KAP Chemistry Syllabus—2016-2017
CHEMISTRY 121, 123, 124, 126
(COURSE DESCRIPTIONS – KENYON.EDU/KAP

Hilliard Davidson High School
Instructor: Bonnie Bloom

KAP Chemistry is a **college-level** chemistry course. It is a *second-year course*—students should have successfully completed a chemistry course in their sophomore or junior years of high school. It emphasizes chemical understanding, both quantitatively and qualitatively, in a laboratory setting. Students should have three credits in Math, credit in Biology, and Chemistry with a "B" or better average.

Students will earn two credits of College Credit Plus laboratory science. The course is taught as a "1 ½ block" course—students will alternate between single period and double period. The double period on alternate days will allow us to complete the more rigorous laboratory activities required by the KAP curriculum. Classes will either be 48 minutes or 100 minutes in length, with an average of 375 minutes of class time each week. The classes are arranged so that students may take 2 KAP and/or AP Sciences in 3 class periods. A minimum of twenty-five percent of instructional time is dedicated to the lab activities.

Students will be able to earn college credit through Kenyon College by participating in the KAP program.

The six **Big Ideas** of this course are:

Big Idea 1: The chemical elements are fundamental building materials of matter, and all matter can be understood in terms of arrangements of atoms. These atoms retain their identity in chemical reactions.
Big Idea 2: Chemical and physical properties of materials can be explained by the structure and the arrangement of atoms, ions, or molecules and the forces between them.
Big Idea 3: Changes in matter involve the rearrangement and/or reorganization of atoms and/or the transfer of electrons.
Big Idea 4: Rates of chemical reactions are determined by details of the molecular collisions.
Big Idea 5: The laws of thermodynamics describe the essential role of energy and explain and predict the direction of changes in matter.
Big Idea 6: Any bond or intermolecular attraction that can be formed can be broken. These two processes are in a dynamic competition, sensitive to initial conditions and external perturbations.

In addition to the Big Ideas, KAP Chemistry incorporates seven **Science Practices**:

Science Practice 1: The student can use representations and models to communicate scientific phenomena and solve scientific problems.
Science Practice 2: The student can use mathematics appropriately.
Science Practice 3: The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course.
Science Practice 4: The student can plan and implement data collection strategies in relation to a particular scientific question. [Note: Data can be collected from many different sources, e.g., investigations, scientific observations, the findings of others, historic reconstruction, and/or archived data.]
Science Practice 5: The student can perform data analysis and evaluation of evidence.
Science Practice 6: The student can work with scientific explanations and theories.
Science Practice 7: The student is able to connect and relate knowledge across various scales, concepts, and representations in and across domains.

Required Text:
Tro, Nivaldo J., *Chemistry, A Molecular Approach*, 3rd ed., Upper Saddle River, NJ: Pearson Education, Inc., 2012.
Laboratory manual designed for Hilliard Davidson High School, 2016-2017.

Other Supplies: Bound lab record book (provided as part of class fees), approved safety goggles (provided as part of class fees), charged iPad, graphing calculator, binder with separated sections for notes and homework, pens, pencils, highlighters. A stylus for the iPad is encouraged but not required.

New for 2016: Required Free apps:
Vernier Graphical Analysis, Period Table by the Royal Society of Chemistry, Socrative (student), Pearson eText,

The Laboratory Program:
The laboratory component is, at minimum, 25% of the instructional time. Investigations will be integrated throughout the course. Students will also need to spend time out of class, both preparing for and completing laboratory investigations. Students will typically work with a partner, but some investigations require groups of three or four.

Students are required to have a bound lab notebook (provided) and a three-ring binder, which will be used as their lab portfolio.

The lab notebook will have a **table of contents**, which will include:

- Date the investigation was performed
- Title of investigation
- Page numbers of the investigation

Each laboratory investigation will have the following components:

- Title and date
- Scientific question
- Procedure
  - What you **actually** do in the lab, written **as you do it**
  - This **must** be initialed by your teacher before you leave the laboratory area
- Data
  - Written **directly into the lab notebook**
  - Written alongside the procedure, or, for repetitive data, in a table
- Data analysis
- Lab questions, copied into the notebook, with answers written clearly and concisely

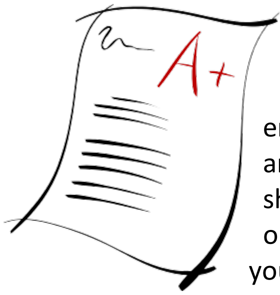
In addition, *some* investigations will include

- Prelab group work
- Prelab Canvas quizzes
- Graphs or charts
- Analysis of class data
- Error analysis
- Presentation to the class
- Other components as needed

Some (but not necessarily all) of the investigations come from, or are modified from:

Kenyon College Department of Chemistry Chemistry 123 Lab Manual, 2013.
Randall, Jack. Advanced Chemistry with Vernier. Oregon: Vernier Software and Technology, 2004.
The College Board. AP Chemistry Guided Inquiry Experiments: Applying the Science Practices. 2013.
Flinn Scientific Advanced Inquiry Labs, 2013

Volz, Donald L.; Smola, Ray; Investigating Chemistry through Inquiry
Holmquist, Dan D.; Randall, Jack; Volz, Donald L.; Chemistry with Vernier
Vonderbrink, Sally. Laboratory Experiments for AP Chemistry. Batavia: Flinn Scientific, 2001.
Bernstein, Jesse; Bracken, Jeffrey; Price, Paul. Advanced Placement Chemistry Laboratory Manual: An Inquiry and Forensic Approach Towards Chemical Experimentation, 2009



Academic honesty:

Students often work together in advanced science classes. This is valuable and I encourage working together. HOWEVER, copying another person's homework, lab report, or answers to any other sort of assessment is CHEATING. While you and your lab partner will share data, you need to do your OWN calculations and your OWN analysis. Using unapproved outside resources is also cheating. You will not receive credit for an assignment or assessment if you cheat.

Example: You do not know how to approach solving an old AP Test question that you have for homework. What should you do?

a) Search the internet and copy down the answer	NO—that is CHEATING
b) Search the internet for another explanation of the topic	YES—good idea!
c) Copy the answer from your friend or older sister	NO—that is CHEATING
d) Tell your friend you could do a, b, and c but are stuck on d. Ask your friend to point you in the right direction.	YES—good idea!
e) Steal the answer key from your teacher	NO—that is CHEATING
f) Ask your teacher for help a day or two before the due date	YES—good idea!
h) Ask your teacher for help a day or two after the due date	OK—Better late than never, but your teacher might get annoyed
i) Cry	OK for the short term, but you still need to figure out the answer!
j) Ignore it and hope it goes away.	NO—it won't go away, and neither will your teacher

About KAP…

Students who will have junior or senior status will have the opportunity to apply for admission to the KAP (Kenyon Academic Partnership) program. The program allows students to get college credit while still in high school. Students will have an official transcript from Kenyon College. Students who wish to enroll in KAP courses must be strongly motivated and should have demonstrated success in the subject areas they wish to pursue. Since KAP courses are demanding, readiness and willingness to work hard are essential for success. When students register for their courses, they must complete a separate application for the KAP program. The application includes a teacher recommendations and a transcript. There is an additional fee for KAP and additional coursework may be required. Students participating in the KAP program will receive **2 high school credit**s and college credit for the **four** following Kenyon courses:
Chemistry 121 Introductory Chemistry Lecture (0.5 Kenyon units; 4 semester hours)
Chemistry 123 Introductory Chemistry Laboratory (0.25 Kenyon units; 2 semester hours)
Chemistry 124 Biophysical and Medicinal Chemistry (0.5 Kenyon units; 4 semester hours)
Chemistry 125 Biophysical and Medicinal Chemistry (0.25 Kenyon units; 2 semester hours)

NOTE:

Although there is a biological focus to the second semester Kenyon courses, the major chemical topics (equilibrium, atomic structure and bonding, kinetics) are the same as a traditional second-semester chemistry course. Students enrolled in KAP will have the same chemistry content as those enrolled only in AP Chemistry.

Assessment…

The class is graded on a weighted scale. Tests and quizzes are 70% of the grade, labs, lab quizzes, and projects are 30%.

For students who receive a C or higher, AP courses at Hilliard Davidson High School receive an extra quality point when calculating grade point average. (A = 5.0, B = 4.0, C = 3.0, D = 1.0, F = 0.0)

Homework Students should be doing homework daily. Homework will be checked by pre-announced quizzes. Homework is for **practice,** and some students need more practice than others. Therefore, students should have the opportunity to continue to show that they have learned from their mistakes. If a student needs more time to understand a topic, he or she should get help with the topic and *may* be permitted to take a requiz. (NOTE: Students must show evidence of doing their homework assignments in order to be allowed to take the retake

Labs are done frequently. Since most occur on double-block days, students should try not to miss lab days. All labs must be completed to receive credit for the course. Some universities require students to submit a lab notebook or portfolio to receive college credit.

Quizzes are given frequently. The primary purpose of the quizzes is to make sure everyone is keeping up with the material.

Tests are given at the end of each unit. Tests will combine multiple-choice and open-ended questions. Some or all of a test may be calculator-free. Tests may include questions from laboratory investigations.

*****All** students take a cumulative test towards the end of the second quarter and an in-class college-level test during the fourth quarter. The fourth-quarter test is the ACS General Chemistry Test. The grades are part of the quarter grades.

More about tests and quizzes…

- Tests and quizzes serve several purposes: they are typically viewed as a way for me to evaluate your progress, but they are also learning experiences for students.
- Tests will always be announced at least two days prior. Quizzes will almost always be announced. They may be written or lab-based.
- To receive full credit on tests and quizzes, *show all calculations*. Explain your answers completely and concisely—explanations help me to understand your thoughts.
- Each new test will include material from previously studied chapters as well as the summer review. Quizzes over earlier material will appear throughout the year.

Curriculum Content Map

<table>
<tr><td colspan="2">Big Idea 1: The chemical elements are fundamental building materials of matter, and all matter can be understood in terms of arrangements of atoms. These atoms retain their identity in chemical reactions.
Big Idea 3: Changes in matter involve the rearrangement and/or reorganization of atoms and/or the transfer of electrons.</td></tr>
<tr><td colspan="2">Textbook Chapter(s): 1,2,3,</td></tr>
<tr><td>Unit & Topics</td><td>Laboratory activities (subject to change)</td></tr>
<tr><td>What’s that compound—Physical and chemical processes
• Nomenclature
o Inorganic compounds
o Simple covalent compounds
o Simple Hydrocarbons and functional groups
o Acids and bases
o Coordination compounds
• Empirical formulas including combustion analysis
• Review
o Balancing equations
o Stoichiometry
o Limiting reactants
o Physical and chemical changes
o Precision, accuracy, and measurement
o Significant figures</td><td>Decomposition of Baking Soda
• Using stoichiometry to determine the products formed when baking soda is heated
• SP 1, 2, 4. 5, 6
Guided inquiry: Green Analysis of a Mixture
• Determine the composition of a carbonate/bicarbonate mixture
• Science Practices 1, 2, 4, 5, 6
Modeling with Hydrocarbons
• Model hydrocarbons with and without functional groups
• Science Practices 1, 6
Synthesis of a Coordination Compound
• Synthesize and isolate crystals of $K_x[Fe(C_2O_4)_y \cdot zH_2O$
• Science Practices 2, 4, 6
Standardization of Sodium Hydroxide
• Determine the concentration of NaOH by titrating with a primary standard
• SP 1, 2, 5, 6
Determining the Empirical Formula of a Coordination Compound
• Dehydration to determine percent water and the waters of hydration in the formula
• Permanganate titration to determine the percent oxalate and the number of oxalate ions in the formula
• Ion exchange and pH titration to determine the percent potassium and percent iron and the number of potassium ions in the formula
• SP 1, 2, 4, 6</td></tr>
<tr><td colspan="2">Activity: Students are given a problem set and asked to determine the limiting reagents for a chemical reaction
Activity: Students will use dry-erase boards to draw particulate models of chemical reactions so that they can translate between macroscopic observations, chemical symbols, and particle views</td></tr>
</table>

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<tr><td colspan="2">Big Idea 1: The chemical elements are fundamental building materials of matter, and all matter can be understood in terms of arrangements of atoms. These atoms retain their identity in chemical reactions.</td></tr>
<tr><td colspan="2">Textbook Chapter(s):</td></tr>
<tr><td>Unit & Topics</td><td>Laboratory activities</td></tr>
<tr><td>What’s that compound—Using spectroscopy
• Mass Spectrometry
o Isotopic determination
o Molar mass and functional groups of a small organic compound
• Types of Spectroscopy
o UV-Vis spectroscopy
o IR spectroscopy
o NMR spectroscopy
• Using spectroscopic techniques to determine the structure of a molecule
• <u>Authentic or Not? Chemistry Solves the Mystery</u>
o ChemMatters article(April 2011) & podcast relating the use of spectroscopy to determining the authenticity of paintings
o Chemical and Engineering News article on the role of chemists in art conservation (http://pubs.acs.org/cen/coverstory/7931/7931art.html</td><td>Guided inquiry: Analysis of Food Dyes in Beverages
• Use visible spectroscopy and Beer’s Law to determine the concentration of blue dye in a sports drink
• Science Practices 2, 4, 5, 6
Guided inquiry: Percent Copper in Brass
• Use visible spectroscopy and Beer’s Law to determine the amount of copper in a sample of brass
• Science Practices 4, 5, 6
What’s that molecule?
• Field trip to a local college to run IR and NMR of an unknown compound then determine the structure of the substance
• Science Practices 1, 4, 5, 6, 7</td></tr>
</table>

Big Idea 2: Chemical and physical properties of materials can be explained by the structure and the arrangement of atoms, ions, or molecules and the forces between them.

Textbook Chapter(s): 5, 11, 12

Unit & Topics	*Laboratory activities*
States of matter • Phases of matter • Particulate models of solids, liquids, and gases • Phase changes and phase diagrams • Vapor pressure, boiling points, and freezing points • Qualitative observations relating pressure, volume, temperature, moles of particles • Calculations involving combined gas laws, the ideal gas law, and gas densities • Stoichiometry involving balanced equations, mass, moles, and gas laws • Dalton's Law of Partial Pressures *including* combining 2 or more flasks into one, mole fractions, and collecting gases over water • Kinetic molecular theory including calculating average kinetic energy and molecular speed of a gas • Deviations between ideal behavior of gases • Types of intermolecular forces • Impact of intermolecular forces on physical properties • Electronegativity, bond polarity, and molecule polarity • Ionic bonding and Coulomb's Law • Metallic bonding	**Extraction and isolation of caffeine** • Concepts include extraction, sublimation, solubility, and chromatography • SP 4, 5, 6, 7 **Qualitative Analysis and Chemical Bonding** • Determine the identity of six unknown substances based upon chemical & physical properties • SP 1, 4, 5, 6, 7 **Demonstration: Separation of Components of a Homogeneous Mixture Using Simple Distillation** • Separate a simple mixture • Test the solubility of iodine in the distillates to determine the identity of the distillates • SP 3 **Properties of Air** • Explore changes in behavior of objects in a reduced-pressure environment and draw particulate models of what they observe • SP 7 **Molar mass of an unknown gas** • Determine the molar mass of an unknown gas using the Ideal Gas Law • SP 2, 5

Activity: Students will use interactive websites and KMT to

- determine macroscopic changes in gases based upon particulate models
- examine phase changes by looking at intermolecular interactions

Big Idea 3: Changes in matter involve the rearrangement and/or reorganization of atoms and/or the transfer of electrons.	
Textbook Chapter(s): 4,182	
Unit & Topics	*Laboratory activities*

Chemical Reactions in Solution
• Types of electrolytes
• Electrolytes
• Concentration Terms – Molarity
• Dilution Problems
• Stoichiometry Problems with Solutions (review)
• Classification of reaction types
  o Double-replacement, synthesis, decomposition, single-replacement, combustion
  o Redox, acid-base, precipitations
• Predicting products of DR reactions based on solubility rules
• Assigning oxidation numbers
• Determining oxidation & reduction half-reactions
• Balancing redox reactions
• Predicting products of SR reactions based on activity series
• Molecular and net-ionic chemical equations
• Predicting products of acid-base reactions
	Mini-labs looking at properties of gases dissolved in solution, redox, acids & bases, and precipitates
	• SP 5
	Growing Crystals in Gels
	• Create a silicate gel "crystal garden" with a combination of redox and precipitate reactions
	• SP 3, 4, 5, 6
	Guided Inquiry: Driving under the influence
	• Use $Cr_2O_7^{2-}/CH_3CH_2OH$ redox reaction. visible spectroscopy, and Beer's Law to determine the percent alcohol in a sample.
	• Write a letter which provides evidence to justify the students' claim
	• SP 3, 4, 5, 6
	Guided Inquiry: Qualitative Analysis
	• Identification of ions present in an unknown solution
	• SP 4, 5, 6
	Iron Chemistry: Variable Oxidation States
	• Observe the differences in reactivity between iron(II) and iron(III)
	• SP 5, 6
	Lab Exam: Qualitative Analysis
	• Create and carry out a procedure to determine the identities of five aqueous solutions

<table>
<tr><td colspan="2">Big Idea 6: Any bond or intermolecular attraction that can be formed can be broken. These two processes are in dynamic competition, sensitive to initial conditions and external perturbations.</td></tr>
<tr><td colspan="2">Textbook Chapter(s):14</td></tr>
<tr><td>Unit & Topics</td><td>Laboratory activities</td></tr>
<tr><td>Equilibrium
• Reversible processes and Reactions
• Types of Systems
• Kinetics relationship to Equilibrium
• Equilibrium Expressions
• Equilibrium Constants
• LeChatelier’s Principle
• Equilibrium Stresses
• Equilibrium Calculations
• Molar Solubility
• Common Ion Effects
• Reaction Quotients</td><td>Guided Inquiry: Applications of LeChatelier’s Principle
• Observing the effects of changes in starting conditions and predicting the direction of shift
• SP 4, 5, 6
Determine the Equilibrium Constant of $FeSCN^{2+}$
• Student will use a prescribed procedure to perform a chemical reaction and use a series of calculations to determine the equilibrium constant for a system at equilibrium:
1. Vernier technology
2. Beer’s Law
• SP 1, 2, 5, 6, 7
Solubility Matters: Determining the K_{sp} of calcium iodate
• Student will use a prescribed procedure perform a microscale titration and determine the solubility product of calcium iodate.
• SP 1, 2, 4, 5, 6
Determining the Equilibrium Constant of a Silver complex
• Student will use semi-guided inquiry to determine the K_{eq} for a complex ion and predict the K_{eq} for other reactions:
• SP 2, 3, 5, 6, 7</td></tr>
<tr><td colspan="2">Activity: Students will use interactive websites to explore the ideas of equilibrium and LeChatelier’s principle. Students will apply their knowledge to maximize the amount of a specific product in a reaction</td></tr>
</table>

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<tr><td colspan="2">Big Idea 6: Any bond or intermolecular attraction that can be formed can be broken. These two processes are in dynamic competition, sensitive to initial conditions and external perturbations.</td></tr>
<tr><td colspan="2">Textbook Chapter(s):15, 16</td></tr>
<tr><td>Unit & Topics</td><td>Possible Laboratory activities</td></tr>
<tr><td>Acids, Bases and Salts
• Dissociation versus Ionization
• Preparation Acids, bases and salts
• Classification of Acids and bases
• Bronsted-Lowry theory of acids and bases
• Degree of Ionization
• Equilibrium constants for acids and bases
• Weak acids and bases
• Binary acids versus oxyacids
• Determination of acid and base properties based on structure
• Ionization of water
• pH and pOH
• Acid-base stoichiometry problems – review
• Ionization calculations of weak acids and bases
• Henderson-Hasselbach equation
• Titration calculations
• Indicators
• Types of salts
• Dissociation of salts and buffers</td><td>Investigating the Effects of Acid Rain
• Students will model an acid-rain environment and make observations of the effects on natural materials
• SP 1, 3, 5
Determination of Molecular Weight and K_a of an Unknown Acid
• pH probes
• Titration curves using data acquisition (Logger Pro)
• Determination of Equivalence Point using 2^{nd} derivatives
• Determination of midpoint to determine pK_a
• Vernier technology
• SP 2, 5, 6
pH of various salts
• Students will predict the relative pH of salts and test their predictions
• SP 5, 6
Characteristics of a Buffer
• Students will explore the effects of a buffer in a microscale environment: effect on pH when OH^- or H^+ are added, effect of dilution of buffer
• SP 3, 4, 5, 6
Using and Designing a Buffer
• Students will use their understanding of buffers to create a buffer of a specific pH
• SP 2, 3, 5, 6
Using pH indicators
• Students will observe the changes of various pH indicators at a range of pH levels and identify an unknown based upon their observations
• SP 5, 7
Titration of Household Ammonia
• Choose the correct indicator for a titration and determine the molarity of household ammonia
• SP 2, 3, 4, 5
Guided Inquiry: Acidity of Beverages, Lab #4
• Using acid-base chemistry to determine the acidity of various beverages
• SP 4, 5, 6, 2,</td></tr>
<tr><td colspan="2">Activity: Students will calculate the pH of solutions under a variety of conditions</td></tr>
</table>

<table>
<tr><td colspan="2">Big Idea 4: Rates of chemical reactions are determined by details of the molecular collisions.</td></tr>
<tr><td colspan="2">Textbook Chapter(s): 13,196</td></tr>
<tr><td>Unit & Topics</td><td>Laboratory activities</td></tr>
<tr><td>Kinetics
• Rates relationship to collisions
• Reaction Mechanisms
• Activation energy
• Nature of reactants and Interfacial Surface Area
• Temperature and Pressure effects on Rates
• Catalyst – Homogenous and Heterogeneous
• Potential Energy Diagrams – review
• Activated Complex and Intermediates
• Arrhenius Equation
• Maxwell-Boltzman Diagram
• Average rate
• Rates relationship to stoichiometry</td><td>Decomposition of Calcium Carbonate
• Work collaboratively to determine the rate law for the decomposition of calcium carbonate; explore the impact of particle size on rate.
• SP 1, 2, 5, 6,
The Vitamin C Iodine Clock reaction
• Small-scale clock reaction with a focus on using greener reactants
• SP 2, 5, 6
Crystal Violet Kinetics
• Determine the integrated rate law of a reaction based on spectrophotometric analysis
• SP 1, 2, 5, 6,</td></tr>
<tr><td colspan="2">Activity: In collaborative groups, students will evaluate possible reaction mechanisms to determine which are consistent with experimental data</td></tr>
</table>

<table>
<tr><td colspan="2">Big Idea 5: The laws of thermodynamics describe the essential role of energy and explain and predict the direction of changes in mater.</td></tr>
<tr><td colspan="2">Textbook Chapter(s): 6,17</td></tr>
<tr><td>Unit & Topics</td><td>Laboratory activities</td></tr>
<tr><td>Thermochemistry
• Introduction to Thermodynamics
• Conservation of Energy
• State Functions
• Potential Energy
• Kinetic Energy
• Calorimetry
• Heat of Fusion
• Heat of Vaporization
• Specific Heat
• Heat of Dilution
• Heat of Solution
• Hess's Law – direct and indirect
• Bond Dissociation energies
• Gibbs Free energy Equation
• Entropy</td><td>Combustion of ethanol
• Students will investigate the effectiveness of a variety of combustion reactions in heating water and perform calorimetry calculations using lab data
• SP 4, 5
Designing an Hand Warmer
• Use an understanding of calorimetry to design a handwarmer, given certain constraints.
• SP 1, 2, 4, 5, 6, 7
Heat Of Dissolution (Determining K, ΔS,ΔG of Urea)
• Students will use a prescribed procedure to perform a chemical reaction and use a series of calculations to determine the heat dissolution for that reaction.
• SP 2, 5</td></tr>
<tr><td colspan="2">Activity: Given a set of conditions, the students determine if the situation is thermodynamically favored or not favored by looking at entropy, enthalpy, and Gibbs Free Energy</td></tr>
</table>

Big Idea 3: Changes in mater involve the rearrangement and/or reorganization of atoms and/or the transfer of electrons**.**	
Textbook Chapter(s): 18	
Unit & Topics	*Laboratory activities*
Electrochemistry and Thermodynamics • Oxidation and reduction • Substances gaining potential • Types of electrochemical cells • Voltaic cells • Cell potential • Concentration dependence of E • Cell potentials and equilibrium • Metal electrodes • Reference electrodes • Indicator electrodes • Applications of voltaic cells • Electrolysis • Faraday's law • Electrolytic Cells • Order of reduction • Application of electrolytic cells • Relationship of Equilibrium and Q and their relationship to E	**Investigations of Voltaic Cells** Measure the voltage of a variety of reactions between a $Cu/Cu(NO_3)_2$ half-cell and other metal/metal ion half-cells • Predict the electrochemical potential of a variety of reactions and evaluate the quality of the predictions by measuring the voltage of those cells • Explore the effects of on the measured electrochemical potential • SP 2, 5, 6 **Determining Avagadro's Number** • Determine the number of faradays, coulombs, and current used to coat an electrode with copper • SP 2, 6
Activity: Students will calculate electrochemical potentials of reactions given a table of half-cell reactions. They will predict the change in potential as the concentration of a metal ion changes.	

Big Idea 1: The chemical elements are fundamental building materials of matter, and all matter can be understood in terms of arrangement of atoms. These Atoms retain their identity in chemical reactions.	
Textbook Chapter(s): 2,7,8,	
Unit & Topics	*Laboratory activities*
Nuclear and Atomic Structure 1. Types of subatomic Particles 2. The nucleus 3. Mass Spectroscopy & Isotopes 4. Stability of the Nucleus 5. Atomic Structure 6. Rutherford Experiment 7. Cathode Ray Experiment 8. Atomic Structure Terms 9. Electromagnetic Radiation 10. Quantization of energy 11. Photoelectric Effect 12. PES data 13. Bohr Atom 14. Spectroscopy 15. Orbital Model of Atom 16. Aufbau Diagram 17. Paramagnetism 18. Quantum Model	On-line atomic modeling • Phet and Molecular workbench • SP 3, 5, 6
Activity: Students will complete activities on interactive websites modeling electrons in atoms and molecules	

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<tr><td colspan="2">Textbook Chapter(s): 8,9,10,12</td></tr>
<tr><td>Unit & Topics</td><td>Laboratory activities</td></tr>
<tr><td>Periodicity and Introduction to Bonding

• Atomic Properties
• Periodic Law
• Elemental Properties
• Types of Bonds
• Metallic Bonding
• Properties of Group One
• Properties of Group Two
• Metals vs. Non-Metals
• Multiple Oxidation Sates of Transition Metals
• Ionic Bonding
• Ionic Bonding and Potential Energy Diagrams
• Energy of Formation of Ionic Compounds
• Lattice Energy</td><td>Guided Inquiry:

Guided Inquiry Flinn Lab #9: Can the individual components of Quick Ache relief be used to resolve consumer complaints'? [SP 3]</td></tr>
<tr><td colspan="2">Activity: Students will use graphs and data to justify exceptions to identified trends and present information in a class discussion.</td></tr>
</table>

<table>
<tr><td colspan="2">Big Idea 2: Chemical and physical properties of materials can be explained by the structure and arrangement of atoms, ions, or molecules and the forces between them.</td></tr>
<tr><td colspan="2">Textbook Chapters: 9, 10, 11</td></tr>
<tr><td>Unit & Topics</td><td>Laboratory activities</td></tr>
<tr><td>Covalent Bonding and Molecules

1. Types of Covalent Bonds
2. Non-polar Covalent Bonds
3. Polar Covalent Bonds
4. Coordinate Covalent-Bonds – Lewis Acids and Bases
5. Lewis Structures
6. Resonance
7. Hybridization
8. Molecular Geometry
9. Energy Effects on Molecules
10. Isomerism
11. Classification of Molecules
12. Intermolecular Interactions
13. Dipole Moments
14. Types of Compounds
15. Properties of Metallic, Molecular, Macromolecular and Ionic Compounds</td><td>What shape is the molecule?
• Modeling molecular geometry
• SP 1

Synthesis of an Ester
• Synthesis of aspirin
• SP 1, 4, 5, 6

Separation of a Dye Mixture Using Chromatography
• SP 1, 6</td></tr>
<tr><td colspan="2">Activity: Students will choose from a list of common organic molecules. They will research the structure, characteristics, and purpose of the molecule and will build a 3-d model of the molecule.</td></tr>
</table>