Chemistry Honors

Grades: 10,11,12

Length: Full Year

Environment: Classroom-based

Honors: Honors

Subject: Science (D)

Discipline: Chemistry

Institution: Alvord Unified School District (Modeled after San Francisco Unified School District)

Course Overview

Honors chemistry is an initial high school laboratory course that is designed to prepare students for both AP chemistry and post-secondary science classes. Honors chemistry offers a fast-paced, rigorous curriculum that challenges students to apply chemistry knowledge to predict chemical phenomena, design experiments, and provide solutions to complex problems. Students will integrate technology, mathematics, and chemical literacy into a wide range of chemistry topics that include, but are not limited to: periodicity, atomic structure, chemical bonding, gases, solutions, thermodynamics, acids and bases, equilibrium, kinetics, electrochemistry, organic chemistry, and nuclear chemistry. We will follow the NGSS Chemistry standards and provide inquiry based curriculum for the course.

Honors chemistry is an in-depth examination of the natural and physical world. Students will begin to build a strong foundation of scientific inquiry through extensive, hands-on laboratory experience that requires students to write clear, concise, summative reflections outlining both quantitative and qualitative evidence gathered as a means to support or reject scientific claims. They will keep regular notes in their lab notebooks, submit written reports, and do class presentations regularly.

Unit 1: Introduction

Students are presented with chemistry foundations that will be used throughout the duration of this course. Because this is a course predicated on the students' ability to work in the laboratory, students will first be presented laboratory safety and necessary information regarding handling, storage, and appropriate use of laboratory glassware and chemicals. Additionally, students will become proficient in making accurate measurements depending on the laboratory equipment being used. Students will be reintroduced to the scientific method as a systematic means of scientific inquiry and will use said method in introductory laboratory experiments. Students will be taught the metric system, common prefixes that should be known, and how to convert between various metric prefixes. Students will continue with basic chemical math skills that include dimensional analysis, converting into and out of scientific notation, and keeping track of significant figures throughout addition, subtraction, multiplication, and division calculations. Students will continue with an introduction to chemistry as they investigate matter and the differences between physical and chemical properties and changes. During this portion of the unit, students will focus on density calculations and applications, identifying physical and chemical changes, and differentiating between heterogeneous and homogeneous mixtures. Lastly, students will learn and apply physical separation techniques such as filtration, distillation, chromatography, and crystallization.

Assignments

Jigsaw Lesson Plans

In groups students will prepare a lesson to teach to the class on one of the following topics:

1. Calculating density
2. Physical vs. chemical changes
3. Heterogeneous and homogeneous mixtures

Students will be responsible for a short lesson on the concept including several examples and visuals. In preparation for teaching the lessons, students will prepare a written lesson plan. They will take notes on each others' lessons in their lab notebooks. Students will learn about the basic chemistry principles of density, physical and chemical changes, and heterogeneous and homogeneous mixtures.

Lab Activities

Intro to Chemistry Labs

Students will be assessed on their ability to successful separate materials that have been combined. Students will be given a beaker that have been mixed with 5 grams of sand, 5 grams of salt, 2 grams of pepper, and 2 grams of iron filings. Students will be required to write a step by step procedure on how to separate each material and will have to perform their procedure in a laboratory setting. Students will be assessed on their percent yield and on how coherent their procedure is. Students will learn that writing detailed procedures allow for better experimentation and will learn that the order in which things are handled plays a large role in the experimentation process. Students will keep a record of their methods and findings in their lab notebook and prepare a written report.

Unit 2: Atoms and Elements

Students will become familiarized with the subatomic particles that make up an atom and will begin to use the periodic table as a tool to predict chemical properties, bonds, and reactions. Students will begin with a brief history of atomic structures and how atomic models have changed as new experiments and instruments have been used and discovered. Students will develop an understanding of subatomic particles that make up every atom. As students are introduced to protons, neutrons, and electrons, they will learn to use the periodic table as a means of determining information about the previously taught subatomic particles and will begin their investigation into the nuclear atom as they learn about isotopes, average atomic mass, and percent abundance. As students explore the nuclear atom, they will be able to develop models that illustrate what changes occur during nuclear processes of fission, fusion, and radioactive decay. Students will then progress towards electronic structure and periodicity focusing on how electrons fill orbitals, shapes of orbitals, and various electronic trends (valence electrons, atomic/ionic radius, reactivity, ionization energy, and electronegativity). Moreover, students will learn how about the atomic emission spectrum and how different elements give on different colors when ignited. Students will be able to discern between atoms and ions and will be able to determine the number of protons, electrons, and neutrons for any given atom or ion. In addition, students will demonstrate their knowledge of subatomic particles through the design of Bohr model representations. Primary emphasis of this unit will be on using the periodic table as a tool to predict the aforementioned topics which will be used as a primary foundation in future units.

Assignments

Atomic Models Through Time

In groups, students will examine different atomic models that have been used throughout the history of chemistry, including the Greek model, Dalton's model, Thomson's model, plum pudding model, Bohr's model, and the Schrodinger and Heisenberg model. They will be presented with an image and description of each model and guess a timeline of the evolution of the atomic model. They will analyze each model for its strengths and weaknesses and develop an argument regarding which model they think is the most accurate representation of a real atom. They will participate in a class discussion. They will learn about the different models and the history of chemistry.

Lab Activities

Two Elements Report

Students will conduct a research report on two elements; one that is a radioactive element and one that is not. Students will analyze the element for varying chemical properties, including, but not limited to, atomic mass, number of protons, electrons, and neutrons, number of valence electrons, and various chemical and physical properties. Students will be able to draw/construct a Bohr model of their atom that depicts the nucleus with appropriate number of protons and neutrons and electrons placed in appropriate energy levels surrounding the nucleus. Additionally, students will show the nuclear change that occurs as their radioactive element undergoes radioactive decay (students will illustrate the decay series of their element). Furthermore, students will be able to illustrate what changes their non-radioactive element undergoes as it becomes ionized and will illustrate such change with the addition or subtraction of valence electrons. Lastly, students will compare their non-radioactive element to three other elements in terms of atomic size, electronegativity, and ionization energy. For both elements, students will conduct further research into its history, uses, and hazards. Students will not only demonstrate their understanding of atomic structure, but will learn the necessary steps needed to conduct a scientific research report as they gather data from a variety of credible resources. Students will keep a record of their methods and findings in their lab notebook and prepare a written report.

Unit 3: Molecules, Compounds, and The Mole

Students will continue using the periodic table as a means of predicting chemical properties, bonds, and reactions as they begin investigating ionic, covalent, and metallic compounds and the bonds that exist between each. Students will be able to write formulas for ionic and covalent compounds from two given elements using their knowledge of valence electrons and the octet rule. Similarly, student will be able to demonstrate their understanding of chemical compounds by drawing models that represent how electrons are shared or transferred in chemical bonds. Students will be able to draw Lewis structures for covalent compounds and will be able to predict when single, double, or triple bonds form in molecules. Additionally, students will be able to identify molecules that might exhibit resonance and will be able to compare resonance bond length and strength to that of single, double, and triple bonds. Furthermore, students will be able to use electronegativity values and trends as a means of explaining bond polarity and as a method to predict whether a bond will behave ionically or covalently.

Lastly, students will be introduced to the mole and will be able to describe how Avogadro's number is related to a mole of any substance. Students will begin to use the mole as a means of converting between measurements of mass, volume, and number of particles. Furthermore, students will be able to use the mole to compare atomic mass and molar mass and will be able to calculate the percent composition of a substance from its chemical formula. Finally, students will be able to use the mole concept as a means of deriving the empirical and molecular formula of a compound from experimental data.

Assignments

Mystery Element

In groups, students will be assigned a mystery element. They will be given some "clues" about the element, like it's common use, number of valence electrons, element group, etc. They will discuss what questions they would still like to ask about the element. They will keep a log of their discussion in their notebook and then come up with a guess for which element they think it is. After a class discussion their mystery element will be revealed and they will write a reflection on how they fared and what else they needed to find out. They will learn about characteristics of the elements and how the periodic table is organized.

Lab Activities

Ionic and Covalent Compounds Lab

Students will conduct an investigation to compare and contrast the properties of ionic and covalent compounds. Students will be given both salt (ionic) and sugar (covalent) and will begin by comparing the amount of heat needed to melt 0.5 grams of each substance. Students will compare the melting points as they see how long it takes to melt each substance over a Bunsen burner. Secondly, students will compare the relative hardness of each substance as they examine the force required to crush a single crystal. Lastly, students will test how well ionic and covalent compounds conduct electricity through the use of an anodizing apparatus that uses a stainless steel screw and iron nail as electrodes. Students will be able to observe the salt solution clearly conducting electricity while the sugar solution does not. Students will perform this after learning about ionic and covalent compounds as a means to introduce the differing properties of each. Students will make predictions prior to each portion of the lab and will be able to write general conclusions on the behavior of both ionic and covalent compounds. Students will keep a record of their methods and findings in their lab notebook and prepare a written report.

Unit 4: Chemical Reactions and Stoichiometry

Students will be introduced to the different types of chemical reactions and will be able to determine the outcome of chemical reactions based on periodic table trends, number of valence electrons, the reactivity series of metals, and solubility rules. Students will be able to demonstrate their understanding of chemical reactions by constructing models and illustrations of events that occur at the submicroscopic level to help explain macroscopic observations. Students will progress in their investigations of chemical reactions as they begin to use stoichiometry as a mathematical representation of the conservation of mass and matter. Students will be able to use the periodic table as a means of predicting products between two chemical reactants, balance the resulting reaction in accordance to the law of conservation of matter, and perform stoichiometric calculations that relate the mass and number of atoms of a given reactant or product to any other reactant or product in the chemical reaction. Students will be able to use stoichiometry to determine the theoretical yield of a reaction given the starting masses of the reactants and will be able to determine the efficiency of a chemical reaction based on the actual yield of a product either explicitly given or determined experimentally.

Assignments

Predicting Chemical Reactions

In groups, students will be given information about a hypothetical chemical reaction, including periodic table trends, the number of valence electrons, reactivity series of metals, solubility rules. They will construct a prediction and argument of the outcome of the chemical reaction. They will construct models and illustrations of the submicroscopic level of their reaction. They will present their prediction to the class and participate in a class discussion.

Lab Activities

Stoichiometry Lab

Students will be given 5 different salts and 5 different metals and will be asked to determine whether each will produce a reaction when combined. Students must not only determine whether a reaction will occur or not, but must also predict the products that will form and balance the chemical equation. After students make predictions (based upon the activity series of metals), they will devise an experiment that will test their initial hypothesis. Students will write out a procedure to test various single replacement reactions and will compare their results with their predictions. During the experiment, students will identify various signs that a chemical reaction is taking place, such as bubbling and changes in color. Students will learn that chemical reactions follow specific rules and that these rules are useful in determining whether or not a reaction will occur. Students will keep a record of their methods and findings in their lab notebook and prepare a written report.

Unit 5: States of Matter and Intermolecular Forces

Students will progress from stoichiometry and chemical reactions and will transition to an investigation of the states of matter and the intermolecular forces that are present within various solids, liquids, and gases. Students will start with an introduction to kinetic molecular theory and will begin to study the effect of surface tension and adhesion as it applies to liquids. Additionally, students will study how different intermolecular forces affect the boiling point, melting point, and vapor pressure of various organic and inorganic substances. Students will be able to construct heating curves of a substance from an experiment that they plan and conduct and will be able to determine the melting and boiling point of said substance. Lastly, students will be able to read and extract information from a phase diagram. They will be able to determine specific temperatures and pressures of a pure substance’s triple point and critical point, as well as ranges of temperatures and pressures at which a pure substance is a solid, liquid, or gas. Moreover, students will be able to compare and contrast various phase diagrams to water and will be able to explain why water has a negative sloping solid-liquid equilibrium line.

Assignments

Surface Tension on a Penny

Students will predict how many drops of water they believe will fit on the face of a penny. They will provide a written prediction based on evidence of their choosing, including but not limited to surface area measurements of the penny, surface area measurements of a water droplet, and volume measurements of a water droplet. Then they will perform the mini-experiment to assess how close their prediction was. They will slowly pipette water droplets onto a penny and count how many drops until the surface tension breaks and the water runs off of the penny. They will participate in a class discussion around the properties of water that lead to its surface tension.

Lab Activities

Organic and Inorganic Substances Lab

Students will devise an experiment that will test the properties of various inorganic and organic substances. Students will be given three organic compounds and three inorganic compounds and will be asked to write a procedure that will enable them to draw heating/cooling curves for each substance. Students will then compare the graphs that they have determined and will be able to equate the differences to the varying intermolecular forces present among each substance. Students will identify the melting and boiling point of each substance on the graph and will use intermolecular forces arguments to explain the differences amongst the various substances. Students will learn that forces at the molecular level can be used to explain the differences in the physical properties that they observed. Lastly, by creating a heating curve, students will continue to use quantitative representations of data to reinforce chemical observations. Students will keep a record of their methods and findings in their lab notebook and prepare a written report.

Unit 6: Solutions

Students will focus on solutions at a particle level and will be able to differentiate between solutes and solvents as they apply to solutions. Students will be able to describe the process of dissolution through the use of molecular level drawings and diagrams. Students will be able to equate the polarity of water as a driving force of dissolution and will be able to show how water molecules arrange themselves around ionic compounds to form solutions. Students will use this information as they transition into concentrations of solutions and will be able to calculate the molarity of a given solution from a known mass of solute and known volume of a solution. Additionally, students will be able to produce desired concentrations of solutions, as well as dilute said solutions to specific volumes and molar concentrations. Students will demonstrate their ability to do so through performance-based labs in which they are asked to make certain concentrations and dilutions. Progressing through this unit, students will continue to look at the molecular level as they begin to describe the differences between unsaturated, saturated, and supersaturated solutions. Pivoting from this, students will investigate colligative properties of solutions and will be able to explain boiling point elevation and freezing point depression using molecular level interactions and mathematical expressions. A portion of this unit will be focused upon water and the role that it plays in the environment. Students will investigate water as it applies to chemical weathering, recrystallization, and melt generation. Students will become familiar with the hydrologic cycle and will design and conduct investigations on how water interacts with a variety of solid materials.

Assignments

Water Polarity Model

Students will develop a model to represent and explain the polarity of water molecules. Using modeling clay, craft sticks, markers and colored pencils, or whatever they choose students will develop a model and provide a written description of their model and how it explains polarity of water molecules. Students will present their models to the class and participate in a class discussion around the strengths and weaknesses of each model. They will learn about the structure of water molecules that leads to its strong polarity and applications of the polarity of water.

Lab Activities

Solutions Lab

Students will be asked to make 100 mL of a 0.50 molar NaCl solution from scratch. Students will be expected to write a detailed procedure to do so and the students will be assessed on the data they collect (mass of NaCl used and volume of water used) and the procedure that they write. Furthermore, students will be asked to make several dilutions as they make 50 mL of 0.4 M, 0.3 M, and 0.1 M solutions. Furthermore, students will investigate how electrical conductivity changes with a change in concentration. Students will measure the electrical conductivity using an electrical conductivity meter and will produce a graph of how it changes as concentration changes. Students will submit procedures for both the original solution and the dilutions, all mathematical work performed to determine appropriate amounts of substances, and a graph depicting how concentration affects conductivity. Students will learn that a decrease in concentration decreases the electrical conductivity of a solution and will be able to use atomic-level arguments to explain why. Students will keep a record of their methods and findings in their lab notebook and prepare a written report.

Unit 7: Kinetics and Chemical Equilibrium

Students will study and investigate factors that affect the rate at which a reaction occurs and they will be introduced to reversible reactions and the concept of chemical equilibrium. Students will begin this unit with collision theory and will be able to explain what each reaction needs in order to be considered successful. Students will be able to describe what occurs at the molecular level during a chemical reaction and will be able to illustrate how reactants transition into products through an activated complex. Students will become well versed in potential energy diagrams and will be able to draw said diagrams given the potential energy of the products, reactants, and activated complex. Students will investigate how different factors affect the rate of reaction and will be able to determine the order of reaction from experimental data. In order to do so, students must be able to write rate equations from given chemical equations. Students will be introduced to chemical equilibrium and will be able to define what chemical equilibrium is. Furthermore, students will be able to apply Le Chatelier's Principle to a system at equilibrium and will be able to predict which direction a reaction will shift when a stress is applied and how the equilibrium shift will affect the concentration of products and reactants. Additionally, students will be able to calculate equilibrium constants from given concentrations of products and reactants and will be able determine whether the reversible reaction favors the products or reactants by the value of the equilibrium constant. Lastly, students will be introduced to ICE tables and will be able to determine unknown concentrations of products or reactants using given information (such as a known equilibrium constant).

Assignments

Potential Energy Diagrams

Students will learn how to draw and interpret potential energy diagrams. In groups, students will investigate several potential energy diagrams, noting the potential energy of the products, reactants, and activated complex. They will develop a set of "rules" to help them predict what the diagrams will look like if they are given the information first. Then students will draw what they predict a potential energy diagram will look like given the information. Students will keep a log of their discussion in their lab notebooks and participate in a class discussion around their predictions and findings.

Lab Activities

Rate of Reaction Lab

Students will be given 2 Alka-Seltzer tablets and will be asked to devise and conduct an experiment that determines how temperature and surface area affect the rate of reaction. Students will produce a step by step procedure of how they plan to conduct the experiment and will be able compare their predictions with actual results following said procedure. Students will produce a graph of the rate of reaction versus both temperature and surface area and will use the graph to argue for or against their original hypotheses. Students will learn that an increase in temperature and an increase in surface area increase the reaction rate and will be able to support their findings with experimental data. Additionally, students will be given a limited number of supplies (no more than 2 Alka-Seltzer tablets, for example). Students must work carefully in the lab and must think of ways to maximize experimental testing while staying “cost-friendly” (as they would have to in the chemical industry). Students will keep a record of their methods and findings in their lab notebook and prepare a written report.

Unit 8: Acids and Bases

Students will be introduced to the concepts and properties of acid-base chemistry with an emphasis on determining the pH of substances and utilizing titration techniques to identify concentrations of unknown acids and bases. Students will begin this unit by revisiting chemical reactions and will start to identify reactants and products as either acids, bases, or their conjugates. Students will use the Bronsted-Lowry definition of acids and bases and will be able to identify species as either proton donors or proton acceptors. Additionally, students will be able to identify a new type of chemical reaction – a neutralization reaction – as one between an acid and a base and will be able to predict the products of any neutralization reaction. Students will learn to identify weak and strong acids and bases and will use molecular level explanations to differentiate between a weak or strong acid or base. Students will progress through this unit as they recall equilibrium constants from the previous unit. Students will use known acid and base equilibrium constants and ICE tables to determine the pH of a solution containing a known concentration of a weak or strong acid or base. Lastly, students will be able to plan and conduct a titration experiment. Students will collect experimental data, construct titration curves, identify the equivalence point, and use molar calculations to determine an unknown concentration of an acid or base.

Assignments

Categorizing Acids and Bases

After learning about the Bronsted-Lowry definition of acids and bases in class, students will develop an argument of how to tell if a species is a proton donor or proton acceptor. They will use their argument to look through several chemical reactions and determine if the reactants and products are acids, bases, or their conjugates. They will keep a record of their process in their lab notebooks and participate in a class discussion.

Lab Activities

Titrations Lab

Students will design a step by step procedure to test the concentration of vinegar in various brands of mustard packets. Mustard contains a natural indicator, Turmeric, and students will determine the titration has reached the equivalence point when the mustard turns from bright yellow to dark brown. Additionally, students will use pH probes and will be able to graph the pH of the solution as the volume of titrant is added to reinforce the volume needed to reach the equivalence point. Students will compare the concentration of vinegar in various mustard packets with other students in the class through the use of data tables and graphs and will construct titration curves based on their gathered data. Students will learn that titrations are useful in determining unknown concentrations of acids (or bases) and that the equivalence point is reached when equivalent molar quantities of acid and base have been mixed. Students will keep a record of their methods and findings in their lab notebook and prepare a written report.

Unit 9: Thermodynamics

Students will be introduced to the study of thermodynamics and how it applies to the transfer of heat (energy) into and out of systems. Students will be able to differentiate between the system and the surrounding and will be able to identify a system as either open, closed, or isolated based upon how heat (energy) is able to flow from the system to the surroundings. Students will be able to equate the system to a chemical reaction and will be able to identify a chemical reaction as either endothermic or exothermic depending on whether energy is released or absorbed. Students will be able to do so through various means including physical observation (does the reaction feel hot or cold?), mathematical expressions (what is the change in enthalpy during the reaction?), and graphically (how did the potential energy of the system change throughout the reaction based upon potential energy diagrams?). Continuing with potential energy diagrams, students will be able to draw said diagrams from given potential energies of products and reactants. Students will be able to determine whether or not the reaction was exothermic or endothermic based upon the change of potential energy. Students will be introduced to calorimetry and will be able to perform calorimetry calculations. Additionally, students will be able to explain how thermal energy is transferred when two components of different temperatures are combined within a closed system. Students will plan and conduct calorimetry-based experiments as they test the transfer of thermal energy between various solids and liquids.

Progressing further, students will begin to study the energy that is needed to break and make bonds (bond energies). Students will be able to determine the change in enthalpy of a chemical reaction given the bond energy of components present in the system. In order to succeed, students must be able to draw Lewis structures of compounds and use data tables to calculate the amount of enthalpy needed to break or form various bonds. Students will be able to determine mathematically (through the use of visual representations) whether or not a chemical reaction is endothermic or exothermic. Furthermore, students will be able to use Hess's Law to determine the overall enthalpy of a reaction from the enthalpies of multiple steps during a chemical reaction. Lastly, students will be introduced to free energy and entropy. Students will be able to define a spontaneous reaction and will be able to determine whether a reaction is spontaneous or not based upon the enthalpy, entropy, or free energy value of a chemical reaction.

Assignments

Endothermic vs. Exothermic

In groups, students will classify several different reactions as endothermic or exothermic and give justification for their choice. They will use evidence from the reaction like physical observations, mathematical expressions, and graphical representations of the potential energy levels of the system. They will keep a log of their arguments in their lab journals and participate in a class discussion.

Lab Activities

Calorimetry Lab

Students will select one of the following chemical reactions to investigate in a coffee cup calorimeter: ammonium nitrate + water, calcium chloride anhydrous + water, lithium chloride + water, sodium acetate + water, sodium chloride + water, sodium carbonate + water, and magnesium sulfate anhydrous + water. Students will write chemical equations for their chosen reaction and will be able to draw Lewis structures that depict a molecular view of the compounds involved. Students will use their knowledge of bond energies to predict whether or not the reaction will release or absorb heat and will test their prediction through the use of the calorimeter. Students will determine the specific heat of the substance they chose (ammonium nitrate, calcium chloride, etc.) and will compare it to known values. Students will complete this lab by submitting a formal lab report. Students will be able to cite sources of error and will learn that breaking bonds is endothermic and making bonds is exothermic. Students will be able to argue this knowledge using data gathered from this lab. Students will keep a record of their methods and findings in their lab notebook and prepare a written report.

Unit 10: Electrochemistry

Students will begin a brief investigation into electrochemistry and will be primarily concerned with oxidation numbers, recognizing oxidized and reduced species, and differentiating between electrolytic and galvanic cells. Students will begin with a review of chemical reactions and will be able to determine the oxidation number of elements present in both reactants and products. Additionally, using oxidation numbers, students will be able to determine which species in a chemical reaction is being oxidized and which species is being reduced. Lastly, students will be able to compare and contrast electrolytic and galvanic cells in terms of their spontaneity, design, and conversion of energy. Students will be able to draw both an electrolytic and galvanic cell and will be able to label the anode, cathode, and salt bridge (for a galvanic cell) and will be able to identify where oxidation and reduction occurs, as well as explain the function of the salt bridge (again, for a galvanic cell). Lastly, students will be able to calculate the voltage for spontaneous redox reactions from the standard reduction potentials.

Assignments

Electrochemistry Pre-Lab

Students will begin by completing a pre-lab that reviews free energy and galvanic cells. Students will set up a galvanic cell, add and measure solutions, record voltages, and record cell potentials. Students will use solutions of silver (I) nitrate, nickel (II) nitrate, iron (II) chloride, copper (II) nitrate, zinc (II) nitrate, and potassium nitrate. Students will also use copper strips, zinc strips, nickel, iron nails, and silver strips to complete each half cell. Students will measure the electrical potential difference between each pair of half cells and will use voltage readings to predict free energy using the equation $G^{o} = -nFE^{o}$. They will keep a record of their methods and findings in their notebook and include this information in the final report for their Electrochemistry lab.

Lab Activities

Electrochemistry Lab

Students will be given the task of determining how temperature affects free energy. Students will devise a plan to conduct such an experiment and will plot a graph of free energy and temperature. Lastly, students will complete a formal lab report that discusses the procedure used, analyzes the data collected (relating to spontaneity and cell potentials), and analyzes error by comparing experimental data to known values. Students will keep a record of their methods and findings in their lab notebook and prepare a written report.

Textbooks

Title	Authors	Publisher	Edition	Website	Is Primary
Chemistry: Matter and Change	Lauren Dingrando; Kathleen Gregg Tallman; Nicholas Hainen; Cheryl Wistrom	McGraw-Hill	2007	--	Yes

"Chemistry Matter and Change" (Glencoe McGraw Hill) 2017

HMH Science Dimensions Chemistry in the Earth System by HMH.