Higher Education

Lab Activities

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Virtual ChemLab

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: NH_4NO_3
- Specific Heat of Al
- 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

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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

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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^{+}, Hg_2^{2+}, Pb^{2+}
- Identification of Cations in Solution - Co^{2+}, Cr^{3+}, Cu^{2+}
- Identification of Cations in Solution - Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}
- Identification of Cations in Solution - Co^{2+}, Cu^{2+}, Ni^{2+}

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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

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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

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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

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Oxidation and Reduction

- Alcohol Oxidation - 1
- Alcohol Oxidation - 2
- Alcohol Oxidation - 3
- Aldehyde Oxidation
- Baeyer-Villiger Oxidation
- Alkene Dihydroxylation
- Quinone Reduction
- Epoxidation - 3

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Virtual Biology

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

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Virtual Biology

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

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Virtual Physics

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

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Virtual Physics

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

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