Indiana's Academic Standards 2010 Chemistry	**Indiana's Academic Standards 2016 Chemistry**
C.1.1 Based on physical properties, differentiate between pure substances and mixtures.	**C.1.1** Differentiate between pure substances and mixtures based on physical and chemical properties.
C.1.2 Observe and describe chemical and physical properties of different types of matter and designate them as either extensive or intensive.	**C.1.2** Use chemical properties, extensive, and intensive physical properties to identify substances.
C.1.3 Recognize observable indicators of chemical changes.	**C.1.3** Recognize observable macroscopic indicators of chemical changes.
C.1.4 Describe physical and chemical changes at the molecular level.	**C.1.4** Describe physical and chemical changes at the particle level.
C.1.5 Describe the characteristics of solids, liquids and gases and changes in state at the molecular level.	**C.1.5** Describe the characteristics of solids, liquids, and gases and changes in state at the macroscopic and microscopic levels.
C.1.6 Explain and apply the law of conservation of mass as it applies to chemical processes.	**C.1.6** Demonstrate an understanding of the law of conservation of mass through the use of particle diagrams and mathematical models.
C.1.7 Define density and distinguish among materials based on densities. Perform calculations involving density.	**C.1.7** Perform calculations involving density and distinguish among materials based on densities.
C.2.1 Describe how models of atomic structure changed over time based on available experimental evidence and understand the current model of atomic structure.	**C.2.1** Using available experimental data, explain how and why models of atomic structure have changed over time.
C.2.2 Describe how the subatomic particles (i.e., protons, neutrons and electrons) contribute to the structure of an atom and recognize that the particles within the nucleus are held together against the electrical repulsion of the protons.	
C.2.3 Determine the number of protons, neutrons, and electrons in isotopes and in those isotopes that comprise a specific element. Relate these numbers to atomic number and mass number.	**C.2.2** Determine the number of protons, neutrons, and electrons in isotopes and calculate the average atomic mass from isotopic abundance data.

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C.2.4 Calculate the average atomic mass of an element from isotopic abundance data.	
C.2.5 Write the electron configuration of an element and relate this to its position on the periodic table.	**C.2.3** Write the full and noble gas electron configuration of an element, determine its valence electrons, and relate this to its position on the periodic table.
C.2.6 Use the periodic table and electron configuration to determine an element's number of valence electrons and its chemical and physical properties.	**C.2.4** Use the periodic table as a model to predict the relative properties of elements based on the pattern of valence electrons and periodic trends.
C.2.7 Compare and contrast nuclear reactions with chemical reactions.	**C.2.5** Compare and contrast nuclear reactions with chemical reactions.
C.2.8 Describe how fusion and fission processes transform elements present before the reaction into elements present after the reaction.	**C.2.6** Describe nuclear changes in matter, including fission, fusion, transmutations, and decays.
C.2.9 Understand that the radioactive decay process is random for any given atom but that this property leads to a predictable and measurable exponential decay of a sample of radioactive material. Know how to calculate the initial amount, the fraction remaining or the half-life of a radioactive isotope when given two of the other three variables.	**C.2.7** Perform half-life calculations when given the appropriate information about the isotope.
C.3.1 Describe, compare and contrast the characteristics of the interactions between atoms in ionic and covalent compounds.	**C.3.1** Investigate the observable characteristics of elements, ionic, and covalent compounds.
C.3.2 Compare and contrast how ionic and covalent compounds form.	**C.3.2** Compare and contrast how ionic and covalent compounds form.
C.3.3 Draw structural formulas for and name simple molecules.	**C.3.3** Draw structural formulas for simple molecules and determine their molecular shape.
C.3.4 Write chemical formulas for ionic compounds given their names and vice versa.	**C.3.4** Write chemical formulas for ionic compounds and covalent compounds given their names and vice versa.

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C.3.5 Compare and contrast ionic, covalent network, metallic and polar and non-polar molecular crystals with respect to constituent particles, strength of bonds, melting and boiling points and conductivity; provide examples of each type.	**C.3.5** Use laboratory observations and data to compare and contrast ionic, covalent, network, metallic, polar, and non-polar substances with respect to constituent particles, strength of bonds, melting and boiling points, and conductivity; provide examples of each type.
C.4.1 Predict products of simple reactions such as synthesis, decomposition, single replacement and double replacement.	**C.4.2** Predict products of simple reactions as listed in C.4.1.
C.4.2 Balance chemical equations using the law of conservation of mass and use them to describe chemical reactions.	**C.4.3** Balance chemical equations and use the law of conservation of mass to explain why this must be true.
C.4.3 Given mass of the sample, use the mole concept to determine the number of moles and number of atoms or molecules in samples of elements and compounds.	**C.4.4** Apply the mole concept to determine the mass, moles, number of particles, or volume of a gas at STP, in any given sample, for an element or compound.
C.4.4 Using a balanced chemical equation, calculate the quantities of reactants needed and products made in a chemical reaction that goes to completion.	**C.4.5** Use a balanced chemical equation to calculate the quantities of reactants needed and products made in a chemical reaction that goes to completion.
C.4.5 Describe, classify and give examples of various kids of reactions-synthesis (i.e., combination), decomposition, single displacement, double displacement and combustion.	**C.4.1** Describe, classify and give examples of various kinds of reactions: synthesis (i.e., combination), decomposition, single displacement, double displacement, acid/base, and combustion.
C.4.6 Determine oxidation states and identify the substances gaining and losing electrons in redox reactions.	
C.4.7 Perform calculations to determine the composition of a compound or mixture when given the formula.	**C.4.6** Perform calculations to determine the composition of a compound or mixture when given the necessary information.
C.5.1 Use kinetic molecular theory to explain changes in gas volumes, pressure, moles and temperature.	**C.5.1** Use the kinetic molecular theory with the combined and ideal gas laws to explain changes in volume, pressure, moles, and temperature of a gas.

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C.5.2 Using the ideal gas equation of state PV = nRT, calculate the change in one variable when another variable is changed and the others are held constant.	**C.5.2** Apply the ideal gas equation (PV = nRT) to calculate the change in one variable when another variable is changed and the others are held constant.
C.5.3 Given the equation for a chemical reaction involving one or more gases as reactants, products or both, calculate the volumes of gas when assuming the reaction goes to completion and the ideal gas law holds.	**C.5.3** Use lab data and a balanced chemical equation to calculate volume of a gas at STP and non STP conditions, assuming that the reaction goes to completion and the ideal gas law holds.
C.6.1 Explain that atoms and molecules are in constant motion and that this motion increases as thermal energy increases.	**C.6.1** Explain that atoms and molecules are in constant motion and that this motion increases as thermal energy increases.
C.6.2 Distinguish between the concepts of temperature and heat flow in macroscopic and microscopic terms.	**C.6.2** Distinguish between the concepts of temperature and heat flow in macroscopic and microscopic terms.
C.6.3 Classify chemical reactions and phase changes as exothermic or endothermic.	**C.6.3** Classify chemical reactions and phase changes as exothermic or endothermic based on enthalpy values. Use a graphical representation to illustrate the energy changes involved.
C.6.4 Solve problems involving heat flow and temperature changes by using known values of specific heat, phase change constants (i.e., latent heat values) or both.	**C.6.4** Perform calculations involving heat flow, temperature changes, and phase changes by using known values of specific heat, phase change constants, or both.
C.7.1 Describe the composition and properties of types of solutions.	**C.7.1** Describe the composition and properties of solutions.
C.7.2 Explain how temperature, pressure and polarity of the solvent affect the solubility of a solute.	**C.7.2** Explain how temperature, pressure, and polarity of the solvent affect the solubility of a solute.
C.7.3 Describe the concentration of solutes in a solution in terms of molarity. Perform calculations using molarity, mass and volume.	**C.7.3** Describe the concentration of solutes in a solution in terms of molarity. Perform calculations using molarity, mass, and volume. Prepare a sample of given molarity provided a known solute.
C.7.4 Prepare a specific volume of a solution of a given molarity when provided with a known solute.	

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C.7.5 Explain how the rate of a reaction is qualitatively affected by changes in concentration, temperature, surface area and the use of a catalyst.	
C.7.6 Write equilibrium expressions for reversible reactions.	
C.8.1 Use Arrhenius and Brønsted-Lowry definitions to classify substances as acids or bases.	**C.8.1** Classify solutions as acids or bases and describe their characteristic properties.
C.8.2 Describe the characteristic properties of acids and bases.	
C.8.3 Compare and contrast the dissociation and strength of acids and bases in solutions.	**C.8.2** Compare and contrast the strength of acids and bases in solutions.
C.8.4 Given the hydronium (H3O+) ion concentration in a solution, calculate the pH and vice versa. Explain the meaning of these values.	**C.8.3** Given the hydronium ion and/or the hydroxide ion concentration, calculate the pH and/or the pOH of a solution. Explain the meanings of these values.
C.8.5 From acid-base titration data, calculate the concentration of an unknown solution.	
C.9.1 Use structural formulas to illustrate carbon atoms' ability to bond covalently to one another to form many different substances.	**C.3.6** Use structural formulas of hydrocarbons to illustrate carbon's ability to form single and multiple bonds within a molecule.
C.9.2 Illustrate the variety of molecular types formed by the covalent bonding of carbon atoms and describe the typical properties of these molecular types.	
	C.4.7 Apply lab data to determine the empirical and molecular formula of a compound.