

WSD Introduction to Chemistry: Units and Learning Targets for 2013-2014

Course Overview

Quarter 1:

- Unit 1: Introduction to the Laboratory and Scientific Inquiry – 3 weeks, ongoing throughout semesters 1 and 2
- Unit 2: Matter and Its Properties* – 5 weeks
- Quarter 1 Mid-Term Assessment

Quarter 2:

- Unit 3: Atomic Theory* -- 4 weeks
- Unit 4: Electron Behavior and The Periodic Table – 5 weeks
- Quarter 2 Mid-Term Assessment

Quarter 3:

- Unit 5: Introduction to Ionic Bonding* -- 4.5 weeks
- Unit 6: Introduction to Covalent Bonding* -- 4.5 weeks
- Quarter 3 Mid-Term Assessment

Quarter 4:

- Unit 7: Chemical Reactions* -- 7 weeks
- Unit 8: Solution Chemistry* -- 2 weeks
- Quarter 4 Mid-Term Assessment

*= the study of stoichiometry will be included in these units

Codes, such as (HS-PS1-1), etc. refer to the performance expectations and disciplinary core ideas in the Next Generation Science Standards supported by a learning target. In some cases, the Common Core Standards for ELA/Literacy or Mathematics are used.

Unit 1: Introduction to the Laboratory and Scientific Inquiry

Objectives in Student Friendly Language:

- 1.1: Know where all laboratory safety apparatus is located in the chemistry classroom. Describe how, why, and when each piece of equipment should be used. Identify the difference between qualitative and quantitative observations. Be able to make both qualitative and quantitative observations in the laboratory. Describe the difference between an observation and an interpretation and know when it is appropriate to use both.
- 1.2: Identify pieces of laboratory equipment by their proper names. Describe the use of each piece of laboratory equipment.
- 1.3: Identify parts of the scientific method used in real-world research. In scientific research, be able to determine the dependent and independent variables that are being investigated. Describe the importance of an experiment being controlled for all variables except for one, and identify potential sources of error in an experiment. (RST.11-12.1, WHST.9-12.7)
- 1.4: Describe the difference between accuracy and precision. Perform percent error calculations to determine the accuracy of an experiment if the theoretical and experimental values are known. (HSN-Q.A.3)
- 1.5: Identify the units of measurement for volume, mass, length, temperature, density, amount and time in the SI system. Understand the difference between a base unit and a derived unit. Use the SI prefixes kilo-, deci-, centi-, milli-, and micro- to convert data to more useful measurements. (HSN-Q.A.1, HSN-Q.A.2)
- 1.6: Use dimensional analysis to convert a piece of data from one unit to another. (HSN-Q.A.1)
- 1.7: Express numbers in scientific notation. Calculate numbers in scientific notation. (MP.4, HSN-Q.A.2)
- *1.8: Apply rules for significant figures to express uncertainty in measured and calculated values. Describe how the number of significant figures in a measurement relates to its accuracy and potential for error. (HSN-Q.A.3)

Activities:

Operation of a Bunsen Burner Lab, Identification of Laboratory Apparatus Guide, Lab Safety How-To Worksheet, Laboratory Techniques Lab, ACT Preparation Work, Percent Error Lab (Density), Dimensional Analysis Practice Problems, Dimensional Analysis Group Jigsaw, Aluminum Atoms Lab for Scientific Notation, Significant Figures Practice Problems, Significant Figures Group Jigsaw

Assessments: Pre- and Post-assessments to determine student growth, formative assessments (daily), Standards-Based Quizzes and Lab Quizzes (once weekly), Unit Summative Assessment

Unit 2: Matter and Its Properties

Objectives in Student Friendly Language:

2.1: Describe how atoms and molecules are arranged in solids, liquids, and gases. Explain what energy changes occur as a substance changes from a one phase of matter to another and describe these as exothermic or endothermic. Draw these changes at the molecular level.(HS-PS1-4)

2.2: Interpret a phase diagram.(HS-PS1-4)

2.3: Understand how matter can be classified into elements, mixtures, and compounds. Be able to identify the differences between these three classifications, like how each is made and separated and the name of the fundamental unit that makes up each one (atom, molecule, etc.). Which classifications of matter can be described as pure substances? Why?(HS-PS1-4)

2.4: Know the evidence for a chemical change and use this knowledge to determine whether a change that a substance goes through is a physical or a chemical change.(HS-PS1-2)

2.5: Explain what a mole is. Use dimensional analysis to determine the number of atoms in a sample given the number of moles of that sample.(HS-PS-1-7)

2.6: Understand the Law of Conservation of Mass and use it to determine the mass of products and reactants in a chemical reaction. Use the Law of Conservation of Mass to balance a chemical equation..(HS-PS-1-7)

- Use coefficients to balance a chemical equation and describe what these coefficients represent. Explain why chemical equations must be balanced.
- Use coefficients to determine the mole ratio of any reactants to any other products or reactants. Use the mole ratio to determine the number of moles of product made or reactant required for a chemical reaction to occur.

Activities:

Graphic: Physical Changes in Matter, Lab: Conservation of Mass, Demo: Evidence for Chemical Change, Group Flowchart Activity: Classification of Matter, Separation of Mixtures Lab, Forensic Science: Mixtures and Arson Activity, Chromatography Lab, Density of Pennies Lab, Balancing Equations group jigsaw

Assessments: Pre- and Post-assessments to determine student growth, formative assessments (daily), Standards-Based Quizzes and Lab Quizzes (once weekly), Unit Summative Assessment

Unit 3: Atomic Theory*

Objectives in Student Friendly Language:

- 3.1: Describe Dalton's Atomic Theory and explain in what ways it differs from modern atomic theory. For each subatomic particle, describe the symbol, charge, relative mass, and location in the atom according to the modern atomic theory.(PS1.A)
- 3.2: Describe the Cathode Ray Tube Experiment and how it helped to discover the existence of the electron in the atom. Describe the Gold Foil Experiment and how it helped to discover the existence of the nucleus of the atom.(PS1.A)
- 3.3: Know what the atomic number of an atom represents and how it is found. Define isotope and explain how an isotope's mass number is related to its mass number. Define ion and explain how an ion's charge is determined.(PS1.A)
- 3.4: Explain how the mass number of an atom and the average atomic mass of an element are different. *Describe how to find each one. Explain why the "masses" on the periodic table are decimals instead of whole numbers. (MP.4, HSN-Q.A.2, HS-PS1-7)
- 3.5: Define molar mass and use it to convert between the number of atoms in a sample, the number of moles in a sample, and the mass of a sample in grams. (HS-PS1-7)
- 3.7: Define what is meant by the strong force and explain how it is responsible for the stability of the nucleus of an atom. Describe the three types of nuclear radiation. For each, identify its relative strength, its charge, and its composition.(HS-PS1-8)
- 3.8: Define half-life. Given the half-life of a radioisotope, determine the age of a sample based on the number of radioactive atoms that remain. (HS-PS1-8)

Activities: The Mole Lab, Twizzler-25 Half-Life Lab, Old Dead Guy Comic Strips, Mole Conversion Practice Problems, The Average Atomic Mass of Pasta-ium, Half-Life Forensic Archaeology Lab, Student Demonstrations with Subatomic Particles and Experiments

Assessments: Pre- and Post-assessments to determine student growth, formative assessments (daily), Standards-Based Quizzes and Lab Quizzes (once weekly), Unit Summative Assessment

Unit 4: Electron Behavior and The Periodic Table

Objectives in Student Friendly Language:

4.1: Describe how the energy, frequency, and wavelength of electromagnetic energy are related. Use the formulas for the speed of light or the energy of a photon to determine the wavelength or frequency of light. (HS-PS4-1)

4.2: Use Bohr's Model of the atom to show how electrons are spaced in energy levels at definite distances from the nucleus. Describe the relationship between an electron's distance from the nucleus and its relative energy/stability. Describe what happens when electrons move from one energy level to another in an atom. (HS-PS3-2)

4.3: Define the four quantum numbers and explain how each is used to find the probable location of an electron inside of an atom. Describe what is meant by the Heisenberg Uncertainty Principle and what that means for the study of electrons in an atom.(HS-PS1-1)

4.4: Write the electron configuration for an atom or ion given the number of electrons that atom or ion contains. Write the electron dot notation for an atom of any element. Explain why only valence electrons are included in this diagram.(HS-PS1-1)

4.5: Explain how the periodic table changed as it was developed. Understand how early thinkers like John Newlands originally organized the table, how this changed with Mendeleev's table, and how Henry Moseley finally organized it into the modern arrangement we now know it as.(PS1.A)

4.6: Describe how the periodic table is arranged based on the electron configuration of the atoms that make it up. Know how the electron configuration changes and stays the same as you move down a family/group and across a period on the Periodic Table. Explain why elements in the same group or family have similar properties.(HS-PS1-1)

4.7: For any atom, use the octet rule to predict what kind of ion that atom would form if it were to gain or lose electrons based on its electron configuration or position on the periodic table(HS-PS1-1)

4.8: Understand how the periodic table is organized, including the location of the metals, non-metals, and metalloids. For families 1,2, 16, 17, and 18, know their common names, their location on the periodic table, and some of their key properties, such as number of valence electrons and charge. (HS-PS1-1)

*4.9: Define atomic radius, ionization energy, and electronegativity and explain how it changes as you move from left to right across a period and from the top to bottom of a group. Explain why these changes occur. (HS-PS1-1)

Activities: The Flame Test Lab, Practice Problems with Formulae for Speed of Light and Energy of a Photon, Electron Configuration Battleship, Periodic Table Bingo, Group Jigsaw Electron Configuration, Electron Probability Simulation

Assessments: Pre- and Post-assessments to determine student growth, formative assessments (daily), Standards-Based Quizzes and Lab Quizzes (once weekly), Unit Summative Assessment

Unit 5: Introduction to Ionic Bonding*

Objectives in Student Friendly Language:

5.1: Describe what is meant by a chemical bond and explain why two atoms form a bond between them in terms of energy. Explain why atoms of the noble gas elements rarely participate in the formation of chemical bonds. Describe the general properties of ionic compounds. (HS-PS1-1, HS-PS1-3, HS-PS1-4, HS-PS1-2)

5.2: Describe how and why ions are formed. Predict what monatomic ions certain atoms on the periodic table would form after gaining or losing electrons based on the number of valence electrons they have. Explain what is meant by a polyatomic ion and describe the number of electrons these ions contain. (HS-PS1-1, HS-PS1-3, HS-PS1-4)

5.3: Define an ionic bond and how it is formed. Given the nature of two ions, predict the formula of an ionic compound. Describe what is meant by lattice energy and explain how it is related to the size of the ions bonded together. (HS-PS1-1, HS-PS1-3, HS-PS1-4)

5.4: Name an ionic compound using the rules for nomenclature discussed in class. (RST.9-10.7)

5.5: Find the molar mass of any ionic compound and use this information to convert between the number of molecules in a sample, the number of moles in a sample, and the mass of a sample in grams. (HS-PS1-7)

5.6: Determine the percent composition of an ionic compound using its molar mass. (HS-PS1-7)

Activities: Percent Composition Lab, Naming Ionic Compounds Small Scale Laboratory, Properties of Ionic Compounds Lab, Crystal Formation of Saturated Solutions Lab, Naming Ionic Compounds Practice Problems and Group Jigsaw, Dimensional Analysis Problems Mole Conversions, Percent Composition Problems

Assessments: Pre- and Post-assessments to determine student growth, formative assessments (daily), Standards-Based Quizzes and Lab Quizzes (once weekly), Unit Summative Assessment

Unit 6 Introduction to Covalent Bonding*

Objectives in Student Friendly Language:

6.1: Basics of Covalent Bonding

- Describe what is meant by a covalent bond and explain why two atoms form a bond between them in terms of energy.(HS-PS1-1, HS-PS1-3, HS-PS1-4, HS-PS1-2)
- Describe what is meant by a covalent or molecular compound and draw a Lewis structure showing shared pairs of electrons in one of these compounds.(HS-PS1-3)
- Describe single, double, and triple bonds. Know how they compare in terms of relative strength (bond dissociation energy), stability, and length.(HS-PS1-3)

6.2: VSEPR Theory (HS-PS1-3)

- Predict the shape of covalent compounds using the Valence Shell Electron Pair Repulsion (VSEPR) Theory.

6.3: Polar vs. Non-Polar Bonds and Molecules (HS-PS1-3)

- Describe what is meant by a non-polar covalent and a polar covalent bond.
- In a polar covalent bond, identify the partial positive end and the partial negative end based on electronegativity.
- Based on the geometry of a covalent molecule and the electronegativities of the atoms in the molecule, predict whether a covalent molecule will be polar overall or non-polar overall.

6.4: Hydrogen Bonding Intermolecular Forces (HS-PS1-3)

- Describe the consequences of a molecule being polar in terms of melting and boiling points. Describe the differences in intermolecular forces between polar and non-polar molecules.
- Describe what is meant by a hydrogen bond.
- Identify the atoms that can be involved in hydrogen bonds.
- Explain why water is so special due to its ability to hydrogen bond.

6.5: Nomenclature (RST.9-10.7)

- Name covalent compounds using the rules discussed in class.
 - Given a name, write the formula for a covalent compound. .

6.6: Stoichiometry (HS-PS1-7)

- Determine the molar mass of any covalent compound and use it to convert between the number of molecules in a sample, the number of moles in a sample, and the mass of a sample in grams.
- Determine the percent composition of a covalent compound using its molar mass.
- Define empirical formula and use the percent composition to find it for a compound.
- Define molecular formula and use the empirical formula and molar mass to determine it for any compound

Activities: Comparison of Ionic and Molecular Compounds Lab, VSEPR Lab, Practice Problems Mole Conversions, Evaporation Races for Intermolecular Forces, Naming Covalent Compounds Practice, Lewis Structures Practice Problems and Group Jigsaw

Assessments: Pre- and Post-assessments to determine student growth, formative assessments (daily), Standards-Based Quizzes and Lab Quizzes (once weekly), Unit Summative Assessment

Unit 7: Chemical Reactions*

Objectives in Student Friendly Language:

7.1: The Fundamentals of Chemical Reactions (HS-PS1-4)

- Describe what changes occur in a chemical reaction.
- Identify the reactants and products of a chemical reaction and use the appropriate symbols to describe the changes that occur in a chemical reaction in a chemical equation.
- Explain how energy changes in a chemical reaction in endothermic and exothermic reactions. Use changes in enthalpy (ΔH) to determine if a reaction is endothermic or exothermic. Write a balanced thermochemical equation for a chemical reaction, given its ΔH value.

7.2: Classification of reactions: (HS-PS1-2)

- Classify a reaction into one of the following reaction types based on what happens during the reaction: synthesis, decomposition, single replacement, double replacement, or combustion.
- Use an activity series to predict whether a single replacement reaction will occur or not. If a single replacement reaction occurs, be able to correctly identify the products that would form.
- Predict the products of a decomposition reaction for a binary ionic compound, a metal carbonate, and a metal chlorate.
- Understand what three things are made in a double replacement reaction. If a precipitate is formed during a double replacement reaction, use the solubility chart to identify which product will be the precipitate.

7.3: Kinetic Molecular Theory and Reaction Rates (HS-PS1-5)

- Describe what is meant by the kinetic molecular theory.
- Explain how the rate of a chemical reaction would change if the temperature or the concentration of reactants were changed according to the kinetic molecular theory.

7.4: Chemical Equilibrium (HS-PS1-6)

- Define equilibrium in a reversible reaction.
- Explain LeChatelier's Principle and describe how a reaction would be affected by changing concentrations of reactants and products.
- Describe how an endothermic or exothermic reaction would be affected by changing the temperature.

Activities: Endothermic and Exothermic Reactions Lab, Balancing Chemical Equations Practice, Types of Reactions Lab, Develop an Activity Series Lab, Double Replacement Reactions Lab, Practice Problems Mole Ratios, Practice Problems Classification of Reaction Types, Practice Problems Prediction of Products in Chemical Reactions

Assessments: Pre- and Post-assessments to determine student growth, formative assessments (daily), Standards-Based Quizzes and Lab Quizzes (once weekly), Unit Summative Assessment

Unit 8: Solution Chemistry*

Objectives in Student Friendly Language:

- 8.1: Identify a solution, describe the components of a solution, and identify these components in real-world examples of solutions. Describe the process of solvation. Predict the results of any compound dissolving in water. (HS-PS-1-2, HS-PS1-3)
- 8.3: Identify the difference between a complete ionic and a net ionic equation. Given two reactants, write a net ionic equation for the reaction that results (including identifying reactions that will not occur - NO RXN). (HS-PS1-2)
- 8.4: Predict how changing variables like temperature and pressure would change the solubility of a solute. Explain why these changes occur at the molecular level. (HS-PS1-5)
- 8.5: Predict how changing variables would change the rate of solvation of a solute. (HS-PS1-5)
- 8.6: Use laboratory data to predict whether a solution will be saturated, saturated with a precipitate, or unsaturated at a certain temperature using a solubility diagram. (HS-PS-1-5)
- 8.7: Predict whether or not certain solutes will dissolve in a certain solvent based on their polarities. Explain why this occurs on the molecular level. (HS-PS1-3)
- 8.8: Given the mass of the solute used and the volume of the solvent, calculate the molarity of the solution. Make a solution of a desired molarity. (MP.4, HSN-Q.A.1)
- 8.9: Describe how adding a solute to a solvent changes the freezing point and boiling point of a solution. (MP.4)

Activities: Make a Molar Solution Lab, Freezing Point Depression Lab (making ice cream), Molarity Practice Problems, Making a Solubility Curve of Potassium Nitrate in Water Lab, Factors Affecting Solubility and Rate of Solubility Lab, Like Dissolves Like Lab

Assessments: Pre- and Post-assessments to determine student growth, formative assessments (daily), Standards-Based Quizzes and Lab Quizzes (once weekly), Unit Summative Assessment