Introductory Chemistry

Concepts and Experiments

Lab 1: Introduction and Safety

Time: $^{1}/_{2}$ hour

Concepts to explore: How to work safely in a chemical laboratory, MSDS, and common labware.

Experiments: There are no experiments in this lab. However, students are required to identify laboratory equipment and review safety practices. No materials are required.

Lab 2: The Scientific Method

Time: ½ hour

Concepts to explore: Testable observations, hypothesis, null hypothesis, "how to conduct a successful experiment, variables, controls, data collection, and analysis.

Experiments: There are no experiments in this lab. However, this section includes several critical thinking activities that test student knowledge of the scientific method. No materials are required.

Lab 3: Measurements

Time: 1 hour

Concepts to explore: Significant figures, measuring techniques, unit conversions, and the relationship between volume and mass.

Experiments:
Experiment 1: Density of Water

- Students calculate density using several methods and compare their results.

Lab 4: Properties of Matter - Density

Time: 1 hour

Concepts to explore: Chemical properties of substances, density, the density formula, and density gradient columns.

Experiments:
Experiment 1: Determination of Density

- Students determine what type of metal different washers are made of by comparing their experimented results to known values. Students also create a density column to determine the density of different plastics.

Lab 5: Mixtures and Solutions

Time: 1 hour

Concepts to explore: Mixtures, solutions, homogeneous mixtures, heterogeneous mixtures, and separation techniques.

Experiments:
Experiment 1: Separation of a Mixture

- Students separate aspirin crystals from a mixture of other ingredients.

Lab 6: Chemical and Physical Change

Time: 1 hour

Concepts to explore: Chemical change, and physical change, and sublimation.

Experiments:
Experiment 1: Chemical and Physical Changes of Caffeine

- Students dissolve aspirin crystals using two techniques to demonstrate physical and chemical changes.

Lab 7: Heat and Calorimetry

Time: 1 hour

Concepts to explore: Calorie, specific heat, and calorimetry.

Experiments:
Experiment 1: The Calorimetry of Junk Food

- Students perform a calorimetry experiment by burning a piece of food under a can of water and measure the associated rise in water temperature.

Lab 8: Chemical Processes

Time: 1 hour

Concepts to explore: Endothermic processes, exothermic processes, and enthalpy.

Experiments:
Experiment 1: Cold Pack versus Hand Warmers

- Students use a calorimeter to capture the energy generated by the chemical reactions that occur within cold packs and hand warmers.

Lab 9: Electron Configuration

Time: 1 hour

Concepts to explore: Energy levels, electron configuration, and ground state.

Experiments:
Experiment 1: Chemistry of Fireworks

- Students perform flame tests using lithium chloride, sodium chloride, potassium chloride, calcium chloride, and activated charcoal to demonstrate energy levels.

Lab 10: Light Spectrum

Time: 1 hour
Concepts to explore: Spectrum, wavelength, diffraction grating, bright line spectrum, and interference.

Experiments:
Experiment 1: Measuring the Wavelength of a Laser Light

- Students analyze the spectra formed by shining a laser pointer through diffraction grating s with different groove separations and calculate the wavelength.

Lab 11: Molecular Models

Time: 1 hour

Concepts to explore: VSEPR model, central atom, and molecular geometry.

Experiments:
Experiment 1: Molecular Structures

- Students experiment with polarity using magnets and create models of various molecular shapes.

Lab 12: Ionic and Covalent Bonds

Time: 1 hour

Concepts to explore: Ions, cations, anions, ionic bonds, and covalent bonds.

Experiments:
Experiment 1: Sugar or Salt

- Students draw comparisons between ionically and covalently bonded materials using electrodes in salt and sugar solutions. Then, students compare melting points.

Lab 13: Polar Bonding

Time: 1 hour

Concepts to explore: Electronegativity, polar bonds, and “like dissolves like”.

Experiments:
Experiment 1: Slime Time

- Students explore polarity with slime, silly putty, and chromatography of inks.

Lab 14: Chemical Reactions I

Time: 1 hour

Concepts to explore: Qualitative tests, polyatomic ions, chemical equations, and coefficients.

Experiments:
Experiment 1: Battle of the Mouth Rinses

- Students qualitatively test which of the sample mouth rinses contain fluoride by looking for a precipitate to form.

Lab 15: Chemical Reactions II

Time: 1 hour

Concepts to explore: Combustion, synthesis, single replacement, double replacement, and decomposition.

Experiments:
Experiment 1: Getting to Know Your Reactions

- Students perform a series of experiments that demonstrate combustion, synthesis, single replacement, double replacement, and decomposition reactions in order to classify types of chemical reactions.

Lab 16: Metals and Oxidation
Time: 1 hour

Concepts to explore: Activity series, oxidation-reduction reaction, and oxidation number.

Experiments:
Experiment 1: Metal Reactivity
- Students analyze the reaction of two metals in an acid solution and use the properties of a reaction product to verify its identity.

Lab 17: The Mole and Avogadro's Number
Time: 1 hour

Concepts to explore: The mole, Avogadro's number, atomic weight, and molecular mass.

Experiments:
Experiment 1: Avogadro's Number
- Students investigate the mole and experimentally calculate Avogadro's number.

Lab 18: The Periodic Table
Time: 1 hour

Concepts to explore: Groups, periods, atomic number, atomic weight, and molar mass.

Experiments:
Experiment 1: Periodic Table Fun
- Students exercise their knowledge of molecular weight and molar ratios. Students also investigate the similarities in reactions by relating the characteristics within a group on the periodic table.

Lab 19: Stoichiometry
Time: 1 hour

Concepts to explore: Stoichiometry, balancing an equation, limiting reagents, and percent yield.

Experiments:
Experiment 1: Synthesis of Garden Lime
- Students explore limiting reagents, theoretical yield, and calculate percent yield of several reactions.

Lab 20: The Ideal Gas Law
Time: 1 hour

Concepts to explore: Ideal gas law.

Experiments:
Experiment 1: Finding Percent H_2O_2 with Yeast
- Students create a gas collection apparatus and evaluate the amount of gas produced by yeast. Students also determine the decomposition rate of their hydrogen peroxide solution.

Lab 21: Reaction Rate
Time: 1 hour

Concepts to explore: Reaction rate.

Experiments:
Experiment 1: Comparing Reaction Rates
- Students calculate and compare rate of five reactions of citric acid and calcium carbonate under varying conditions to see how temperature, surface area, and concentration influence the rate of a reaction.

Lab 22: Catalysts
Time: 1 hour

Concepts to explore: Catalysts, activation energy, heterogeneous catalyst, and homogeneous catalyst.

Experiments:
Experiment 1: Reactions with Catalysts
- Students evaluate various metals mixed with yeast to see which speed up a decomposition reaction; and, analyze how varying concentrations of catalysts affect the reaction rate.

Lab 23: Acids and Bases
Time: 1 hour

Concepts to explore: Acids, bases, salt, neutralization, and pH.

Experiments:
Experiment 1: Acidity of Common Household Products
- Students observe the neutralization of acids and bases using grape juice as an indicator; and, test common household chemicals for their acidity or alkalinity.

Lab 24: Titration
Time: 1 hour

Concepts to explore: Standard solution, titration, and equivalence points.

Experiments:
Experiment 1: Titration of Sour Candy
- Students use titration with a standard Na_2CO_3 solution to determine whether Swee-Tarts® or Smarties® candies requires more standard base per gram of candy to reach the endpoint. Then, students determine whether Swee-Tarts® or Smarties® candies have more moles of acid per gram of candy.