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| **Chemistry 2016-2017** | | |
| **\*Inquiry, Math, and Technology/Engineering standards should be embedded in your instruction and used all year.**  **\*The Law of Conservation of mass/energy and historical models of the atom should be embedded in your instruction throughout the year.** | | |
| **Unit #** | **Unit Name** | **# of days** |
| 1 | **Matter and Energy**  **CLE 3221.2.2** Explore the interactions between matter and energy.  **CLE 3221.2.3** Apply the kinetic molecular theory to describe solids, liquids, and gases.  **CLE 3221.2.4** Investigate characteristics associated with the gaseous state.  **CLE 3221.2.5** Discuss phase diagrams of one- component systems.  **CLE 3221.3.4** Explain the law of conservation of mass/energy.  **SPI 3221.2.5** Compare and contrast heat and temperature changes in chemical (endothermic and exothermic) and physical processes e.g., phase transformations and specific heat.  **SPI 3221.2.6** Investigate similarities and differences among solids, liquids and gases in terms of energy and particle spacing.  **SPI 3221.2.7** Predict how changes in volume, temperature, and pressure affect the behavior of a gas.   * KMT, particle diagrams and particle motion, particles and energy, , P,V, T, n problems, temperature vs. heat, heating curves, phase diagrams, significant figures, Q = mc∆t, boiling point/melting point of substances   **Begin Monday, August 8 – Friday, September 16** | 28 |
| 2 | **Properties of Matter**  **CLE 3221.2.1** Investigate the characteristic properties of matter.  **SPI 3221.2.1** Distinguish among elements, compounds, and mixtures.  **SPI 3221.2.4** Identify properties of matter (e.g., physical: density, boiling point, melting point, or chemical: ability to rust  or tarnish, be sour) or changes in matter (e.g., physical: phase changes, shape, color, or chemical: formation of a gas  or precipitate.)   * Physical properties and physical changes of matter, elements, compounds, and mixtures   **Begin Monday, September 19 – Tuesday, September 27** | 7 |
| 3 | **Solutions**  **CLE 3221.2.1** Investigate the characteristic properties of matter.  **SPI 3221.2.2** Identify properties of a solution: solute and solvent in a solid, liquid or gaseous solution; procedure to make or determine the concentration of a solution in units of ppm, ppb, molarity, percent composition, factors that affect the rate of solution.  **SPI 3221.2.3** Classify a solution as saturated, unsaturated, or supersaturated based on its composition and temperature  and a solubility graph.   * Solvent/solute, rates of dissolving, concentrations: ppm, ppb, % by mass/volume, solubility curves   **Begin Wednesday, September 28 – Wednesday, October 19** | 11 |
| 4 | **Atomic Structure**  **CLE 3221.1.1** Compare and contrast historical models of the atom  **CLE 3221.1.2** Analyze the organization of the modern periodic table.  **CLE 3221.1.3** Describe an atom in terms of its composition and electron characteristics. **CLE 3221.3.2** Analyze chemical and nuclear reactions.  **SPI 3221.1.1** Compare and contrast the major models of the atom (e.g., Bohr, and the quantum mechanical model).  **SPI 3221.1.2** Interpret the periodic table to describe an element’s atomic makeup.  **SPI 3221.3.8** Describe radioactivity through a balanced nuclear equation and through an analysis of the half-life  concept.   * Evidence for atomic structure: Brief overview of Dalton, Thomson, Rutherford; atomic nucleus, isotopes, mass number/atomic mass, isotopic mixtures, nuclear, half-life   **Begin Thursday, October 20 – Thursday, November 3** | 11 |
| 5 | **Periodic Table**  **CLE 3221.1.2** Analyze the organization of the modern periodic table.  **SPI 3221.1.3** Describe the trends found in the periodic table with respect to atomic size, ionization energy, or electronegativity.  **SPI 3221.1.4** Determine the Lewis electron-dot structure or number of valence electrons for an atom of any main-group element from its atomic number or position in the periodic table.  **SPI 3221.1.5** Represent an electron’s location in the quantum mechanical model of an atom in terms of the shape of electron clouds (s and p orbitals in particular), relative energies of orbitals, and the number of electrons possible in the s, p, d and f orbitals.   * Electron configurations, trends, shielding   **Begin Friday, November 4 – Thursday, November 17** | 8 |
| 6 | **Bonding**  **CLE 3221.3.3** Explore the mathematics of chemical formulas and equations.  **CLE 3221.3.1** Investigate chemical bonding.  **SPI 3221.3.1** Analyze ionic and covalent compounds in terms their formation (electron transfer vs. sharing), names,  chemical formulas e.g., molecular: H2O, CO2, NH3; empirical: NaCl, CaBr2, Al(NO3)3), percent composition, and molar  masses.  **SPI 3221.3.5** Convert among the following quantities of a substance: mass, number of moles,  number of particles, molar volume at STP.   * Ionic/covalent, formulas: naming and writing, Lewis dot structures   **Begin Friday, November 18 – Friday, Dec. 9** | 13 |
| **Review and Semester Exam: Monday, Dec. 12 – Friday, Dec. 16 (5 days)**  **Benchmark 1**  **Monday, December 5, 2016 – Thursday, December 15, 2016**  Units 1 - 6 and all appropriate Math, T/E and Inquiry GLE’s and SPI’s. | | |
| 7 | **Formulas Revisited**  **CLE 3221.3.1** Investigate chemical bonding.  **CLE3221.3.3** Explore the mathematics of chemical formulas and equations.  **SPI 3221.3.1** Analyze ionic and covalent compounds in terms their formation (electron transfer vs. sharing), names,  chemical formulas e.g., molecular: H2O, CO2, NH3; empirical: NaCl, CaBr2, Al(NO3)3), percent composition, and molar  masses.  **SPI 3221.3.5** Convert among the following quantities of a substance: mass, number of moles,  number of particles, molar volume at STP.   * % composition, molar mass, empirical formula, molecular formula   **Begin Wednesday, January 4 – Monday, January 23, 2016** | 13 |
| 8 | **Reactions**  **CLE 3221.2.2** Explore the interactions between matter and energy.  **CLE3221.3.2** Analyze chemical and nuclear reactions.  **CLE 3221.3.3** Explore the mathematics of chemical formulas and equations.  **CLE 3221.3.4** Explain the law of conservation of mass/energy.  **SPI 3221.3.2** Identify the reactants, products, and types of different chemical reactions: composition, decomposition, double replacement, single replacement, combustion.  **SPI 3221.3.3** Predict the products of a chemical reaction (i.e. composition and decomposition of binary compounds).  **SPI 3221.3.4** Balance a chemical equation to determine molar ratios.   * Chemical properties/changes/signs of a reaction, balancing equations, mole ratios, types of reactions, predicting products * Law of Conservation of Mass/ Energy needs to be reinforced in this unit for students to fully master the standards   **Begin Tuesday, January 24 – Thursday, February 9** | 13 |
| 9 | **Stoichiometry**  **CLE 3221.3.3** Explore the mathematics of chemical formulas and equations.  **SPI 3221.3.4** Balance a chemical equation to determine molar ratios.  **SPI 3221.3.5** Convert among the following quantities of a substance: mass, number of moles, number of particles, molar volume at STP.  **SPI 3221.3.6** Identify and solve stoichiometry problems, which interconvert volume of gases at STP, moles, and mass.   * All types of stoichiometry problems *(Honors classes should include limiting reactions and percent yield problems; This is optional for general classes as time permits.)*   **Begin Friday, February 10 – Friday, March 10** | 20 |
| **Benchmark 2**  **Monday, March 6, 2017 – Friday, March 10, 2017**  Units 7 - 9 and all appropriate Math, T/E and Inquiry GLE’s and SPI’s. | | |
| 10 | **Gas Stoichiometry**  **CLE 3221.2.3** Apply the kinetic molecular theory to describe solids, liquids, and gases.  **CLE 3221.3.3** Explore the mathematics of chemical formulas and equations.  **SPI 3221.2.7** Predict how changes in volume, temperature, and pressure affect the behavior of a gas.  **SPI 3221.3.5** Convert among the following quantities of a substance: mass, number of moles, number of particles, molar  volume at STP.  **SPI 3221.3.6** Identify and solve stoichiometry problems, which interconvert volume of gases at STP, moles, and mass.   * Ideal vs. real gases, Ideal Gas Law and Equation   **Begin Monday, March 13 – Friday, March 24** | 10 |
| 11 | **Acids and Bases**  **CLE 3221.2.1** Investigate the characteristic properties of matter.  **SPI 3221.2.2** Identify properties of a solution: solute and solvent in a solid, liquid or gaseous solution; procedure to make or determine the concentration of a solution in units of ppm, ppb, molarity, percent composition, factors that affect the rate of solution.  **SPI 3221.3.7** Classify substances as acids or bases based on their formulas and how they react with litmus and phenolphthalein.   * Molarity, Naming acids and bases   **Begin Monday, April 3 – Friday, April 13** | 9 |
| **Review and EOC -- Monday, April 17 – Day of EOC** | | |
| **After EOC – Thursday, May ? Teacher choice of enrichment activities**  Teachers should use this time to address topics such as colligative properties, chemical equilibrium, or neutralization reactions. | | |
| **Review and Final Exam Thursday, May 18 – Wednesday, May 24 (5 days)** | | |

**Chemistry Embedded Standards**

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| **Embedded Inquiry**  **CLE 3221.Inq.1** Recognize that science is a progressive endeavor that reevaluates and extends what is already accepted.  **CLE 3221.Inq.2** Design andconduct scientific investigations to explore new phenomena, verify previous results, test how well a theory predicts, and compare opposing theories.  **CLE 3221.Inq.3** Use appropriate tools and technology to collect precise and accurate data.  **CLE 3221.Inq.4** Apply qualitative and quantitative measures to analyze data and draw conclusions that are free of bias.  **CLE 3221.Inq.5** Compare experimental evidence and conclusions with those drawn by others about the same testable question.  **CLE 3221.Inq.6** Communicate and defend scientific findings. | | |
| **Checks for Understanding** | | **State Performance Indicators** |
| ✓3221.Inq.1 Trace the historical development of a scientific principle or theory.  **✓3221.Inq.2** Identify an answerable question and formulate a hypothesis to guide a scientific investigation.  **✓3221.Inq.3** Design a simple experiment including appropriate controls.  **✓3221.Inq.4** Perform and understand laboratory procedures directed at testing hypothesis.  **✓3221.Inq.5** Select appropriate tools and technology to collect precise and accurate quantitative and qualitative data.  **✓3221.Inq.6** Correctly read a thermometer, balance, metric ruler, graduated cylinder, pipette, and burette.  **✓3221.Inq.7** Record observations and/or data using correct scientific units and significant figures.  **✓3221.Inq.8** Export data into the appropriate form of data presentation (e.g., equation, table, graph, or diagram).  **✓3221.Inq.9** Translate data into the correct units and dimension using conversion factors and scientific notation**.**  ✓3221.Inq.10 Analyze information in a table, graph or diagram (e.g., compute the mean of a series of values or determine the slope of a line).  **✓3221.Inq.11** If accepted values are known, calculate the percent error for an experiment.  **✓3221.Inq.12** Determine the accuracy and precision of experimental results.  **✓3221.Inq.13** Analyze experimental results and identify possible sources of bias or experimental error.  **✓3221.Inq.14** Recognize, analyze, and evaluate alternative explanations for the same set of observations.  **✓3221.Inq.15** Design a model based on the correct hypothesis that can be used for further investigation. | | SPI 3221 Inq.1 Select a description or scenario that reevaluates and/or extends a scientific finding.  SPI 3221 Inq.2 Analyze the components of a properly designed scientific investigation.  SPI 3221 Inq.3 Determine appropriate tools to gather precise and accurate data.  SPI 3221 Inq.4 Evaluate the accuracy and precision of data.  SPI 3221 Inq.5 Defend a conclusion based on scientific evidence.  SPI 3221 Inq.6 Determine why a conclusion is free of bias.  SPI 3221 Inq.7 Compare conclusions that offer different, but acceptable explanations for the same set of experimental data. |
| **Embedded Technology & Engineering**  **CLE 3221.T/E.1** Explore the impact of technology on social, political, and economic systems.  **CLE 3221.T/E.2** Differentiate among elements of the engineering design cycle: design constraints, model building, testing, evaluating, modifying, and retesting.  **CLE 3221.T/E.3** Explain the relationship between the properties of a material and the use of the material in the application of a technology.  **CLE 3221.T/E.4** Describe the dynamic interplay among science, technology, and engineering within living, earth-space, and physical systems. | | |
| **✓3221.T/E.1** Select appropriate tools to conduct a scientific inquiry.  **✓3221.T/E.2** Apply the engineering design process to construct a prototype that meets developmentally appropriate specifications.  **✓3221.T/E.3** Explore how the unintended consequences of new technologies can impact human and non-human communities.  **✓3221.T/E.4** Present research on current bioengineering technologies that advance health and contribute to improvements in our daily lives.  **✓3221.T/E.5** Design a series of multi-view drawings that can be used by other students to construct an adaptive design and test its effectiveness. | | **SPI 3221.T/E.1** Distinguish among tools and procedures best suited to conduct a specified scientific inquiry.  **SPI 3221.T/E.2** Evaluate a protocol to determine the degree to which an engineering design process was successfully applied.  **SPI 3221.T/E.3** Evaluate the overall benefit to cost ratio.  **SPI 3221.T/E.4** Use design principles to determine if a new technology will improve the quality of life for an intended audience. |
| **Embedded Math**  **CLE 3221.Math.1** Understand the mathematical principles associated with the science of chemistry.  **CLE 3221.Math.2** Utilize appropriate mathematical equations and processes to understand chemistry concepts. | | |
| **✓3221.Math.1** Use a variety of appropriate notations (e.g., exponential, functional, square root).  **✓3221.Math.2** Select and apply appropriate methods for computing with real numbers and evaluate the reasonableness of the results.  **✓3221.Math.3** Apply algebraic properties, formulas, and relationships to perform operations on real-world problems (e.g., solve for density, determine the concentration of a solution in a variety of units: ppm, ppb, molarity, molality, and percent composition) calculate heats of reactions and phase changes, and manipulate gas law equations.  **✓3221.Math.4** Interpret rates of change from graphical and numerical data (e.g., phase diagrams, solubility graphs, colligative properties, nuclear decay or half-life).  **✓3221.Math.5** Analyze graphs to describe the behavior of functions (e.g., concentration of a solution, phase diagrams, solubility graphs, colligative properties, nuclear decay half-life).  **✓3221.Math.6** Model real-world phenomena using functions and graphs.  **✓3221.Math.7** Apply and interpret algebraic properties in symbolic manipulation (e.g., density, concentration of a solution, chemical equations, effect of volume, temperature or pressure on behavior of a gas, percent composition of elements in a compound, molar mass, number of moles, and molar volume, amount of products or reactants given mole, molarity, volume at STP or mass amounts, heat loss or gain using mass, temperature change and specific heat, and half-life of an isotope).  **✓3221.Math.8** Apply and communicate measurement units, concepts and relationships in algebraic problem-solving situations.  **✓3221.Math.9** Select appropriate units, scales, and measurement tools for problem situations involving proportional reasoning and dimensional analysis.  **✓3221.Math.10** Select, construct, and analyze appropriate graphical representations for a data set.  **✓3221.Math.11** Identify and solve different types of stoichiometry problems (e.g., volume at STP to mass, moles to mass, molarity).  **✓3221.Math.12** Calculate the amount of product expected in an experiment and determine percent yield.  **✓3221.Math.13** Convert among the quantities of a substance: mass, number of moles, number of particles, molar volume at STP. | All Math SPI have been dropped. These concepts should be integrated in the teaching of the course and taught as needed to deepen student understanding. | |