

# COURSE: Regents Chemistry

## Grade Level: 11th

MAIN/ GENERAL TOPIC	SUB-TOPIC:	ESSENTIAL QUESTIONS:	WHAT THE STUDENTS WILL KNOW:	WHAT THE STUDENT WILL BE ABLE TO DO:	Assessments:	WHEN STUDENT DOES IT:
Lab Guidelines	Lab Safety	Where is lab safety equipment located? How do you use safety equipment? What types of accidents specific equipment are used for?	The location of and how to use fire extinguisher, shower, fire blanket, eye wash How to handle and dispose of chemicals such as flammables, acids, nitrates, salts. What to do in the event of an accident in the lab.	Remember the location of and how to use fire extinguisher, shower, fire blanket, eye wash Proper handling and disposal of chemicals and lab equipment. How to react to an accident in the lab.	Lab Safety Quiz	Sept
Lab Guidelines	Scientific Method	What makes a good hypothesis? How do you test something using the scientific method?	The parts of a lab report include purpose, materials, procedure, results, analysis, and conclusion.	Demonstrate ability to perform the lab and write a complete lab report using their data.	Lab reports Ability to perform lab experiments Paper Airplane Lab	Sept
Measurements	Metric System and measurements used in chemistry	What units are used in chemistry to measure mass, volume, time, and temperature? What is the importance of having SI units? What level of uncertainty is associated with measurements? What is the difference between accuracy and precision?	The units of measure used in chemistry are grams for mass, meters for distance, liters for volume, seconds for time, and Kelvin for temperature. Prefixes used in chemistry (Reference Table C) Accuracy is how close your data is to the accepted value. Precision is how close your data points are to each other. Accurate data must be precise, but precise data is not always accurate. How to calculate percent error from their data and accepted data. How to explain possible sources of error that could have occurred in their experiment.	Convert between standard units and prefixes (ex. 1 L is equal to 1000 mL) Record data using correct units Make calculations using various formulas including the percent error formula.	Units and Unit Conversions Quiz In lab reports	Sept
Measurements	Significant figures	What are significant figures? Why are significant figures used in chemistry calculations?	The rules for determining how many significant figures are in a number. How to perform calculations using significant figures. How and when to estimate the last digit in a measurement.	Report lab data in correct number of significant figures. Report answers to calculations in correct number of significant figures.	Lab write-ups Significant Figures Quiz	Sept
Measurements	Density	How is the density of a substance determined? How do substances with different densities interact?	Density is equal to a samples mass divided my volume. Substances with lower density "float" in substances with greater density.	Use the density formula to calculate density of various substances.	Density Lab Density worksheet and quiz	Sept

Measurements	Graphing	What is the difference between linear and exponential relationships? What is the difference between the independent and dependent variables? What is an inverse relationship?	How to recognize the type of relationship between variables based on the shape of the line on the graph. How to determine which variable goes on which axis (y or x)	Graph lab data or data from a table. Make a graph with appropriate scale and units. Draw a line of curve to fit their data.	Labs throughout the year.	Sept
Measurements	Temperature scales	What is the difference between Fahrenheit, Celsius and Kelvin Temperature scales? How to you convert between temperature scales?	Celsius and Kelvin are the temperature scales used in chemistry How to convert between Celsius and Kelvin temperature using equation from Ref. Table T.	Read Celsius temperature off of a thermometer. Convert between Celsius and Kelvin temperature	Labs throughout year. Temperature conversion worksheet and quiz	Sept
Introduction to Chemistry	Origins of Chemistry	What is chemistry and what are its origins?				Sept
Introduction to Chemistry	Types of changes	What is the difference between a physical and chemical change?	Examples of physical and chemical changes from everyday life	Identify a change as being physical or chemical	Types of Changes Quiz Physical and Chemical Changes Lab	Sept
Atomic Structure	Models of the atom	How did Dalton, Thomson, Rutherford, and Bohr develop models of the atom?	Describe the findings of Dalton, Thomson, Rutherford, and Bohr. Gold foil experiment determined the nucleus was small and positive and the atom is mostly empty space.	Interpret models of the atom. Describe Rutherford's and Thomson's experiments. Understand the historical significance of the development of various models.	Models of the atom quiz.	Sept
Atomic Structure	The Atom	What are the parts of the atom and where are the parts located (inside or outside of nucleus)?	Protons and neutrons are found in the nucleus Electrons are located in orbitals outside the nucleus Atomic number is equal to the number protons Atomic number is equal to the number electrons Atomic mass is equal to the protons and neutrons Isotopes have the same number of protons but different numbers of neutrons.	Describe and identify the parts of the atom Calculate the number of protons, electrons, and neutrons in an atom from the nuclear symbol Understand the relationship between atomic mass, atomic number, mass number, and isotopes.	Nuclear symbols worksheet and quiz	Sept
Atomic Structure	Electron arrangement	What is the difference between an orbit and an orbital? When is an electron in the excited state? How do valence electrons affect the chemical properties of an element?	Difference between ground and excited state electrons. Difference between valence and non-valence electrons.	Distinguish between ground and excited state electron configurations. Identify an element by comparing its bright-line spectrum to given spectra. Draw Lewis dot structure of an atom. Distinguish between valence and non-valence electrons in a configuration.	Flame test lab Spectral line lab Electron configuration Quiz Electron movement quiz	Sept

Nuclear Chemistry	Isotopes	What are isotopes? How do you determine the number of neutrons in an isotope?	Isotopes are atoms of the same element with different atomic masses, due to different numbers of neutrons. The average atomic mass for an element on the P.T. is the weighted average for all naturally occurring isotopes of the given element	Determine the number of neutrons in an isotope by subtracting the atomic number from the atomic mass. Calculate a weighted average given a set of mass and percent abundance data for a particular element.	Homework Isotopes Quiz Average Atomic Mass Quiz	Oct
Nuclear Chemistry	Radioactivity	What is the definition of radioactivity? What makes a nucleus stable? What is the belt of stability? What are the 3 types of radiation? What is the difference between spontaneous (natural) and nonspontaneous radioactive decay?	Radioactivity is the release of energy caused by the breakdown of unstable nuclei. Stability of isotopes (nuclei) is based on the ratio of the neutrons and protons in the nucleus. Although most nuclei are stable, some are unstable and spontaneously decay emitting radiation. The 3 types of radiation are alpha decay, beta decay, and positron emission. Spontaneous decay can involve the release of alpha particles, beta particles, positrons, or gamma radiation from the nucleus of an unstable isotope.	Determine if an isotope will be radioactive based on its position in relation to the belt of stability. Use Table N to determine the decay mode for various radioisotopes.	Homework Decay mode quiz Radioactive Decay Lab	Oct
Nuclear chemistry	Nuclear Equations	What are the different types of nuclear equations? How do you balance a nuclear equation? What is a transmutation? What is the difference between fission and fusion?	Nuclear reactions include natural and artificial transmutation, fission, and fusion. Energy released during nuclear reactions is much greater than energy released during chemical reactions. A change in the nucleus of an atom that converts it from one element to another is called a transmutation. This can occur naturally or can be induced by the bombardment of the nucleus with a high-energy particle. Fission and fusion are examples of artificial transmutations. Both release very large quantities of energy. Fission breaks a heavy nucleus apart (like U), fusion fuses small nuclei together (like H). Fusion takes place naturally on the sun.	Determine decay mode and write nuclear equations showing alpha and beta decay. Complete nuclear equations, predicting missing particles from nuclear equations.	Homework Radioactive Decay Lab Nuclear Equations Quiz	Oct
Nuclear Chemistry	Half-life	How long does it take something radioactive to become stable? How can you calculate the age of something using half-life?	Each radioactive isotope has a specific mode and rate of decay (half-life). These values are found on Ref. Table N	Calculate the initial amount, the fraction remaining, or the half-life of a radioactive isotope, given two of the three variables. Determine the age of biological specimen using carbon-14 dating.	Homework Half-life Lab Half-Life Quiz	Oct
Nuclear Chemistry	Uses, risks, and benefits of radiation	What ways do humans use radiation? Are all types of radiation dangerous?	There are benefits and risks associated with fission and fusion reactions. There are inherent risks associated with radioactivity and the use of radioactive isotopes. Risks can include biological exposure, long-term storage and disposal, and nuclear accidents. Radioactive isotopes have many beneficial uses. Radioactive isotopes are used in medicine and industrial chemistry, radioactive dating, tracing chemicals and biological processes, industrial measurement, nuclear power, and detection and treatment of diseases	Identify specific uses of some radioisotopes, such as: I-131 in diagnosing and treating thyroid disorders; C-14 to C-12 ratio in dating living organisms; U-238 to Pb-206 ratio in dating geological formations; Co-60 in treating cancer	Homework Discussion Quiz	Oct

Energy	Kinetic and Potential Energy	What is kinetic energy? What is potential energy? What is the difference between an exothermic and an endothermic process?	Kinetic Energy is the energy of motion. Temperature is a measure of a substances average KE. Potential energy is stored energy. The energy stored within the bonds of chemical is PE. Exothermic processes release energy, endothermic processes absorb energy.	Understand the difference between KE and PE. Provide examples of each. Provide examples of exothermic and endothermic processes.	Homework Exo/Endo Quiz	Oct
Energy	Electromagnetic Spectrum	How do different forms of energy compare in frequency and wavelength on the EM spectrum? Why can't we see all types of EM radiation?	Gamma rays, x-rays, and UV are high intensity (ionizing) radiation. Infrared, microwaves, and TV/Radio waves are low intensity (nonionizing) radiation. Visible light falls between 400 nm and 700 nm (violet to red).	Be able to read an EM spectrum and determine wavelength and frequency,	Homework EM Spectrum Quiz	Oct
Matter	States of matter	What are the three states of matter and the properties associated with them? What are the phase changes? How do you interpret a phase diagram?	The three states of matter (solid, liquid, and gas) have properties that are similar and different between various substances. Solids have defined shape and volume Liquids have undefined shape and defined volume. Gases have undefined shape and volume. Solid to liquid (melting), liquid to gas (evaporation/boiling), solid to gas (sublimation), gas to liquid (condensation), liquid to solid (freezing), gas to solid (deposition) A phase diagram represents experimental data and show how temperature and time change as a substance transitions between phases	Use a simple particle model to differentiate among properties of a solid, a liquid, and a gas. Describe what is happening to particles during a phase change.	Draw particle diagrams quiz homework	Oct
Matter	Law of Conservation of Mass/Law of Definite Proportions	Can mass be created or destroyed? What are compounds made of?	Matter (mass) cannot be created or destroyed in ordinary chemical and physical changes (non nuclear). A chemical compound always contains the same elements in the same proportions.	Understand these laws and how they apply to chemistry Be able to determine elements that make up a compound from a formula.	In class questions	Oct
Matter	Classifying matter	What makes matter a pure substance or a mixture? What is the difference between a homogeneous and heterogeneous mixture?	Matter is classified as a pure substance or a mixture of substances. A pure substance (element or compound) has a constant composition and constant properties throughout a given sample, and from sample to sample.	Demonstrate knowledge of differences by separating pure substance from a mixture. Discuss real life examples of homogeneous and heterogeneous mixtures.	Substances lab Quiz homework	Oct
Matter	Separation of Mixtures	What could one do to separate a homogeneous mixture? A heterogeneous mixture? What are the advantages to separating mixtures?	Differences in properties such as density, particle size, molecular polarity, boiling point and freezing point, and solubility permit physical separation of the components of a mixture.	Describe the process and use of filtration, distillation, and chromatography in the separation of a mixture. Demonstrate the use of these equipments.	Analysis of a Mixture lab Chromatography Lab Quiz homework	Oct

Math in Chemistry	Intro to Formulas and Equations	How do you write the formula for a compound? What do the numbers in the formula correspond to? What is a chemical equation?	A formula represents the ratio of atoms in a compound. Subscripts tell you how many of each atom is present in the formula. Equations represent the reacting matter (reactants) and the matter that is produced (products) of a chemical reaction.	Calculate the number of atoms in a formula. Be able to determine the reactants and products in a chemical equation.	Formula and Equation homework and quiz	Oct
Math in Chemistry	The mole and Avagadro's number	What is a mole in chemistry? How is the mole related to mass and volume?	A mole is $6.02 \times 10^{23}$ things. In chemistry a mole of atoms is $6.02 \times 10^{23}$ atoms of a particular element. One can convert from moles to grams, liters of gas at STP, or atoms/molecules using various conversion factors (the "Mole Airport" method)	Convert between various units using the mole airport method	Mole Conversions homework and quiz	Oct
Math in Chemistry	Percent Composition and other problems using formulas	How do you determine the percentage of an element in a compound? How do you determine a formula given percent composition data?	Ref. Table T gives various formulas that are used in Math in Chem.	Use the percent composition formula		
Periodic Table	Properties of elements	How are the properties of metals different from the properties of nonmetals?	Differences between the physical properties of substances, such as density, conductivity, malleability, solubility, and hardness	Compare and contrast the properties of elements within a group or across a period.	Quiz homework	In class
Moles and Stoichiometry	Chemical Formulas	What are the differences between empirical, molecular, and structural formulas? How are these formulas used to provide information about a substance?	How to use and write empirical, molecular, and structural formulas	Determine the molecular formula, given the empirical formula and molecular mass. Determine the empirical formula from the molecular formula.	Empirical formula determination lab Quiz homework	In class and lab
	Balanced equations	What does a balanced equation represent? Why is it important to balance equations? How can we use a balanced equation to predict the products of a reaction?	In all chemical reactions there is a conservation of mass, energy, and charge. The coefficients in a balanced chemical equation can determine the mole ratios in the reaction.	Balance equations, given formulas for reactants and products. Create and use model particles to demonstrate balance equations. Calculate simple mole-mole stoichiometry problems, given a balanced equation.	Mole of chalk lab Quiz homework	In class and lab
	Formula mass	How do you calculate the formula mass for a substance? What information does the formula mass give us? How to you determine the percent composition of a part of a substance?	The formula mass is the sum of the atomic masses of the atoms in a substance. The gram formula mass of a substance equals one mole of a substance.	Calculate the formula mass and gram formula mass. Determine the number of moles of a substance given its mass. Determine the mass of a given number of moles of a substance.	Moles, molecules, and grams lab Popcorn lab Determining the percent water in a chemical compound lab Molecular calculations quiz Homework	In class and lab

	Types of chemical reactions	How can you determine what type of reaction will occur?	Types of reactions include synthesis, decomposition, single replacement, double replacement	Identify types of chemical reactions	Quiz homework	In class and lab
Chemical bonding	Types of bonds	What is the difference between an ionic bond, a covalent bond, and a metallic bond?	Chemical bonds are formed when valence electrons are: transferred from one atom to another (ionic), shared between atoms (covalent), or mobile within a metal (metallic).	Distinguish between ionic, molecular, and metallic substances given their properties. Demonstrate bonding concepts using Lewis dot structures representing valence electrons: transferred (ionic bonding), shared (covalent bonding), in a stable octet.	Ionic and covalent compound lab Chemical bonding lab Quiz homework	In class and lab
	Molecular polarity and intermolecular forces	What makes a bond polar or nonpolar? How are polar molecules different from nonpolar molecules in terms of their properties? How do intermolecular forces differ between polar and nonpolar molecules?	Molecular polarity can be determined by the shape and distribution of charge (symmetrical = nonpolar, asymmetrical = polar) The electronegativity difference between two bonded atoms is used to assess the degree of polarity in a bond. Physical properties of substances (such as conductivity, malleability, solubility, hardness, melting point, and boiling point) can be explained in terms of intermolecular forces	Distinguish between nonpolar covalent bonds (two of the same nonmetal) and polar covalent bonds. Distinguish between polar and nonpolar molecules	Snow globe lab Quiz homework	In class and lab
	Bond energy and bond stability	What happens in terms of energy when a bond is formed? When a bond is broken?	When a bond is broken, energy is absorbed. When a bond is formed, energy is released. Atoms attain a stable valence electron configuration by bonding with other atoms.	Determine the noble gas configuration an atom will achieve when bonding.	Quiz homework	In class
	Solutions	How can you determine if a sample of matter is a solution? What is the difference between a solute and a solvent? How can you predict if a solute will dissolve in a solvent?	A solution is a homogeneous mixture of a solute dissolved in a solvent. The solubility of a solute in a given amount of solvent is dependent on the temperature, pressure, and chemical natures of the solute and solvent.	Interpret and construct solubility curves. Use solubility curves to distinguish among saturated, supersaturated, and unsaturated solutions. Apply "like dissolves like" to real life situations.	Solubility curve lab Interpreting solubility curves on the reference tables Quiz homework	In class and lab
	Concentrations	How are quantitative concentrations different from qualitative concentrations?	Concentration of a solution can be expressed as Molarity, percent by volume, percent by mass, or parts per million	Describe the preparation of a solution, given the Molarity. Interpret solution concentration data. Calculate solution concentrations.	Making a solution lab Dilutions lab Quiz homework	In class and lab

	Measurement of heat energy and temperature	What is the difference between heat and temperature? How can one calculate how much energy is lost or gained by a sample of matter?	Heat is the transfer of energy (usually thermal) from a body of higher temperature to a body of lower temperature. Temperature is a measure of the average kinetic energy of particles in a sample of matter. Temperature is not energy.	Distinguish between heat energy and temperature in terms of molecular motion and amount of matter. Qualitatively interpret heating and cooling curves in terms of changes in kinetic and potential energy, heat of vaporization, heat of fusion, and phase changes. Explain phase changes in terms of the changes in energy and intermolecular distance.	Heat of fusion lab Heat of crystallization lab Calorimeter lab Finding the heat capacity of water lab Quiz homework	In class and lab
Kinetics and equilibrium	Collision theory and rate of reaction	What must happen in order for a reaction to occur? What factors influence the rate of a reaction?	A reaction is most likely to occur if the reactant particles collide with the proper energy and orientation. The rate of a chemical reaction depends on several factors including temperature, concentration, nature of reactants, surface area, and the presence of a catalyst.	Use collision theory to explain how various factors influence reaction rate.	Kinetics activity Quiz homework	(SEMESTER 2)  In class
	Equilibrium	How can you tell if a reaction is at equilibrium? How can you predict what will happen to a reaction if the conditions of the reaction are changed?	Some chemical and physical changes can reach equilibrium. At equilibrium the rate of the forward reaction equals the rate of the reverse reaction. The measurable concentration of reactants and products remain constant at equilibrium. LeChatelier's principle can be used to predict the effect of stress (change in pressure, volume, concentration, and temperature) on a system at equilibrium.	Identify examples of chemical and physical equilibria as solution equilibrium and phase equilibrium. Describe the concentration of particles and rates of opposing reactions in an equilibrium system. Qualitatively describe the effect of stress on equilibrium, using LeChatelier's principle.	Disrupting equilibrium lab Quiz homework	In class and lab
	Potential energy diagrams	How can you tell if a reaction will be exothermic or endothermic? What effect does adding a catalyst have on the rate of a reaction?	Energy released or absorbed by a chemical reaction can be represented by a potential energy diagram. Heat of reaction is equal to the difference between the potential energy of the products and the potential energy of the reactants. A catalyst provides an alternative pathway which has a lower activation energy than the uncatalyzed reaction	Read and interpret potential energy diagrams: PE of reactants and products, activation energy (with and without a catalyst), heat of reaction	PE diagram lab Quiz homework	In class and lab
Organic Chemistry	Bonding of carbon atoms	How can you tell what an organic compound looks like?	Organic compounds contain carbon atoms that bond to one another in chains, rings, and networks to form a variety of structures. Organic compounds can be named using the IUPAC system. Isomers of organic compounds have the same molecular formula, but different structures and properties.	Classify an organic compound based on its structural or condensed structural formula	Model building activity Quiz homework	In class
	Hydrocarbons	What is the difference between a saturated organic compound and an unsaturated organic compound?	Hydrocarbons are compounds that contain only carbon and hydrogen. Saturated hydrocarbons contain only single carbon-carbon bonds. Unsaturated hydrocarbons contain at least one multiple carbon-carbon bond. In a multiple covalent bond, more than one pair of electrons are shared between two atoms. Unsaturated organic compounds contain at least one double or triple bond.	Draw structural formulas for alkanes, alkenes, and alkynes.	Quiz homework	In class

	Functional groups	How can one determine what type of organic compound is present in a sample?	Organic acids, alcohols, esters, aldehydes, ketones, ethers, halides, amines, amides, and amino acids are types of organic compounds that differ in their structures. Functional groups give distinct chemical and physical properties to organic compounds.	Draw a structural formula with the functional group on a straight chain hydrocarbon backbone, when given the correct IUPAC name for the compound.	Quiz homework	In class
	Organic reactions	How is soap made? What are the applications of organic reactions?	Types of organic reactions include: addition, substitution, polymerization, esterification, fermentation, Saponification, and combustion	Identify types of organic reactions. Determine the missing reactant or product in a balanced equation.	Silly putty lab Preparation of esters lab Saponification lab Quiz homework	In class and lab
Oxidation-reduction	Oxidation and reduction	What is the difference between oxidation and reduction?	An oxidation-reduction (REDOX) reaction involves the transfer of electrons. Reduction is the gain of electrons. Oxidation is the loss of electrons. In a redox reaction the number of electrons lost equals the number of electrons gained	Determine the missing reactant or product in a balanced equation. Write the balanced half-reactions for oxidation and reduction of free elements and their monatomic ions.	Quiz homework	In class
	Oxidation numbers	How can I determine which oxidation state an element will assume in a redox reaction?	Oxidation numbers (states) can be assigned to atoms and ions using the Periodic table. Changes in oxidation number indicate that oxidation and reduction have occurred.	Assign oxidation numbers to atoms and ions in an equation	Quiz homework	In class
	Electrochemical Cells	How are redox reactions used in real-world applications? How can one distinguish between types of electrochemical cells? How can you determine if a redox reaction will be spontaneous?	An electrochemical cell can be either voltaic or electrolytic. In an electrochemical cell, oxidation occurs at the anode and reduction occurs at the cathode. A voltaic cell spontaneously converts chemical energy to electrical energy. An electrolytic cell requires electrical energy to produce a chemical change. This process is called electrolysis.	Compare and contrast voltaic and electrolytic cells. Identify and label the parts of a voltaic cell (cathode, anode, salt bridge) and the direction of electron flow, given the reaction equation. Use an activity series to determine whether a redox reaction is spontaneous.	Electrochemical cell lab Quiz homework	In class and lab
Acids, bases, and salts	Arrhenius Theory	What makes a substance an acid? What makes a substance a base? What are common properties of acids and bases?	Behavior of many acids and bases can be explained by the Arrhenius theory. Arrhenius acids and bases are electrolytes. An electrolyte is a substance that when dissolved in water, forms a solution capable of conducting an electric current, due to mobile ions. The ability of a solution to conduct electric current depends on the concentration of ions.	Given the properties of a substance, identify the substance as an Arrhenius acid or an Arrhenius base.	Quiz homework	In class
	Acid-Base Titration	How can one determine the concentration of an unknown acid or base? What type of reaction occurs when an acid is mixed with a base?	In the process of neutralization, an acid and a base react to form water and salt. Titration is a laboratory process in which a volume of solution of known concentration is used to determine the concentration of another solution.	Write simple neutralization reactions when given the reactants. Calculate the concentration or volume of a solution, using titration data.	Titration lab Characteristic reactions of acids lab Quiz homework	In class and lab

	The pH scale	What is the pH scale and how is it used? How can one tell if a solution is acidic or basic?	The acidity and alkalinity of an aqueous solution can be measured by its pH value. The relative level of acidity or alkalinity of a solution can be shown by using indicators. On the pH scale, each decrease of one unit of pH represents a tenfold increase in the hydronium ion concentration.	Interpret changes in acid-base indicator color. Identify solutions as acid, base, or neutral based upon the pH.	Making an indicator lab Percentage of acetic acid in vinegar lab Quiz homework	In class and lab