

Options EHS Chemistry B		Scope and Sequence
Unit	Lesson	Objectives
<b>States of Matter</b>		
Gases		
		Describe the postulates of kinetic-molecular theory.
		Interpret the behavior of ideal gases in terms of kinetic-molecular theory, including diffusion and effusion.
		Describe how kinetic-molecular theory explains the properties of gases, including temperature, pressure, compressibility, and volume.
		Science Practice: Identify the limitations of kinetic-molecular theory.
Liquids		
		Describe how the postulates of kinetic-molecular theory apply to liquids.
		Describe how kinetic-molecular theory explains the properties of liquids, including compressibility and shape.
		Science Practice: Use the kinetic-molecular theory model to explain the behavior of liquids.
Solids and Plasmas		
		Use kinetic-molecular theory to compare and contrast atomic or molecular motion in solids and plasmas.
		Describe how kinetic-molecular theory explains the properties of solids, including compressibility, shape, and volume.
		Describe how kinetic-molecular theory explains the properties of plasmas.
		Science Practice: Give examples of plasmas in nature and technology.
Phase Changes		
		Describe phase changes in terms of kinetic-molecular theory.
		Describe the energy changes that happen during changes of state.
		Science Practice: Make and interpret graphs of temperature vs. time for changes of state.
Gas Laws		
		State Boyle's law, Charles's law, and Gay-Lussac's law, and apply these laws to calculate the relationships among volume, temperature, and pressure.

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		Derive the combined gas law from Boyle's law, Charles's law, and Gay-Lussac's law.
		Define partial pressure.
		Apply Dalton's law of partial pressures to describe the composition of gases.
		Science Practice: Make a table to compare the various gas laws.
	Lab: Charles's Law	
		Science Practice: Analyze and interpret data gathered in an investigation about Charles's law.
		Calculate relationships between volume and temperature according to Charles's law.
	Lab: Boyle's Law	
		Calculate relationships between volume and pressure according to Boyle's law.
		Science Practice: Obtain, evaluate, and communicate information gathered in an investigation about Boyle's law.
	The Ideal Gas Law	
		Explain how Avogadro's law, or principle, can be combined with other gas laws to describe the relationships among pressure, temperature, volume, and number of moles of a gas.
		State the ideal gas law, which relates pressure, temperature, and volume of an ideal gas.
		Solve problems using the ideal gas law.
		Science Practice: Use math to solve ideal gas law problems.
	Unit Test	
<b>Thermodynamics</b>		
	Energy	
		Differentiate among the various forms of energy, including kinetic energy, potential energy, chemical energy, and thermal energy.
		Explain that energy can be transformed from one form to another.
		Describe the law of conservation of energy.

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		Science Practice: Integrate concepts from both chemistry and physics to analyze energy transformations and the conservation of energy.
	Heat	
		Relate temperature to the average molecular kinetic energy.
		Describe heat flow in terms of the motion of atoms or molecules.
		Distinguish between exothermic chemical processes and endothermic chemical processes.
		Science Practice: Analyze and interpret information about a reaction to classify the reaction as either an exothermic process or an endothermic process.
	Calorimetry	
		Differentiate between heat capacity and specific heat.
		Solve problems involving heat flow and temperature changes to calculate the specific heat of a substance.
		Define calorimetry and explain how calorimeters work.
		Use calorimetry to calculate the heat of a chemical process.
		Science Practice: Perform mathematical calculations involving heat, mass, temperature change, and specific heat.
	Lab: Calorimetry and Specific Heat	
		Determine the specific heat of a metal using a calorimeter.
		Systematically collect, organize, record, and analyze data.
		Demonstrate safe laboratory practices while using a calorimeter.
		Identify possible sources of procedural and mathematical errors in an experiment.
		Science Practice: Precisely follow a multistep procedure to build and use a calorimeter.
	Thermochemical Equations	
		Understand the use of enthalpy in thermochemistry.
		Use thermochemical equations to calculate energy changes (i.e., enthalpy changes) that occur in a chemical reaction.

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		Use thermochemical equations to calculate energy changes (i.e., enthalpy changes) that occur in a combustion reaction.
		Science Practice: Examine books and other sources of information to find standard enthalpies of formation to solve thermochemical problems.
	Enthalpy and Phase Changes	
		Analyze conceptually the flow of energy during changes of state (phase).
		Analyze quantitatively the flow of energy during changes of state (phase) using the molar enthalpies (heats) of fusion, solidification, vaporization, and condensation.
		Science Practice: Use appropriate scientific tools and techniques to gather and analyze data.
	Enthalpy of Reaction	
		Demonstrate how to produce an overall chemical equation from equations for intermediate reaction steps.
		Apply Hess's law to calculate enthalpy change in a reaction.
		Science Practice: Translate quantitative information expressed in words in a text into a visual form by drawing enthalpy diagrams.
	Lab: Enthalpy	
		Know specific hazards of chemical substances used in an experiment about enthalpy and entropy as summarized on the MSDS.
		Select and use appropriate tools to gather and analyze data during an experiment about enthalpy and entropy.
		Collect data with accuracy and precision, and organize the data while doing repeated trials in an experiment about enthalpy and entropy.
		Determine the enthalpy change in a reaction by applying Hess's law.
		Science Practice: Develop reasonable conclusions about changes in enthalpy based on data collected.
	Enthalpy, Entropy, and Free Energy	
		Compare spontaneous and nonspontaneous reactions.
		Describe and give examples of entropy.

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		Differentiate “enthalpy” and “entropy” and describe how enthalpy and entropy affect a reaction's spontaneity.
		Define free energy and use the Gibbs free energy equation to determine whether a reaction is spontaneous.
		Science Practice: Use mathematics to solve problems involving the Gibbs free energy equation.
	Unit Test	
<b>Acids and Bases</b>		
	Properties of Acids and Bases	
		Describe the observable properties of acids.
		Describe the observable properties of bases.
		Describe applications of acids and bases.
		Science Practice: Determine the meaning of the key terms acid and base as they are used in chemistry.
	Arrhenius, Bronsted-Lowry, and Lewis Acids and Bases	
		Describe the Arrhenius definitions of acids and bases.
		Describe the Bronsted-Lowry definitions of acids and bases.
		Identify conjugate acids and conjugate bases in a Bronsted-Lowry acid-base reaction.
		Describe the Lewis definitions of acids and bases.
		Science Practice: Describe how Arrhenius's, Bronsted's, Lowry's, and Lewis's competing interpretations of the same evidence are useful in different ways.
	pH	
		Describe the self-ionization of water.
		Define pH and pOH.
		Convert between pH and hydrogen ion concentration, and between pOH and hydroxide ion concentration.
		Convert between pH and pOH, and between hydrogen ion concentration and hydroxide ion concentration.

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		Use the pH scale to characterize the acidity and basicity of solutions.
		Science Practice: Solve scientific problems involving pH using logarithmic functions.
	Lab: Measuring pH	
		Measure the pH of various substances using a universal indicator and its key.
		Science Practice: Calibrate the scale for a pH indicator by comparing it to data measured using a known scale.
	Neutralization Reactions	
		Predict the products of acid-base neutralization reactions.
		Define salt and describe the observable properties of salts and salt solutions.
		Write equations and net ionic equations for neutralization reactions.
		Science Practice: Use domain-specific symbols to correctly write net ionic equations.
	Titration Reactions	
		Describe how to measure pH with indicators and meters.
		Describe the steps of the titration process.
		Explain the use of titration in chemistry.
		Science Practice: Construct an explanation of what happens during the titration process, and describe why each step of a titration is performed.
	Lab: Titration	
		Select and properly use tools to perform a titration.
		Determine the concentration of an acid using titration.
		Science Practice: Use designated laboratory techniques to perform a titration.
	Unit Test	
	Organic Chemistry	
	Organic Compounds	

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		Describe carbon's unique bonding characteristics that make the diversity of carbon compounds possible.
		Read and draw structural formulas of organic compounds.
		Explain the difference between structural isomers and geometric isomers.
		Science Practice: Use different models to represent the same idea (ball-and-stick models, space-filling models, and structural formulas) and explain the usefulness and limitations of each kind of model.
	Properties and Uses of Saturated Hydrocarbons	
		Describe the properties of straight-chain alkanes, branched-chain alkanes, and cycloalkanes.
		Use the system for naming the ten simplest linear hydrocarbons and isomers that contain single bonds.
		Identify uses of saturated hydrocarbons.
		Science Practice: Build vocabulary knowledge by learning how to name hydrocarbons.
	Properties and Uses of Unsaturated Hydrocarbons	
		Describe the properties of alkenes, alkynes, and aromatic hydrocarbons.
		Use the system for naming the ten simplest linear hydrocarbons and isomers that contain double bonds, triple bonds, and benzene rings.
		Identify uses of unsaturated hydrocarbons including uses in pharmaceuticals, petrochemicals, plastics, and food.
		Science Practice: Describe different alkenes and alkynes that can be found in nature.
	Functional Groups	
		Identify the functional groups that form the basis of alcohols, ketones, ethers, amines, esters, aldehydes, and organic acids.
		Describe uses and natural occurrences of compounds containing functional groups.
		Science Practice: Translate technical information expressed in words in a text about functional groups into a visual form, such as a chart.
	Organic Reactions	

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		Identify substitution, addition, condensation, and elimination reactions.
		Explain that large molecules (polymers) are formed by repetitive combinations of simple subunits.
		Compare addition polymerization and condensation polymerization.
		Science Practice: Construct explanations on how polymers form.
	Unit Test	
Nuclear Chemistry		
	The Nucleus	
		Explain how protons and neutrons in the nucleus are held together by nuclear forces.
		Differentiate chemical and nuclear reactions in terms of energy released.
		Explain why Einstein's equation $E = mc^2$ is used to determine the nuclear binding energy.
		Identify some naturally occurring isotopes of elements that are radioactive.
		Science Practice: Analyze a sequence (i.e., radioactive decay) that is characteristic of natural phenomena.
	Types of Radioactive Decay	
		Differentiate between chemical reactions and nuclear reactions.
		Identify types of radioactive decay.
		Science Practice: Translate technical information expressed in words in a text about nuclear radiation into a visual form, such as a table, to compare the different types of radiation.
	Balancing Nuclear Reactions	
		Write symbols for nuclides using mass numbers and atomic numbers.
		Balance nuclear equations by balancing both mass and atomic numbers.
		Science Practice: Determine the meaning of nuclide symbols and use those symbols to balance nuclear equations.
	Half-Life	
		Describe what a half-life is.



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		Calculate the amount of a radioactive substance remaining after an integral number of half-lives have passed.
		Calculate the number of half-lives that have passed given mass data for the radioactive substance.
		Science Practice: Solve scientific problems by substituting quantitative values.
	Lab: Half-Life	
		Understand the concept of half-life through simulation.
		Explain how the half-life of a radioactive element is determined.
		Collect, organize, and record appropriate data while doing an investigation on half-life.
		Communicate valid conclusions for a investigation modeling half-life.
		Science Practice: Develop and use a model for studying half-life.
	Nuclear Fission and Nuclear Fusion	
		Explain and compare fission and fusion reactions.
		Relate the role of nuclear fusion to the production of essentially all elements heavier than helium.
		Science Practice: Justify the need for peer review in science.
	Nuclear Energy	
		Describe how nuclear power plants work.
		Describe the issues surrounding nuclear waste.
		Science Practice: Weigh the merits of using nuclear energy to solve society's need for electrical energy by comparing a number of human, economic, and environmental costs and benefits.
	Nuclear Radiation	
		Explain that alpha, beta, and gamma radiation produce different amounts and kinds of damage in matter and describe the effects of each kind of radiation on living things.
		Describe how radiation is measured and detected.
		Describe applications of radiation.

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		Science Practice: Describe careers that involve working with radioactive substances.
	Unit Test	
<b>Cumulative Exam</b>		
	Cumulative Exam Review	
	Cumulative Exam	