when given the masses of more than one reactant.
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.
C5.2d: Calculate the mass of a particular compound formed from the masses of starting materials.
C5.2e: Identify the limiting reagent when given the masses of more than one reactant.

Literacy Activities:
- Close reading of high level, complex text
- Entrance and exit slips
- Teacher/Student Think/Read Aloud
- Complex, Contextual Problem Solving
- Pair & share, Group work
- Using the Internet for accurate information acquisition

Skills:
- solve limiting reactant problems

Vocabulary:

limiting reactant		

Unit Title: Electronic configurations	**Duration:** 2.5 weeks

Objectives:
TLW describe the energy of electrons according to quantum theory and express the organization of the electron using electron configuration and kernel structures
TLW categorize elements of the periodic table and explain how elements, ions, and isotopes differ in atomic structure.

Standards:
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.
C4.10e: Write the symbol for an isotope, X Z A , where Z is the atomic number, A is the mass number, and X is the symbol for the element.
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.
C4.8e: Write the complete electron configuration of elements in the first four rows of the periodic table.
C4.8f: Write kernel structures for main group elements.
C4.8h: Describe the shape and orientation of s and p orbitals.
C4.8i: Describe the fact that the electron location cannot be exactly determined at any given time.
C4.9A: Identify elements with similar chemical and physical properties using the periodic table.

Literacy Activities:
- Close reading of high level, complex text
- Entrance and exit slips
- Teacher/Student Think/Read Aloud
- Complex, Contextual Problem Solving
- Pair & share, Group work
- Using the Internet for accurate information acquisition

Skills:
- write electronic configuration of atoms, ions and compounds
- understand electronic orbitals
- understand energy levels and sublevels
- write both ground and excited states for compounds
- understand compound stability in terms of electronic configuration
- understand isotopes

Vocabulary:

absorption spectrum	energy level	orbital
bright-line spectrum	energy sublevel	p orbital
d orbital	excited state	protons
electrons	ground state	s orbital
electronic configuration	neutrons	valence electrons

Unit Title: Lewis Structures and Molecular Shape	**Duration:** 2.5 weeks

Objectives:
TLW predict bonding between two atoms of different elements and classify bonds as ionic, covalent, or polar covalent; and explain intermolecular forces
TLW be able to draw Lewis structure of molecules and use those structures to generate a 3D drawing of the expected shape of the molecule

Standards:
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.
C4.3c: Compare the relative strengths of forces between molecules based on the melting point and boiling point of the substances.
C4.3d: Compare the strength of the forces of attraction between molecules of different elements. (For example, at room temperature, chlorine is a gas and iodine is a solid.)
C4.3e: Predict whether the forces of attraction in a solid are primarily metallic, covalent, network covalent, or ionic based upon the elements' location on the periodic table.
C4.3f: Identify the elements necessary for hydrogen bonding (N, O, F).
C4.4b: Identify if a molecule is polar or nonpolar given a structural formula for the compound.

Literacy Activities:
- Close reading of high level, complex text
- Entrance and exit slips
- Teacher/Student Think/Read Aloud
- Complex, Contextual Problem Solving
- Pair & share, Group work
- Using the Internet for accurate information acquisition

Skills:
- writing Lewis structures of elements and compounds
- using Lewis structures, draw 3D pictures of molecules
- determine polarity of bonds and molecules

Vocabulary:

covalent compounds electronegativity pi bonds intramolecular	intermolecular ionic compounds metals metalloids	nonmetals polarity sigma bonds

Unit Title: Solutions	**Duration:** 1.5 week

Objectives:
TLW understand the solution process, including factors that affect rates and degree of solution, especially in terms of polarity of the solute/solvent.
TLW solve complex, contextual solution problems.

Standards:
C3.4A: Use the terms endothermic and exothermic correctly to describe chemical reactions in the laboratory.
C1.1C: 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).

Literacy Activities:
- Close reading of high level, complex text
- Entrance and exit slips
- Teacher/Student Think/Read Aloud
- Complex, Contextual Problem Solving
- Pair & share, Group work
- Using the Internet for accurate information acquisition

Skills:
- identifying the solute and solvent of a solution
- distinguish between the terms aqueous and liquid when applied to solutions
- predict solubility based on the polarity of the solute/solvent
- predict solubility based on solubility rules
- predict the degree and rate of solubility
- read solubility curves
- read solubility tables
- solve complex, contextual solution problems involving molarity, molality and percent mass.

Vocabulary:

aqueous	heat of solution	reaction rate	unsaturated
colligative properties	Le Chatelier's Principle	saturated	
concentration	molarity	solubility	
dissolving mechanism	molality	solute	
equilibrium	percent mass	solvent	

Unit Title: Acids and Bases	**Duration:** 3.5 weeks

Objective:
Using acid-base theory, TLW write equations for various acid-base reactions and determine the pH and concentration of various samples.

Standards:
C5.7A: Recognize formulas for common inorganic acids, carboxylic acids, and bases formed from families I and II.
C5.7B : Predict products of an acid-based neutralization.
C5.7D: Classify various solutions as acidic or basic, given their pH.
C5.7f: Write balanced chemical equations for reactions between acids and bases and perform calculations with balanced equations.
C5.7g: Calculate the pH from the hydronium ion or hydroxide ion concentration.

Literacy Activities:
- Close reading of high level, complex text
- Entrance and exit slips
- Teacher/Student Think/Read Aloud
- Complex, Contextual Problem Solving
- Pair & share, Group work
- Using the Internet for accurate information acquisition

Skills:
- define and identify acids and bases
- know strong acids and bases
- understand and use the equilibrium constant for aqueous solutions
- understand and use the pH and pOH scale
- solve complex, contextual strong acid-base problems
- solve complex, contextual dilution problems
- solve complex, contextual acid-base neutralization problems
- solve complex, contextual acid-base titration problems

Vocabulary:

acid	basic	hydroxide	neutralization
acid-base reaction	Bronsted-Lowry	ion	neutralize
acidic	carboxyl group	ionization	pH
alkaline	hydrogen ion	molarity	salt
aqueous (aq)	hydronium ion	neutral	titration

Unit Title: Introduction to Organic Chemistry	**Duration:** 2 week

Objective:
TLW draw and name structural formulas and isomers for simple hydrocarbon chains and recognize biological polymers.

Standards:
C5.8A: Draw structural formulas for up to ten carbon chains of simple hydrocarbons.
C5.8B: Draw isomers for simple hydrocarbons.
C3.2b: Describe the relative strength of single, double, and triple covalent bonds between atoms.
C2.r5d: Describe how and where all the elements on earth were formed.

Literacy Activities:
- Close reading of high level, complex text
- Entrance and exit slips
- Teacher/Student Think/Read Aloud
- Complex, Contextual Problem Solving
- Pair & share, Group work
- Using the Internet for accurate information acquisition

Skills:
- identify organic molecules
- understand and use structural complexity of organic compounds
- understand and use the different forms of isomerisms
- draw hydrocarbons
- name alkanes, alkenes, alkynes, cyclical and aromatic compounds
- identify the main functional groups

Vocabulary:

alkane	carbon	chemical bond	organic compound
alkene	carbon bonds	double bond	polymer
alkyne	carbon chain	hydrocarbon	structural formula
bond energy	carbon chemistry	isomer	synthetic polymer
branching network of carbon atoms	carbon ring	monomer	
alcohol	amine	ester	ether
aldehyde	carboxylic acid	ethene	ketone