Higher Education

Lab Activities
Atomic Theory

- Thomson Cathode Ray Tube Experiment
- Millikan Oil Drop Experiment
- Rutherford’s Backscattering Experiment
- Investigating the Properties of Alpha and Beta Particles
- Blackbody Radiation
- Photoelectric Effect
- The Rydberg Equation
- Atomic Emission Spectra
- Heisenberg Uncertainty Principle
- Emission Spectra for Sodium and Mercury

Reactions and Stoichiometry

- Names and Formulas of Ionic Compounds
- Writing Balanced Precipitation Reactions
- Strong and Weak Electrolytes
- Precipitation Reactions
- Counting Atoms (1)
- Counting Atoms (2)
- Counting Atoms (3)
- Counting Molecules (1)
- Counting Molecules (2)
- Counting Protons, Neutrons, and Electrons (1)
- Counting Protons, Neutrons, and Electrons (2)
- Creating a Solution of Known Molality
- Creating a Solution of Known Molarity
- Converting Concentrations to Different Units

Thermodynamics

- Endothermic vs. Exothermic
- Enthalpy of Solution: NH₄NO₃
- Specific Heat of AI
- Specific Heat of Pb
- Heat of Combustion: Chicken Fat
- Heat of Combustion: Sugar
- Heat of Combustion: TNT
- Heat of Formation: Ethanol
- Heat of Formation: Aspirin
- Heat of Reaction: NaOH (aq) + HCl (aq)
- Heat of Reaction: MgO (s) + HCl (aq)
- Hess’s Law
- The Balance Between Enthalpy and Entropy
Colligative Properties

- Heat of Fusion of Water
- Heat of Vaporization of Water
- The Boiling Point of Water at High Altitude
- Boiling Point Elevation
- Freezing Point Depression
- Molar Mass Determination by Boiling Point Elevation
- Molar Mass Determination by Freezing Point Depression
- Changes in the Boiling Point

Gas Properties

- Boyle’s Law: Pressure and Volume
- Charles’ Law: Temperature and Volume
- Avogadro’s Law: Moles and Volume
- Derivation of the Ideal Gas Law
- Dalton’s Law of Partial Pressures
- Ideal vs. Real Gases
- The Effect of Mass on Pressure

Acid-Base Chemistry

- Acid-Base Classification of Salts
- Ranking Salt Solutions by pH
- Concepts in Acid-Base Titrations
- Predicting the Equivalence Point (1)
- Predicting the Equivalence Point (2)
- Predicting the Equivalence Point (3)
- Ionization Constants of Weak Acids
- Acid-Base Titration: Practice
- Acid-Base Titration: Unknown HCl
- Study of Acid-Base Titrations – Monoprotic Acids
- Weak Acid-Strong Base Titrations
- Strong Acid-Weak Base Titrations
- Weak Acid-Weak Base Titrations
- Study of Acid-Base Titrations – Polyprotic Acids
- Acid-Base Standardization
- Analysis of Baking Soda
Electrochemistry

• Study of Oxidation-Reduction Titrations
• Standardization of a Permanganate Solution
• Analysis of a Ferrous Chloride Sample

Descriptive Chemistry

• Flame Test for Metals
• Identification of Cations in Solution - Flame Tests
• Identification of Cations in Solution - Ag⁺, Hg²⁺, Pb²⁺
• Identification of Cations in Solution - Co²⁺, Cr³⁺, Cu²⁺
• Identification of Cations in Solution - Ba²⁺, Sr²⁺, Ca²⁺, Mg²⁺
• Identification of Cations in Solution - Co²⁺, Cu²⁺, Ni²⁺
Techniques

- Using Thin Layer Chromatography
- Performing a Separatory Funnel Extraction
- Performing a Distillation
- Recrystallizing a Compound and Determining its Melting Point
- Interpreting a Mass Spectrum

Alkene Reactions

- Alkene Halogenation - 1
- Alkene Halogenation - 2
- Alkene Hydration - 1
- Alkene Hydration - 2
- Alkene Hydration - 3
- Etherification - 1
- Alkene Hydration - 4
- Alkene Halogenation - 3
- Alkene Halogenation - 4
- Alkene Halogenation - 5
- Halohydrin Formation - 1
- Epoxidation - 1
- Hydroboration - 1
- Hydroboration - 2
- Alkene Bromination - 1
- Alkene Bromination - 2
- Halohydrin Formation - 2
- Epoxidation - 2

Diene Reactions

- Diene Halogenation - 1
- Etherification - 2
- Diene Halogenation - 2
- Diels Alder - 1
- Diels Alder - 2
- Diels Alder - 3
- Diels Alder - 4
- Diels Alder - 5
Substitution Elimination

• Alkyl Halide Solvolysis
• Nucleophilic Substitution - 1
• Williamson Ether Synthesis - 1
• Alkene Formation
• Nucleophilic Substitution - 2
• Williamson Ether Synthesis - 2
• Amine Formation

Alcohol Reactions

• Alcohol Halogenation - 1
• Alcohol Halogenation - 2
• Alcohol Halogenation - 3
• Alcohol Dehydration

Spectroscopy

• Interpreting FTIR Spectra
• Interpreting NMR Spectra - 1
• Interpreting NMR Spectra - 2
• Interpreting NMR Spectra - 3
• Interpreting NMR Spectra - 4

Qualitative Analysis

• Qualitative Analysis - Alkenes
• Qualitative Analysis - Alcohols
• Qualitative Analysis - Aldehydes
• Qualitative Analysis - Ketones
• Qualitative Analysis - Acids
• Qualitative Analysis - Esters
• Qualitative Analysis - Amines
• Qualitative Analysis - Amides
• Qualitative Analysis - Halides
• Qualitative Analysis - Ethers
• Qualitative Analysis - General
Aromatic Substitution

- Benzene Nitration - 1
- Benzene Nitration - 2
- Benzene Nitration - 3
- Friedel-Crafts - 1
- Friedel-Crafts - 2
- Friedel-Crafts - 3
- Friedel-Crafts - 4

Carboxylic Acids

- Ester Formation
- Amide Formation
- Ester Hydrolysis
- Transesterification

Carbonyl Additions

- Grignard Addition - 1
- Grignard Addition - 2
- Grignard Addition - 3
- Carbonyl Reduction
- Acetal Formation

Enols and Enolates

- α - Halogenation - 1
- α - Halogenation - 2
- α - Halogenation - 3
- Aldol - 1
- Aldol - 2
- Aldol - 3
- Aldol - 4
- Claisen Condensation - 1
- Claisen Condensation - 2
- Claisen Condensation - 3
- Dieckmann Reaction
- Aldol - 5
Oxidation and Reduction

• Alcohol Oxidation - 1
• Alcohol Oxidation - 2
• Alcohol Oxidation - 3
• Aldehyde Oxidation
• Baeyer-Villiger Oxidation
• Alkene Dihydroxylation
• Quinone Reduction
• Epoxidation - 3
Organic and Natural History

- Introduction to the Microscopy Lab
- Staining Bacteria
- Unicellular Eukaryotic Life
- TEM and Membranes
- Parasites
- Introduction to the Systematics Lab
- What is a Fish?
- Bugs and Barnacles
- Centipedes and Millipedes
- Land Plants
- Seaweed
- Worms

DNA

- Introduction to the Molecular Lab
- Fish Cousins
- Shark Fin Sequencing
- Tiger DNA Sequencing
- DNA Profiling

Heredity

- Introduction to the Genetics Lab
- Labrador Fur Color Inheritance
- Colorblindness Inheritance
- Mice Inheritance
- Sickle Cell Inheritance
- Gene Linkage in Fruit Flies

Biomes and Populations

- Introduction to the Ecology Lab
- Invasive Species
- Keystone Species
- Predator Competition
Projects

• Ecology 1: Disruption of a Marine Food Web
• Ecology 2: Invasive Species
• Ecology 3: The Effects of Removing a Predator
• Genetics 1: Inheritance in Mendel’s Peas
• Genetics 2: The Inheritance of Color Blindness
• Genetics 3: Sickle-Cell Inheritance
• Microscopy 1: Introduction to Microscopy
• Microscopy 2: Structural and Functional Diversity of Protists
• Microscopy 3: Identifying Bacteria through Staining
• Molecular 1: Crime Scene Forensics
• Molecular 2: Is an Endangered Species Being Traded Illegally?
• Molecular 3: DNA Analysis of Three Fish Species
• Systematics 1: Introduction to Systematics
Kinematics

• Measuring Speed
• Graphing Constant Velocity Motion
• Graphing Accelerated Motion

Forces

• Balanced Forces
• Newton’s First Law
• Newton’s Second Law
• Newton’s Third Law
• Acceleration and Friction
• Gravity and Projectile Motion
• Projectile Motion and Air Resistance
• Gravitational Interactions
• Universal Gravitation

Circular Motion

• Centripetal Motion
• Satellite Motion
• Rotational Inertia

Momentum and Energy

• Conservation of Momentum
• Energy Conversions

Optics and Waves

• Refraction of Light
• Plane Mirror Images
• Concave Mirror Images
• Lenses
• Diffraction and Interference
• Wave Diffraction
• Blackbody Radiation
• Photoelectric Effect
Electricity and Magnetism

• The Effect of an Electric Field on a Moving Charge
• Circuit Diagrams
• Building Circuits with Light Bulbs
• Electric Current
• Series and Parallel Circuits
• Capacitors
• The Effect of a Magnetic Field on Moving Charges

Thermodynamics

• Specific Heat of Metals
• Phase Changes

Density and Buoyancy

• Density and Buoyancy
• Density and the Solid Structure Model
• Introduction to Scientific Inquiry
• Density of Solids and Liquids