

**CRLS**  
**Science Learning Expectations**  
**Chemistry Grade 10**

<b>CRLS Learning Expectations</b>	<b>Massachusetts Standard</b>	<b>Topic/Theme</b>	<b>Key Understandings</b>	<b>Assessments/Evidence</b>
First Quarter	1.1 Identify and explain some of the physical properties that are used to classify matter, e.g., density, melting point, and boiling point. 1.3 Describe the four states of matter (solid, liquid, gas, plasma) in terms of energy, particle motion, and phase transitions. 10.1 Interpret the law of conservation of energy 10.2 Explain the relationship between energy transfer and disorder in the universe  1.2 Explain the differences between mixtures and pure substances. 1.4 Distinguish between chemical and physical changes.	<b>Properties of Matter</b>  <i>Broad Concept:</i> Physical and chemical properties can be used to classify and describe matter.  There is a difference between a mixture of two elements and a new compound formed by the two elements.  <b>Thermochemistry (Enthalpy)</b>  <i>Broad Concept:</i> The driving forces of phase changes and chemical reactions are energy and entropy	The student will be able to . . .  <ul style="list-style-type: none"> <li>• Use dimensional analysis to convert units and solve density problems.</li> <li>• Interpret mass vs. volume graphs</li> <li>• Classify matter as a heterogeneous mixture, a homogeneous mixture, or a pure substance.</li> <li>• Identify and explain ways to physically separate two or more substances.</li> <li>• Distinguish between a compound and an element.</li> <li>• Distinguish between chemical and physical changes.</li> <li>• Describe the direction of flow of heat energy in a phase change.</li> <li>• Identify the phase or phase change in each section of a warming or cooling curve</li> <li>• Explain why a physical or chemical change is spontaneous based on entropy and enthalpy.</li> </ul>	<ul style="list-style-type: none"> <li>• Density lab</li> <li>• Classification of Matter Lab</li> <li>• Separation of a Physical Mixture Lab</li> <li>• Chemical or Physical Change Lab</li> <li>• Warming Curve Worksheet</li> <li>• Ice cube lab with Formal Lab Report</li> <li>• Rubber band lab</li> </ul>
	2.1 Trace the	<b>Atomic Structure</b>	• Describe experiments that led to	• Paragraph about the

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	<p>development of atomic theory and the structure of the atom from the ancient Greeks to the present (Dalton, Thomson, Rutherford, Bohr, and modern theory).</p> <p>2.2 Interpret Dalton's atomic theory in terms of the Laws of Conservation of Mass, Constant Composition, and Multiple Proportions.</p> <p>2.3 Identify the major components of the nuclear atom (protons, neutrons, and electrons) and explain how they interact.</p>	<p><i>Broad Concept:</i> The model of the atom has changed over time. An atom is a discrete unit. The atomic model can help us understand the interaction of elements and compounds observed on a macroscopic scale.</p>	<p>the discovery of subatomic particles.</p> <ul style="list-style-type: none"> <li>• Explain how the experimental results contributed to the current understanding of atomic structure.</li> <li>• Describe the Law of Definite Composition and the Law of Multiple Proportions, using examples to illustrate these laws.</li> <li>• Explain Dalton's Atomic Theory using the Laws of Definite Composition and Multiple Proportions.</li> </ul>	<p>properties of the electron and the supporting experimental evidence</p> <ul style="list-style-type: none"> <li>• Paragraph on the nucleus</li> <li>• Posters on the historical development of atomic theory, including diagrams of experiments</li> <li>• Paragraph on Dalton's Atomic Theory and the evidence to support the idea of the atom as a discrete unit.</li> <li>• Models of atoms</li> </ul>
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	<p>2.4 Understand that matter has properties of both particles and waves.</p> <p>2.5 Using Bohr's model of atom, interpret changes (emission/absorption) in electron energies in the hydrogen atom corresponding to emission transitions between quantum levels.</p> <p>2.6 Describe the electromagnetic spectrum in terms of wavelength and energy; identify regions of the electromagnetic spectrum.</p> <p>2.7 Write the electron configurations for elements in the first three rows of the periodic table.</p> <p>2.8 Describe alpha, beta, and gamma particles; discuss the properties of alpha, beta, and gamma radiation; and write balanced nuclear reactions. .</p>	<p><b>Atomic Structure (continued)</b></p>	<p>The student will be able to . . .</p> <ul style="list-style-type: none"> <li>• Draw the shapes of the orbitals and relate the number of nodes to the relative energy of the orbital sublevel.</li> <li>• Relate the wavelength of light in a line spectrum of an element to the difference in energy between two electron energy levels.</li> <li>• Determine the relative energy of electromagnetic radiation given the wavelength or region in the electromagnetic spectrum.</li> <li>• Calculate the energy of a photon, given the wavelength</li> <li>• Write the electron configurations for the elements in the first three rows of the periodic table.</li> <li>• Explain the penetrating ability of nuclear radiation as it relates to the size of the particle.</li> <li>• Write balanced equations for nuclear reactions.</li> </ul>	
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	<p>2.9 Compare nuclear fission and nuclear fusion and mass defect.</p> <p>2.10 Describe the process of radioactive decay as the spontaneous breakdown of certain unstable elements (radioactive) into new elements (radioactive or not) through the spontaneous emission by the nucleus of alpha or beta particles. Explain the difference between stable and unstable isotopes.</p> <p>2.11 Explain the concept of half-life of a radioactive element.</p>	<p><b>Atomic Structure (continued)</b></p>	<ul style="list-style-type: none"><li>• Describe ways in which nuclear chemistry has influenced society through development of nuclear weapons as well as cancer treatments.</li> <li>• Explain the concept of half-life of a radioactive element, e.g., explain why the half-life of C14 has made carbon dating a powerful tool in determining the age of very old objects.</li></ul>	<ul style="list-style-type: none"><li>• Nuclear Chemistry Topic Class Presentation</li></ul>
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<p>Second Quarter</p>	<p>3.1 Explain the relationship of an element's position on the periodic table to its atomic number and mass.</p> <p>3.2 Use the periodic table to identify metals, nonmetals, metalloids, families (groups), periods, valence electrons, and reactivity with other elements in the table.</p> <p>3.3 Relate the position of an element on the periodic table to its electron configuration.</p> <p>3.4 Identify trends on the periodic table (ionization energy, electronegativity, electron affinity, and relative size of atoms and ions).</p>	<p><b>3. Periodicity</b>  Broad Concept: Periodicity of physical and chemical properties relates to atomic structure and led to the development of the periodic table. The periodic table displays the elements in order of increasing atomic number.</p>	<ul style="list-style-type: none"> <li>• Determine the electron configuration of the element based on the position in the periodic table.</li> <li>• Explain the relationship between electron arrangement and physical and chemical properties of an element.</li> <li>• Explain the differences in the properties of metals and non-metals based differences in electron configuration</li> <li>• Explain the trends in the periodic table using electrostatic interactions.</li> </ul>	<ul style="list-style-type: none"> <li>• Element Report for Classroom Periodic Table of Elements</li> <li>• Metals and Non-metals lab</li> <li>• Discovering Properties of the Elements Lab</li> </ul>
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	<p>4.1 Explain how atoms combine to form compounds through both ionic and covalent bonding.</p> <p>4.2 Draw Lewis dot structures for simple molecules.</p> <p>4.3 Relate electronegativity and ionization energy to the type of bonding an element is likely to undergo.</p> <p>4.4 Predict the geometry of simple molecules and their polarity (valence shell electron pair repulsion).</p> <p>4.5 Identify the types of intermolecular forces present based on molecular geometry and polarity.</p> <p>4.6 Predict chemical formulas based on the number of valence electrons.</p> <p>4.7 Name and write the chemical formulas for simple ionic and molecular compounds, including those that contain common polyatomic ions.</p>	<p><b>4. Chemical Bonding</b>  <b>Broad Concept:</b>  <b>Atoms form bonds by the interactions of their valence electrons.</b></p> <p>Atomic structure influences bonding within molecules.</p> <p>The forces within and between particles explain the behavior of matter, such as why some substances are solid at room temperature while others are liquid and some are gases.</p>	<ul style="list-style-type: none"> <li>• Predict whether a bond between two elements will be ionic or covalent based on differences in electronegativities.</li> <li>• Draw Lewis structures and ball and stick diagrams of molecules.</li> <li>• Predict the shape of a molecule from Lewis structures.</li> <li>• Relate intermolecular forces to molecular geometry, bond polarity, and properties such as boiling point.</li> <li>• Name compounds using the binary and stock systems</li> <li>• Name organic molecules and draw the molecular structure.</li> </ul>	<ul style="list-style-type: none"> <li>• Molecular Model Building Lab</li> <li>• Begin Experimental Research Project</li> </ul>
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<p>Third Quarter</p>	<p>5.1 Balance chemical equations by applying the law of conservation of mass.</p> <p>5.2 Recognize synthesis, decomposition, single displacement, double displacement, and neutralization reactions.</p> <p>5.3 Understand the mole concept in terms of number of particles, mass, and gaseous volume.</p> <p>5.4 Determine molar mass, percent compositions, empirical formulas, and molecular formulas.</p> <p>5.5 Calculate mass-mass, mass-volume, volume-volume, and limiting reactant problems for chemical reactions.</p> <p>5.6 Calculate percent yield in a chemical reaction.</p>	<p><b>5. Chemical Reactions and Stoichiometry</b>  <b>Broad Concept: The conservation of atoms in chemical reactions leads to the ability to calculate the mass of products and reactants.</b></p> <p>It is possible to predict what product(s) will form when two substances are combined.</p> <p>Stoichiometry enables one to predict how much product will result from certain amounts of reactants.</p>	<ul style="list-style-type: none"> <li>• Predict the products that will form in a chemical reaction and identify the type of reaction.</li> <li>• Balance chemical equations including redox reactions.</li> <li>• Write net ionic equations.</li> <li>• Demonstrate an understanding of the mole concept.</li> <li>• Determine the percent composition of water in a hydrated compound.</li> <li>• Determine empirical formulas and chemical formulas</li> <li>• Relate stoichiometry problems to scaling up recipes</li> <li>• Perform mole to mole, mole to mass, mass to mole, and mass to mass calculations</li> <li>• Explain the concept of limiting reagents and predict how much product is possible</li> <li>• Calculate % yield</li> </ul>	<ul style="list-style-type: none"> <li>• Lab to Identify an Unknown Hydrate (Squeezing Water from Stone)</li> <li>• Lab to Determine the Percent Oxygen in Potassium Chlorate</li> <li>• Stoichiometry Lab using micropipettes and epindorfs.</li> </ul>
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	<p>6.1 Using the kinetic molecular theory, explain the relationship between pressure and volume (Boyle's law), volume and temperature (Charles' law), and the number of particles in a gas sample (Avogadro's hypothesis).</p> <p>6.2 Explain the relationship between temperature and average kinetic energy.</p> <p>6.3 Perform calculations using the ideal gas law.</p> <p>6.6 Use the combined gas law to determine changes in pressure, volume, or temperature.</p>	<p><b>6. Gases and Kinetic Molecular Theory</b></p> <p><b>Broad Concept: The behavior of gases can be explained by the Kinetic Molecular Theory.</b></p> <p>Gas behavior can explain how automobile engines work.</p> <p>When a country is interested in making nuclear weapons, they utilize gas behavior to make weapons grade fissionable material.</p>	<ul style="list-style-type: none"> <li>• Explain Boyle's, Charles', Dalton's, and Gay-Lussac's laws using the kinetic molecular theory of gases.</li> <li>• Demonstrate an understanding of Avogadro's number.</li> <li>• Determine the molar volume of a gas and use molar volume to solve stoichiometry problems.</li> <li>• Use the ideal gas law and general gas law to solve problems.</li> <li>• Use the kinetic molecular theory of gases to explain Graham's law of diffusion.</li> <li>• Determine molecular weight of a gas based using diffusion rates.</li> </ul>	<ul style="list-style-type: none"> <li>• Report and poster display for Experimental Research Project</li> <li>• Exploring gases lab</li> <li>• Computer simulations of gas laws using software from Concord Consortium</li> <li>• Make hydrogen gas</li> </ul>
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	<p>7.1 Describe the process by which solutes dissolve in solvents.</p> <p>7.2 Identify and explain the factors that affect the rate of dissolving, i.e., temperature, concentration, and mixing.</p> <p>7.4 Calculate concentration in terms of molarity, molality, and percent by mass.</p> <p>7.5 Use a solubility curve to determine saturation values at different temperatures.</p> <p>7.7 Write net ionic equations for precipitation reactions in aqueous solutions.</p>	<p><b>7. Solutions</b> <b>Broad Concept: Solids, liquids, and gases dissolve to form solutions.</b></p>	<ul style="list-style-type: none"><li>• Identify conditions that are necessary for growing a crystal.</li><li>• Describe the dissolving process and crystal growing process on a molecular scale.</li><li>• Interpret solubility curves to predict the behavior of substances.</li><li>• Distinguish between molarity and molality and determine appropriate circumstances to use each type of concentration.</li><li>• Relate conductivity of a solution to the degree of dissociation of an ionic compound and the charges on the ions.</li><li>• Write net ionic equations.</li></ul>	<ul style="list-style-type: none"><li>• Grow a crystal</li></ul>
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<p>Fourth Quarter</p>	<p>8.1 Define Arrhenius' theory of acids and bases in terms of the presence of hydronium and hydroxide ions, and Bronsted's theory of acids and bases in terms of proton donor and acceptor, and relate their concentrations to the pH scale.</p> <p>8.2 Compare and contrast the nature, behavior, concentration and strength of acids and bases.</p> <ol style="list-style-type: none"> <li>a. Acid-base neutralization</li> <li>b. Degree of dissociation or ionization</li> <li>c. Electrical conductivity</li> </ol> <p>8.4 Explain how indicators are used in titrations and how they are selected</p> <p>8.5 Describe an acid-base titration. Identify when the equivalence point is reached and its significance.</p> <p>8.6 Calculate the pH or pOH of aqueous solutions using the hydronium or hydroxide ion concentration.</p>	<p><b>8. Acids and Bases</b></p> <p><b>Broad Concept:</b></p> <p><b>Acids and bases are important in numerous chemical processes that occur around us, from industrial processes to biological ones, from the laboratory to the environment</b></p>	<ul style="list-style-type: none"> <li>• Write equilibrium expressions for the dissociation of an acid.</li> <li>• Identify the characteristics of acids and bases.</li> <li>• Calculate the pH of a solution of a strong acid or base of known concentration.</li> <li>• Develop the skills of performing a titration in the lab.</li> <li>• Explain how indicators can be used to determine the equivalence point in a titration.</li> <li>• Determine the concentration of a solution using titration.</li> </ul>	<ul style="list-style-type: none"> <li>• pH Indicator Lab</li> <li>• Acid/Base Titration Lab to determine the molarity of stomach acid and the effectiveness of antacid tablets</li> </ul>
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