Chemistry Curriculum
Boyceville Community School District
Created: July 2008
Updated: July 2010
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I. Introduction

Chemistry is a rigorous year-long course that teaches students chemistry at the entry college level. Students who enroll in chemistry are expected to have completed one year of algebra and one year of Physical Science with a "C" average or better.

Chemistry focuses on six major areas of study: scientific math, measurement, and significant figures, atomic structure and electron configuration, chemical bonding and the Periodic Table, chemical nomenclature and stoichiometry, phases of matter and the gas laws, and solutions, chemical equilibrium, and acid/base chemistry. In-class discussions and advanced problem solving are both supplemented by inquiry-based teaching methods, including extensive use of laboratory exercises and classroom demonstrations, both heavily supplemented by the use of technology and computer-based probes and data collection. Students are expected to maintain a laboratory notebook throughout the course displaying a thorough understanding of the chemical concepts addressed in the laboratory activities, providing students with insight into real-world investigative and research techniques used by scientists in the laboratory every day; this laboratory notebook is worth a substantial portion of their final grade.

II. Course Resources

The textbook used for chemistry at will be *Chemistry: The Study of Matter* (4th Ed.) by Dorin, Demmin, & Gabel (Prentice Hall, 1992). Though this is an older textbook, it contains wonderful problems including innovative applications of the main concepts discussed in the class; in addition, this textbook avoids the use of Calculus and provides students with solely Algebra-based equations, derivations, and problem-solving techniques, providing students who have no background in Calculus with a high probability to succeed. In addition, I will be using *Chemistry with Computers* (1st Ed.) by Holmquist & Volz (Vernier, 1997) as a lab resource and *Foundations of Chemistry, Applying POGIL Principles* (2nd Ed.) by David M. Hanson (Pacific Crest, 2006) as an activity resource.

III. Assessment and Grading

Students will be assessed using a combination of techniques, including written exams, oral exams, laboratory assessments, and performance assessments.

Student grades are comprised of the following parts:

Tests/Quizes	**30%**
Laboratory Notebook	**30%**
Homework Assignments	**30%**
Midterm/Final Exam	**10%**

The laboratory notebook is an important part of the course and it is very important for students to maintain accurate and well-organized notebooks containing all aspects of the laboratory report writing process. Students' laboratory notebooks will be graded not only on content (including the laboratory set-up, procedure, and results/observations) but also on organization and formatting, graphing techniques, error analysis, and their conclusions. I have included a list of laboratory exercises completed during the course on the next page.

Students are assigned two homework problem sets for each chapter of their textbook, and these problems comprise the homework portion of their quarter grades. One of the homework problem sets will be created from their textbook while the other problem set is created from worksheets generated from *Foundations of Chemistry, Applying POGIL Principles.* I expect all students to show all of their work from start to finish and to keep their solutions well-organized.

I have tied many of my labs into the events used in the Science Olympiad, as I strongly believe that the Science Olympiad curriculum can be used as a strong tool in preparing students for post-secondary education. Specific Science Olympiad events that are highlighted in this course include Forensics, Chemistry Lab, and Technical Problem Solving.

I have attached my Curriculum Map for Chemistry to provide you with additional information about the course structure and the content taught including a timeline and information on the laboratory exercises completed throughout the year. I have included references to Wisconsin's Model Academic Standards as further evidence of the reasoning behind my Curriculum Map.

IV. Chemistry Laboratory Exercises

1. **Finding the Relationship: An Exercise in Graphical Analysis (1 day)**
   Students will use the Vernier ProLogger software to graph various sets of data and investigate different relationships.
2. **Mystery Plastic (1 day)**
   Students will investigate the physical properties of different polymers
3. **Scientific Method Lab (1 day)**
   Students use the scientific method to investigate various physical and chemical properties of substances.
4. **Coin Density Lab (4 days)**
   Students use measurement techniques to determine the density of standard US coins to three significant figures.
5. **Freezing and Melting of Water (1 day)**
   Students will experimentally determine the freezing and melting temperatures of water using the Vernier LoggerPro and a Temperature sensor.
6. **Another Look at Freezing Temperature (1 day)**
   Students will observe and determine the freezing temperature of a pure substance other than water: phenyl salicylate.
7. **The Specific Heat of a Metal (1 day)**
   Students determine the specific heat of an unknown metal and use it to determine the composition of the sample.
8. **M & M Element Lab (1 day)**
   Students will use M & Ms to investigate percent abundance and the atomic weight of an element.
9. **Molecular Geometry Lab (1 day)**
   Students use a molecular model kit to build several different molecules and examine their shape in three dimensions.
10. **Qualitative Analysis Lab (8 days)**
    Students investigate various powders, liquids, and metals to determine their varying properties in preparation for a series of ten identification tests.
11. **Determining the Empirical Formula of Magnesium Oxide (1 day)**
    Students will experimentally determine the empirical formula for Magnesium Oxide by heating a piece of magnesium.
12. **Endothermic and Exothermic Reactions (1 day)**
    Students will study an endothermic reaction and an exothermic reaction using Vernier LoggerPro and a Temperature sensor.

13. **A Qualitative Reaction Lab: Cupric Carbonate (1 day)**
    Students complete a qualitative reaction lab to determine the percent yield of their product of interest, cupric oxide.
14. **Stoichiometry and Baking Soda (1 day)**
    Students use stoichiometry to determine the percent yield of their product of interest, sodium chloride.
15. **Heat of Fusion for Ice (1 day)**
    Students empirically determine the heat of fusion for ice using a Vernier temperature sensor, ice cubes, and warm water.
16. **Peanut Brittle Demonstration (1 day)**
    The teacher creates peanut brittle as a demonstration of different crystal structures while the students read about crystal structure and crystalline candy.
17. **Molarity Kool-Aid (1 day)**
    Students determine how many grams of drink mix to add to a 0.50 L bottle of water to make Kool-Aid of the right concentration, according to the regular recipe.
18. **Effect of Temperature on Solubility of a Salt (1 day)**
    Students will study the effect of changing temperature on the amount of solute that will dissolve in a given amount of water using a Vernier temperature probe and a hot plate.
19. **Salt Titration Lab (5 days)**
    Students will determine the amount of salt in a mixture of saltwater of unknown concentration using mixtures of saltwater of unknown concentration using a titration technique.
20. **Determining the Concentration of a Solution using Beer's Law (1 day)**
    Students will determine investigate an unknown solution of unknown concentration using a Vernier LoggerPro and a Colorimeter and several solutions of known concentration.
21. **The Ink is Still Wet (1 day)**
    Students will solve a Forensic case by differentiating between different types of ink by using a Vernier LoggerPro and a Colorimeter.
22. **Chemical Equilibrium: Find a Constant (2 days)**
    Students will determine the equilibrium constant for a given chemical reaction using a Vernier LoggerPro and a Colorimeter.

23. Household Acids and Bases (1 day)

Students will determine the pH of household chemicals using a Vernier LoggerPro and a pH sensor.

24. Titration Curves of Strong and Weak Acids and Bases (2 days)

Students will titrate strong acids and bases and observe the pH changes in the chemical reactions using a Vernier LoggerPro and a pH sensor. Students will create titration curves of all reactions and comment on the differences.

25. The Great Titration Race (2 days)

Students will engage in a titration race based on the 2009 Science Olympiad event "Chemistry Lab."

26. Acid Dissociation Constant (1 day)

Students will investigate the effect of initial solution concentration on the equilibrium constant and experimentally determine the dissociation constant of an acid.

27. What Does a Buffer Do? (1 day)

Students will add an acid and a base to a buffer solution and examine the change in pH for the system over time.

Half-Year Block Crse 1 Credit	***CURRICULUM*** *End Product of Learning, "What" You Teach*			***INSTRUCTION*** *Means to the End Product, "How" You Teach*	***ASSESSMENT*** *Validation to Revise Curriculum & Instruction*
TIME FRAME [By Date, Week, Etc.]	**WI STANDARD OR BENCHMARK** [Include ITL STANDARDS, if relevant]	**CONTENT: What we want students to "KNOW".**	**SKILL: What we want students to "DO".**	**Varied Teaching/Learning Strategies Resources/Comments** [ITL Connection, if relevant] [Modifications for IEP, Remediation, Intervention, Gifted/Talented]	**Varied Classroom Assessment Strategies** [How we know that students "GET IT".]
Chapters 1, 2, and 3 1 day	A.12.1 A.12.5 B.12.3 B.12.4	-Explain what chemistry is and define the six branches of chemistry -Compare/contrast basic research, applied research and technological development	-Identify different jobs under the six branches of chemistry -Identify what type of research is being used in a given situation	-Lecture -Examples of chemistry related jobs and the type of research that is done	-worksheet -in class discussion -test questions
1 day	A.12.1 A.12.3 B.12.3	-Discuss safety in the Chemistry laboratory -Discuss equipment used in the Chemistry laboratory	-Use proper safety procedures in the laboratory -Be able to identify and use proper tools in the laboratory	-Lecture -Class discussion -Demonstrations of proper safety techniques -Demonstrations of proper laboratory tools -Video: Safety in the Chemistry Laboratory	-class discussion -quizzes -test questions
1 day	A.12.1 A.12.3 A.12.5 A.12.6 A.12.7 B.12.3 B.12.5	-Understand the purpose of the scientific method -Explain between qualitative and quantitative observation -Explain the differences between hypotheses, theories and models	-Identify the steps of the scientific method in given examples -Identify qualitative and quantitative information -Use models to solve problems -Identify information in a graph and interpret graphs	-Lecture -Real life examples of using the scientific method -Class discussion	-worksheets -activity results -in class discussion -test questions
2 days	A.12.3 A.12.6 A.12.7`	-Distinguish between a quantity, unit and measurement standard -List common SI units -Distinguish between mass and weight -Perform density calculations -Use conversion factors -Perform dimensional analysis properly	-Assign metric prefixes to numerical data -Convert from on e metric unit to another -Identify the appropriate measuring device to use for a given problem -Calculate mass and weight -Calculate density, mass and volume	-Lecture -Example problems for calculating mass, weight, density, volume -Class discussion -Example problems using SI prefixes and dimensional analysis	-worksheets -in class discussion -test questions/problems -lab write-up/questions
3 days	A.12.6 C.12.3 D.12.6	-Distinguish between accuracy and precision -Use significant figures correctly in calculations -Use scientific notation -Distinguish between directly and inversely proportional relationships	-Give examples of accuracy and precision and determine which is present in a problem -Solve problems using significant figures -Use scientific notation to report answers -Interpret graphs as being directly/inversely proportional	-Lecture -Accuracy/precision activity -Example problems using significant figures -Discussion on using calculators correctly for scientific notation calculations -Examples of directly and inversely proportional graphs and data **-Laboratory Activity 1: Finding the Relationship: An Exercise in Graphical Analysis**	-worksheets -class discussion -student participation in example problems -test questions/problems -lab write-up/questions

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Chapter 4 7 days	A.12.5 B.12.3 B.12.4 B.12.5 D.12.1 D.12.5 D.12.12	-Distinguish between chemical and physical properties of matter -Classify changes of matter as chemical/physical -Explain the states of matter in terms of particles -Distinguish between a mixture and a pure substance	-Classify substances as homogeneous/heterogeneous substances -Classify examples as a chemical/physical change -Show the particle arrangements for three states of matter	-Lecture -Examples of mixtures/pure substances -Class discussion -POGIL activity 1 due at the end of the chapter **-Laboratory Activity 2: Mystery Plastic Lab** **-Laboratory Activity 3: Scientific Method Lab** **-Laboratory Activity 4: Coin Density Lab**	-in class discussion -test questions -POGIL activity
1 day	D.12.1 D.12.11 D.12.12	-Understand how to use the Periodic Table to determine information about a specific element -Recognize the seven diatomic molecules	-Wrte the chemical symbols for various elements -Identify the seven diatomic molecules	-Lecture -Classroom discussion	-In class discussion -test questions

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Chapter 5 7 days	C.12.5 D.12.1 D.12.5 D.12.10	-Define energy and its relationship to work -Describe the six types of energy -Explain conservation of energy -Describe temperature as a measure of the heat content of a substance	-Complete various calorimetry calculations -Apply the definition of heat on a molecular level -Differentiate between the different types of energy	-Lecture -Class discussion -POGIL activities 17 & 18 due at end of chapter **-Laoratory Activity 5: Freezing and Melting of Water** **-Laboratory Activity 6: Another look at freezing temperature** **-Laboratory Activity 7: The Specific Heat of a Matal**	-POGIL worksheets -In class review -Student participation in example problems -test questions -lab write-up/questions

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Chapter 6 2 days	A.12.4 B.12.1 B.12.5 D.12.1	-Explain the law of conservation of mass -Explain the law of definite proportions -Explain the law of multiple proportions -Summarize the five essential points of Dalton's atomic theory -Explain the relationship between Dalton's atomic theory and the above laws	-Apply the law of conservation of mass to chemical reaction descriptions -Use the law of definite proportions to determine percentages of elements present in a compound -Use the law of multiple proportions to determine the ratio of masses of elements in a compound	-Lecture -Real life examples of the three laws -Classroom discussion	-worksheets -class discussion -test questions
1 day	A.12.4 B.12.1 D.12.1	-Describe how the electron was discovered -Summarize Rutherford's experiment -Explain the properties of the three subatomic particles -Define an atom	-Identify steps of Thomson's and Rutherford's experiments -Identify the significance of the various outcomes of Thomson's and Rutherford's experiments -Identify the charge, mass and location of the three subatomic particles -Describe the structure of an atom	-Lecture -Class discussion	-worksheets -class discussion -test questions
2 days	A.12.3 B.12.1 D.12.1	-Describe electromagnetic radiation -Explain the mathematical relationship between the speed, wavelength, and frequency of electromagnetic radiation -Describe the Bohr model of the hydrogen atom	-Calculate speed, wavelength and frequency of electromagnetic radiation -Differentiate between different types of electromagnetic radiation -Explain the limitations of Bohr's model	-Lecture -In class discussion -Example problems using wave equation	-worksheets -in class review questions/discussions -student participation in example problems -test questions
2 days	A.12.3 A.12.6 B.12.4 C.12.3 C.12.5 D.12.1 D.12.11	-Describe the atomic weight of an atom and how it is calculated -Differentiate between the modern standard of atomic mass and the historical standard of atomic mass -Understand the concept of an isotope and how it relates to percent abundance	-Calculate the atomic mass of a given sample with a given percent abundance -Calculate the percent abundance of several different isotopes of a given atom	-Lecture -In Class discussion **-Laboratory Activity 8: Element Mm Lab**	-worksheets -in class review questions/discussions -student participation in example problems -test questions -lab write-up/questions

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Chapter 13 1 day	D.12.1	-Describe the relationship between the electrons in sublevels and the length of the periods -Locate and name the four blocks and discuss the reason for the names -Discuss the relationship between group configurations and group numbers -Describe the locations in the periodic table and the general properties of the alkali metals, alkaline-earth metals, halogens and noble gases	-Write electron configurations for elements in each period and correspond that to the period length -Identify elements within each block of the periodic table -Understand what information the group number tells -Locate the alkali metals, alkaline-earth metals, halogens and noble gases and give examples of each	-Lecture -In class discussion -Example questions -POGIL activity 19 due at the end of the chapter	-worksheets -class discussions -POGIL activity -test questions
3 days	D.12.1	-List the total number of electrons per main energy level -State the Aufbau principle and Hund's rule -Describe electron configurations -Describe orbital notation, electron configuration notation, and noble-gas notation	-Assign electrons to main energy levels and write electron configurations -Use Aufbau's principle and Hund's rule to correctly write orbital notations	-Lecture -In class discussion -Example problems	-worksheets -example problems -test questions

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Chapter 14 2 days	D.12.1	-Explain the role of Mendeleev and Moseley in the development of the periodic table -Describe the modern periodic table -Explain how the periodic table can be used to predict physical and chemical properties of the elements -Describe how the elements belonging to a group of the periodic table are interrelated in terms of atomic number	-Create a periodic table of fictional elements using Mendeleev's and Moseley's techniques -Use the modern periodic table to predict an element's chemical and physical properties -Use the periodic table to locate information about elements	-Lecture -In class discussion -Example problems -Building their own periodic table activity -POGIL activity 20 due at the end of the chapter	-worksheets -student participation in class activity -class discussion -test questions -POGIL activity
3 days	D.12.1 D.12.5	-Define atomic radii, ionic radii, ionization energy, electron affinity and electronegativity -Compare periodic trends of these properties -State reasons for variations in periodic trends -Define valence electrons and determine number present -Distinguish differences between main group elements and d-block elements	- Define atomic radii, ionic radii, ionization energy, electron affinity and electronegativity -Predict properties of elements based on their position on the periodic table -Define valence electrons and determine the number of valence electrons for any main group element -Describe the differences between main group elements and d-block elements	-Lecture -Example problems -Class Periodic Table activity	-worksheets -class discussion -test questions -Periodic Table activity

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Chapter 15 2 days	D.12.4 D.12.5 D.12.6	-Definition of chemical bond -Explain why most atoms form chemical bonds -Describe ionic and covalent bonds -Explain why most chemical bonding is neither purely ionic or covalent -Classify bond type according to electronegativity differences	-Define chemical bond -Determine when atoms will form chemical bonds and what type of bond will form -Calculate the electronegativity difference to determine bond type	-Lecture -In class example problems -POGIL activities 21 & 22 due at the end of the chapter	-worksheets -in class discussion -student participation in example problems -test question/problems -POGIL activities
2 days	A.12.3 D.12.1 D.12.2 D.12.3 D.12.4	-Definition of molecule and molecular formula -Explain the relationships between potential energy, distance between approaching atoms, bond length and bond energy -State the octet rule -List the six basic steps used in writing Lewis structures	-Define molecule and molecular formula -Describe what happens when two atoms begin to form a bond -Use the octet rule and the sic steps to write Lewis structure for molecular formulas	-Lecture -Student involved demonstration -In class example problems	-worksheets -in class discussion -test questions/problems
2 days	D.12.1 D.12.2 D.12.3 D.12.4 D.12.5	-Compare and contrast a chemical formula for a molecular compound with one for an ionic compound -Discuss the arrangement of ions in crystals -Define lattice energy and explain its significance -List and compare the distinctive properties of ionic and molecular compounds -Write Lewis structures for polyatomic ions	-Give examples of chemical formulas for ionic and covalent compounds -Draw an ion arrangement -Use lattice energy to determine the energy needed to break bonds -Distinguish between ionic and molecular properties -Draw Lewis structures for polyatomic ions	-Lecture -In class examples -Demonstration of ionic vs. molecular compounds	-worksheets -in class discussion -test questions
1 day	D.12.1 D.12.5 D.12.11	-Describe the electron-sea model of metallic bonding -Explain why metals have the properties they do	-Know how electrons in metals behave -Identify the metallic properties of conductivity, malleability, ductility and luster	-Lecture -Class discussion	-worksheets -in class discussion -test questions

3 days	D.12.1 D.12.2 D.12.4	-Explain VSEPR theory -Predict the shapes of molecules or polyatomic ions using VSEPR theory -Explain how the shapes of molecules are accounted for by hybridization theory -Describe dipole-dipole forces, hydrogen bonding, induced dipoles and London dispersion forces -Explain what determines molecular polarity	-Use VSEPR theory to draw Lewis structures correctly -Use Lewis structures to determine molecular polarity -Identify when dipole-dipole forces are present -Identify when hydrogen bonding is present -Define London dispersion forces and where they are mostly seen	-Lecture -In class discussion -In class example problems **-Laboratory Activity 9: Bond Geometry and Polarity** -Demonstration: "A Cup of Water"	-worksheets -discussions -test questions/problems -Lab write-up/questions -Demonstration write-up/questions

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Chapter 7 1 day	D.12.1	-Explain the significance of a chemical formula -Determine the formula of an ionic compound -Name an ionic compound given its formula	-Describe what a information a chemical formula gives -Write ionic formulas given the names of the ions present -Write the names of ionic compounds given the formula	-Lecture -Example problems -Nomenclature packet	-worksheets -in class participation -quiz on ion names/charges -test questions/problems
11 days	D.12.4 D.12.5	-List the rules for assigning oxidation numbers -Give the oxidation number for each element in a formula -Name binary molecular compounds using oxidation numbers and the Stock system	-Use the rules for assigning oxidation numbers to determine the oxidation numbers of each element in a formula -Use oxidation numbers to name compounds using the Stock system	-Nomenclature packet -Lecture -Example problems **-Laboratory Activity 10: Qualitative Analysis Lab**	-worksheets -in class participation -lab write-up/questions -test questions/problems

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Chapter 8 2 days	A.12.3 A.12.6 B.12.1 D.12.1	-Explain a mole in terms of Avogadro's number -Define molar mass -Solve problems involving mass, moles and atoms	-Use Avogadro's number to solve problems dealing with number of atoms present -Use molar mass to solve problems dealing with an amount in grams -Use factor-label method to solve all types of problems	-Lecture -Example problems -Class discussion -Mole Box Activity -POGIL activity 2 due by the end of the chapter	-worksheets -student participation in example problems -test questions/problems -mole box activity -POGIL activity
1 day	D.12.3 D.12.4 D.12.5	-Calculate the formula mass or molar mass of any given compound -Use molar mass to convert from grams to moles -Calculate the number of molecules, formula units, or ions in a given molar amount of a compound -Calculate the percentage composition of a given compound	-Use the periodic table to calculate formula masses and molar masses -Use the factor label method to convert from grams to moles and vice versa of a compound -Use formula/molar mass to calculate percentage composition	-Lecture -Example problems -Class discussion	-worksheets -student participation in example problems -test questions/problems
2 day	D.12.4 D.12.5	-Define empirical formula -Explain how empirical formula applies to ionic and molecular compounds -Determine an empirical formula from a percentage composition -Explain the relationship between the empirical formula and the molecular formula -Determine a molecular formula from an empirical formula	-Identify a compound's empirical formula -Using the percentage or mass composition determine the empirical formula -Calculate the molecular formula from an empirical formula	-Lecture -Class discussion -Example problems **-Laboratory Activity 11: Empirical Formula of Magnesium Oxide**	-worksheets -in class participation -lab write-up/questions -test questions/problems

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Chapter 9 2 days	D.12.3 D.12.4 D.12.5 D.12.10	-List the three observations that indicate a chemical reaction has taken place -List three requirements for a correctly written chemical equation -Write word and formula equations -Balance equations	-Recognize when a chemical reaction has occurred -Correctly write a formula equation from a word equation -Correctly write a word equation from a formula equation -Balance equations	-Lecture -Example problems	-worksheets -in class discussion -student participation in class examples -lab write-up/questions -test questions
3 day	D.12.5 D.12.6	-Define and give general equations for synthesis, decomposition, single-replacement, double-replacement and combustion reactions -Classify a reaction as one of the five types -Predict the products of simple reactions given the reactants	-Identify synthesis reactions -Identify decomposition reactions -Identify single-replacement reactions -Identify double-replacement reactions -Identify combustion reactions -Write the products for each type of reaction, given the products	-Notes on overhead -Lecture -Example problems **-Laboratory Activity 12: Endothermic and Exothermic Reactions**	-worksheets -student participation in class examples -test questions/problems
2 days	D.12.4 D.12.6	-Explain the significance of an activity series -Use an activity series to predict whether a reaction will occur and what the products will be	-Use an activity series to predict whether a reaction will occur and what the products will be	-Lecture -Example problems	-worksheets -class discussion -lab write-ups/questions -test questions/problems

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Chapter 10 2 day	D.12.5	-Define stoichiometry -Describe the importance of the mole ratio in calculations -Write mole ratios relating substances in a chemical equation	-Use mole ratios to solve stoichiometric problems	-Lecture -Example problems -Class discussion -POGIL activity 7 due by the end of the chapter	-worksheets -class discussion -test questions/problems -POGIL activity
1 day	D.12.4 D.12.5	-Calculate moles/mass of a reactant/product given the amount in moles/grams of a reactant or product	-Use stoichiometry and the factor label method to solve problems involving given amounts of a reactant or product	-Lecture -Example problems -Class discussion	-worksheets -student participation in example problems -test questions/problems
4 days	D.12.4 D.12.5 D.12.10	-Describe a method for determining which of two reactants is a limiting reactant -Calculate the unknown amount given the quantities of the reactants -Distinguish between theoretical, actual and percent yield and calculate all three	-Use stoichiometry to determine the limiting reactant -Use the limiting reactant to determine the amount of product -Calculate theoretical yield and use it with actual yield to determine percent yield	-Lecture -Example problems -Class discussion **-Laboratory Activity 13: Percent Yield of Cupric Oxide** **-Laboratory Activity 14: Stoichiometry and Baking Soda**	-worksheets -student participation in example problems -test question/problems -lab write-up/questions

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Chapter 11 2 day	D.12.5 D.12.11 D.12.12	-State the kinetic-molecular theory of matter and describe how it explains properties of matter -List the five assumptions of the KM theory of gases -Define ideal gas and real gas -Describe expansion, density, fluidity, compressibility, diffusion and effusion -Describe the conditions under which a real gas deviates from "ideal" behavior	-Use the kinetic-molecular theory of matter to identify behaviors of real and ideal gases -Use the kinetic-molecular theory of gases to identify the phenomena of expansion, density, fluidity, compressibility, diffusion, and effusion -Interpret graphs of number of molecules vs. molecular speed at different temperatures	-Lecture -Demonstrations -In class example problems -POGIL activity 14 due by the end of the chapter **-Laboratory Activity 15: Peanut Brittle Demonstration**	-worksheets -class discussion -participation in example problems -test questions/problems -POGIL activity
1 day	D.12.7 D.12.11	-Define pressure and relate it to force -Describe how pressure is measured -Convert units of pressure -State the standard conditions of temperature and pressure	-Calculate pressure and force given the other -Use barometric pressure readings to solve problems -Use the factor label method to convert pressure units -Use standard temperature and pressure to solve problems	-Lecture -Demonstrations -In class example problems	-worksheets -student participation in example problems -test questions/problems
3 days	B.12.1 B.12.4 D.12.1 D.12.7 D.12.11	-Use the kinetic-molecular theory to explain the relationships between gas volume, temperature, and pressure -Use the combined gas law to calculate changes in V, T, and P -Use Dalton's law of partial pressures and total pressures	-Solve problems using the combined gas law -Solve problems using Dalton's law -Draw the phase change diagram for water	-Lecture -In class example problems -Class discussion **-Laboratory Activity 16: Heat of Fusion for Ice**	-worksheets -student participation in example problems -test questions/problems

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Chapter 12 2 days	A.12.6 D.12.11	-State the law of combining volumes -State Avogadro's law and explain its significance -Define standard molar volume of a gas and use it in calculations	-Calculate mass, volume or moles of a gas at STP using Avogadro's law and the standard molar volume of a gas -Calculate combined gas volumes	-Lecture -Example problems -POGIL activities 11 & 12 due by the end of the chapter	-worksheets -in class participation -discussion -test questions/problems -POGIL activities
3 day	D.12.5 D.12.11	-State the ideal gas law -Derive the ideal gas constant and discuss its units -Using the ideal gas law do calculations -Describe the conditions under which each law applies	-Calculate a gases volume, pressure, temperature or amount given one quantity	-Lecture -Discussion -Example problems -Ideal Gas Law Worksheet	-worksheets -participation in example problems -test questions/problems
1 day	D.12.7 D.12.11	-Use a chemical reaction to specify volume ratios for gaseous reactants and products -Use volume ratios and the gas laws to calculate molar amounts of gaseous reactants or products	-Calculate the molar amounts of gaseous reactants and products using volume ratios	-Notes on overhead -Lecture -Example problems	-worksheets -participation in example problems -test questions/problems

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Chapter 16 1 day	A.12.1 A.12.5 B.12.3 B.12.4	-Distinguish between heterogeneous and homogeneous mixtures -List three different solute-solvent combinations -Compare the properties of suspensions, colloids, and solutions -Distinguish between electrolytes and nonelectrolytes	-Identify a mixture by its particle composition -Identify the solvent and the solute in solutions -Identify a solution as a suspension or colloid -Draw a model showing an electrolyte and a nonelectrolyte solution	-Lecture -Example problems	-worksheets -in class discussion
1 day	A.12.1 A.12.5 B.12.3 B.12.4	-List and explain three factors that affect dissolving rate -Explain solution equilibrium -Distinguish between saturated, unsaturated, and supersaturated solutions -Explain "like dissolves like" in terms of polar an d nonpolar substances -List the three interactions that contribute to heat of solution and explain what causes dissolution to be exothermic or endothermic -Compare the effects of temperature and pressure on solubility	-Explain how changing the pressure above a solution will affect its solubility -Explain how changing the temperature will affect solubility -Explain how changing surface area will affect solubility -Determine whether a solution is saturated, unsaturated or supersaturated given information about the solute/solvent -Calculate how many grams of a solute are needed to make a saturated solution	-Lecture -Demonstrations -Example problems	-in class discussion -worksheets -test questions/problems
11 days	A.12.1 A.12.5 B.12.3 B.12.4	-Calculate the concentration of a solution -Determine the amount of solute in a given amount of solution -Determine the amount of solution that contains a given amount of solute	-Calculate molarity and molality of solutions -Calculate the volume or amount of a substance needed to produce a given molarity or molality solution	-Lecture -Example problems **-Laboratory Activity 17: Molarity Kool-Aid** **-Laboratory Activity 18: Effect of Temperature on Solubility of a Salt** **-Laboratory Activity 19: Salt Titration Lab** **-Laboratory Activity 20: Determining the Concentration of a Solution: Beer's Law** **-Laboratory Activity 21: The Ink is Still Wet**	-in class participation in examples -worksheets -test questions/problems -lab write-up/questions

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Chapter 18 4 days	A.12.3 A.12.5 C.12.3 C.12.4 D.12.4 D.12.5 D.12.12	-Differentiate between a reversible and nonreversible reaction -Define the equilibrium constant and describe how to calculate it for a chemical equation -Describe the variables that can change an equilibrium constant	-Calculate the equilibrium constant for a reversible chemical reaction	-Lecture -Classroom Discussions -Example Problems **-Laboratory Activity 22: Finding a Chemical Equilibrium Constant** -POGIL activities 30 & 32 due by the end of the chapter	-in class participation in examples -worksheets -test questions/problems -lab write-up/questions -POGIL activities
2 days	C.12.6 D.12.4 D.12.5 D.12.12	-Describe Le Chatelier's Principle and how stresses on systems affect equilibrium	-Predict how specific stresses on a chemical system at equilibrium will affect the system	-Lecture -Classroom Discussions -Example Problems	-in class participation in examples -worksheets -test questions/problems

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Chapter 19 2 day	D.12.1 D.12.4 D.12.5 D.12.6 D.12.11	-List the five general properties of aqueous acids and bases -Identify common acids and bases -Define Arrhenius' acids and bases -Explain the difference between strong and weak acids and bases	-Use the five general properties of acids and bases to identify them -Write formulas for and name the common acids and bases -Identify strong and weak acids and bases	-Notes on overhead -Lecture -Class discussion -Demonstration of pH paper -Example problems **-Laboratory Activity 23: Household Acids and Bases** -POGIL activity 9 due by the end of the chapter	-class discussion -worksheets -test questions/problems -lab write-up/questions -POGIL activity
1 day	D.12.1 D.12.4 D.12.5 D.12.6 D.12.11	-Define Brønsted-Lowry acids and bases -Define and relate conjugate acids and bases -Explain what determines whether an amphoteric compound acts as an acid or a base	-Label conjugate acid-base pairs -Compare the strengths of the conjugate acids and bases -Use the number of oxygen atoms present to determine the strength of an acid	-Notes on overhead -Lecture -Class discussion -Example problems	-worksheets -student participation in example problems -test questions/problems
1 day	D.12.1 D.12.4 D.12.5 D.12.6 D.12.11	-Explain the process of neutralization -Explain how acid rain damages marble structures -Define a Lewis acid and base	-Identify Lewis acids and bases from Arrhenius acids and bases and from Bronsted-Lowry acids and bases -Determine the products from a neutralization reaction	-Notes on overhead -Lecture -Class discussion -Example problems	-worksheets -student participation in example problems -test questions/problems

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Chapter 20 2 days	D.12.1 D.12.4 D.12.6	-Describe the self-ionization of water -Define pH and give the pH of a neutral solution -Explain and use the pH scale -Find/calculate pH and pOH	-Explain how the hydronium ion and hydroxide ion form -Identify the pH of common solutions -Calculate the pH and pOH concentrations -Experimentally determine the pH of an unknown solution	-Lecture -Example problems -Class discussion -POGIL activities 10, 35, 36, & 37 due by the end of the chapter	-worksheets -class participation -test questions/problems -POGIL activities
9 days	D.12.1 D.12.4 D.12.6	-Describe how an acid-base indicator functions -Explain how to carry out an acid-base titration -Calculate the molarity of a solution form titration data	-Identify common indicators and the pH range they are used for -Carry out an acid-base titration and calculate the molarity of the unknown	-Lecture -Example problems -Class discussion -Demonstrations of indicators **-Laboratory Activity 24: Titration Curves of Strong and Weak Acids and Bases** **-Laboratory Activity 25: The Great Titration Race** **-Laboratory Activity 26: Acid Dissociation Constant Ka** **-Laboratory Activity 27: What does a Buffer do?**	-class discussions -student participation in example problems -lab write-ups/questions -test questions/problems