Chemistry Honors
Science Curriculum
Francis Howell School District

Board Approved: draft

Francis Howell School District

Mission Statement

Francis Howell School District is a learning community where all students reach their full potential.

Vision Statement

Francis Howell School District is an educational leader that builds excellence through a collaborative culture that values students, parents, employees, and the community as partners in learning.

Values

Francis Howell School District is committed to:

- Providing a consistent and comprehensive education that fosters high levels of academic achievement for all
- Operating safe and well-maintained schools
- Promoting parent, community, student, and business involvement in support of the school district
- Ensuring fiscal responsibility
- Developing character and leadership

Francis Howell School District Graduate Goals

Upon completion of their academic study in the Francis Howell School District, students will be able to:

1. Gather, analyze and apply information and ideas.
2. Communicate effectively within and beyond the classroom.
3. Recognize and solve problems.
4. Make decisions and act as responsible members of society.

Science Graduate Goals

The students in the Francis Howell School District will graduate with the knowledge, skills, and attitudes essential to leading a productive, meaningful life.

Graduates will:

- Understand and apply principles of scientific investigation.
- Utilize the key concepts and principles of life, earth, and physical science to solve problems.
- Recognize that science is an ongoing human endeavor that helps us understand our world.
- Realize that science, mathematics, and technology are interdependent, each with strengths and limitations that impact the environment and society.
- Use scientific knowledge and scientific ways of thinking for individual and social purposes.

Course Rationale

Science education develops science literacy. Scientific literacy is the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity. A sound grounding in science strengthens many of the skills that people use every day, like solving problems creatively, thinking critically, working cooperatively in teams, using technology effectively, and valuing life-long learning. Scientific literacy has become a necessity for everyone.

To accomplish this literacy, science courses will reflect the following:

- Develop scientific reasoning and critical thinking skills.
- Extend problem-solving skills using scientific methods.
- Include lab-based experiences.
- Strengthen positive attitudes about science.
- Incorporate the use of new technologies.
- Provide relevant connections to personal and societal issues and events.

Course Description

Chemistry Honors– Course # 131250
Credit: 1 unit
Prerequisite: Physical Science (C or better); completion of Algebra I or equivalent and concurrent enrollment in or completion of Algebra II; meet honors criteria

This course is highly recommended for college-bound students. In this course, students will be introduced to the study of the composition and properties of matter. Topics include measurement skills, atomic theory, classification of matter, nomenclature, stoichiometry, gas laws, periodic table, chemical bonding, solutions, and acids and bases. Lab experiences are an integral part of this course. This course will emphasize critical thinking as well as advanced reading, writing, and problem-solving skills. This course requires a high degree of independent initiative.

Notes on color coding:

- Any type that is in **red** indicates the information is new to that curriculum from DESE's original document.
- Anything that is highlighted in yellow, DESE originally indicated that it may be tested on the End of Course Exam (EOC); this has been retained on this document to show teachers the importance DESE has put on those particular objectives.
- Any type that is in **black** is a continuation of what has been included in the strands in previous years.
- Any type that is in **green** indicates the information has been specifically added to the Honors curriculum and not found in the regular Chemistry curriculum.
- Any type that is in **blue** indicates additional information that will be locally assessed and not in the CLE's.

Francis Howell School District
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Francis Howell School District
Chemistry Honors Curriculum Map

First Semester: (First and Second Quarters) 15 weeks

Matter and Measurement	**Atomic Structure and Radioactivity**	**Chemical Nomenclature**	**Chemical Composition**	**Chemical Reactions**	**Chemical Stoichiometry**
• Scientific process • Density • Identify Pure Substances • Lab Safety • Significant Figures • Chemical vs. physical changes • Dimensional analysis • Measuring with analog equipment • Scientific notation • Metric system IN1Aa IN1Ca IN1Ab IN1Cb IN1Ad IN1Cd IN1Ae IN1Da IN1Af IN1Db IN1Ba IN1Dc IN1Bb ME1Aa IN1Bd ME1Ab IN1Bf ME1Ac ME1Ga **3 weeks**	• Atomic structure • Calculate protons, electrons, neutrons • Ions and atoms • Calculate atomic mass from isotope abundance • Predict products of nuclear decay (alpha, beta, gamma), fission and fusion • Half-lives • Radiocarbon dating ME1Ea ST2 ME1Eb ST2Ba ME1Ec ST3 ME2Ea ST3Bb **2 weeks**	• Classify metals, nonmetals, metalloids, Noble gases • Nomenclature of ionic and covalent compounds (polyatomic ions included) • Relationships between names and number of oxygen atoms in polyatomic ions • Nomenclature of acidic compounds ME1Ab ME1Ad ME1Ea ME1Eb ME1Ec ME1Fa ME1Fb ME1Fc ME1Ha **2.5 weeks**	• Mole • Molar Mass • Percent composition • Empirical Formula • Molecular Formula • Mass/mole/particle conversions • Avogadro's number • Molar volume of a gas at STP **3 weeks**	• Classify and predict products of precipitation, acid-base and redox reactions • Solubility Rules • Balancing reactions • Activity series of metals and halogens • Molecular, ionic and net ionic reactions • Assign oxidation numbers • Identify elements oxidized and reduced • Balancing redox reactions in acidic and basic environments ME1Hb ME1Hd **2 weeks**	• Stoichiometry • Limiting reagents • Percent yield IN1Ag IN1Be IN1Cc ME1Ia **2.5 weeks**

Francis Howell School District
Chemistry Honors Curriculum Map

Second Semester: (Third and Fourth Quarters) 17 weeks

Energy and Phase Changes	**Gas Laws**	**Electronic Structure Periodic Trends**	**Chemical Bonding**	**Aqueous Solutions**	**Acids and Bases**
• Heating Curves • Phase Diagrams • Thermal energy, heat and temperature • Exothermic / endothermic reactions • Conservation of energy • Kinetic Theory • Specific heat capacity • Chemical (bond energies), nuclear and thermal energy ME1D ME2B ME1Da ME2Ba ME1Db ME2D ME1Dc ME2Da ME2A ME2F ME2Aa ME2Fc ME2Ac	• Ideal Gas Law • Combined Gas law • Dalton's law of partial pressure • Stoichiometry involving gases • Gas collection by water displacement IN1Ac	• Atomic theory evolution (Dalton, Thomson, Rutherford, Bohr, Quantum Mechanical) • Wavelength, energy and frequency • Periods / groups (repeating and common properties) • Electron configurations • Valence electrons • Exceptional configurations • Relate emission spectra to the Bohr model of the atom • Electronegativity and reactivity • Atomic and ionic size • Ionization energy • Quantum numbers ME1Ad ME2C ME1F ME2Ab ME1Fa ME2Ad ME1Fb ME2Cb ME1Fc ST3Ba ME1Ha	• Lewis structures • Polar bonds using Pauling scale • Resonance structures • Molecular geometry (VSEPR) • Ionic and covalent bonding • Polar molecules ME1H ME1Hc	• Solubility Curves • Dissolving process • Effects of polarity, surface area, agitation and temperature on solubility • Molarity • Separation techniques • Molarity by dilution • Stoichiometry with aqueous solutions ES1Ba ME1Ba ME1Bc IN1Bc ST3Da	• Properties of acids, bases, and neutral solutions • Compare and contrast Arrhenius, Bronsted-Lowry and Lewis theories • Calculate pH, pOH, [H+] and [-OH] • Acid-base neutralization • Titration of an unknown acid or base • Conjugate acid/base pairs IN1B ST2Aa ME1Bb ST3Db
2 weeks	**3.5 weeks**	**2.5 weeks**	**2 weeks**	**3.5 weeks**	**3.5 weeks**

Content Area: Science	Course: Chemistry Honors	Unit: Matter and Measurement

Learner Objectives:

- Science understanding is developed through the use of science process skills, scientific knowledge, scientific investigation, reasoning, and critical thinking. IN1
- Chemistry is a quantitative science that relies on the accurate collection and interpretation of data and appropriate use of numbers in calculations.

Concepts:

A. Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigative methods in order to obtain evidence relevant to the explanation. IN1A
B. Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations. IN1B
C. Scientific inquiry includes evaluation of explanations (laws/principles, theories/models) in light of evidence (data) and scientific principles (understandings). IN1C
D. The nature of science relies upon communication of results and justifications of explanations. IN1D
E. Objects, and the materials they are made of, have properties that can be used to describe and classify them. (ME1A)
F. Properties of objects and states of matter can change chemically and/or physically. (ME1G)
G. Significant figures relay information about the accuracy and precision of a measurement.

Students Should Know	Students Should Be Able to
• It is not always possible, for practical or ethical reasons, to control some conditions (e.g., when sampling or testing humans, when observing animal behaviors in nature) IN1Ad • Some scientific explanations (e.g., explanations of astronomical or meteorological phenomena) cannot be tested using a controlled laboratory experiment, but instead by using a model, due to the limits of the laboratory environment, resources, and/or technologies IN1Ae • There is no fixed procedure called "the scientific method", but that some investigations involve systematic observations, carefully collected and relevant evidence, logical reasoning, and some imagination in developing hypotheses and other explanations IN1Af • Observation is biased by the experiences and knowledge of the observer (e.g., strong beliefs about what should happen in particular circumstances can prevent the detection of other results) IN1Bf • The independent variable is manipulated by the experimenter. The dependent variable is the measured variable of the outcome. Constant variables are conditions that remain constant throughout the experiment so as not to affect the outcome.	• Formulate testable questions and hypotheses IN1Aa • Analyzing an experiment, identify the components (i.e., independent variable, dependent variables, control of constants, multiple trials) and explain their importance to the design of a valid experiment IN1Ab • Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders) IN1Ba • Measure length to the nearest millimeter, mass to the nearest gram, volume to the nearest milliliter, force (weight) to the nearest Newton, temperature to the nearest degree Celsius, time to the nearest second IN1Bb • Judge whether measurements and computation of quantities are reasonable IN1Bd • Use quantitative and qualitative data as support for reasonable explanations (conclusions) IN1Ca • Analyze experimental data to determine patterns, relationships, perspectives, and credibility of explanations (e.g., predict/extrapolate

• A control in an experiment is the standard by which the dependent variable can be compared. • Scientist typically perform 3 trials of each condition in an experiment validate accuracy. • Quantitative data is numerical data. Qualitative data is descriptive data. Correct lab procedures are followed to ensure safety. • Significant figures are used in measurements and calculations to relay accuracy and precision. • Density is mass/volume • Matter is classified by its physical and chemical properties • Elements contain 1 type of atom and compounds contain 2 or more types of atoms • Homogeneous solutions can be separated using a group of techniques called chromatography • Heterogeneous solutions can be separated using filtration • The Law of Conservation of Mass states that matter cannot be created or destroyed • Chemical changes result in a new compound being formed • Physical changes involve changes that do not result in a new compound being formed • Scientific notation is used to simplify calculations. • Well-designed and conducted scientific experiments increase the experimental credibility of conclusions. • The ability of other scientific investigators to replicate the results of an experiment increases the experimental credibility of the conclusions.	data, explain the relationship between the independent and dependent variable) IN1Cb • Analyze whether evidence (data) and scientific principles support proposed explanations (laws/principles, theories/models) IN1Cd • Communicate the procedures and results of investigations and explanations through: Oral presentations, drawings and maps, data tables (allowing for the recording and analysis of data relevant to the experiment such as independent and dependent variables, multiple trials, beginning and ending times or temperatures, derived quantities), graphs (bar, single, and multiple line), equations and writings IN1Da • Communicate and defend a scientific argument IN1Db • Explain the importance of the public presentation of scientific work and supporting evidence to the scientific community (e.g., work and evidence must be critiqued, reviewed, and validated by peers; needed for subsequent investigations by peers; results can influence the decisions regarding future scientific work) IN1Dc • Compare the densities of regular and irregular objects using their respective measures of volume and mass (ME1Aa) • Identify pure substances by their physical and chemical properties (i.e., color, luster/reflectivity, hardness, conductivity, density, pH, melting point, boiling point, specific heat, solubility, phase at room temperature, chemical reactivity) (ME1Ab) • Classify a substance as being made up of one kind of atom (element) or a compound when given the molecular formula or structural formula (or electron dot diagram) for the substance (ME1Ac) • Distinguish between physical and chemical changes in matter (ME1Ga) • Solve problems using Dimensional Analysis

Instructional Support

Student Essential Vocabulary					
Problem statement	Hypothesis	Independent variable	Dependent variable	Constant variable	Control
Accuracy	Precision	Significant Figures	Mixture	Pure Substance	Heterogeneous
Homogeneous	Chemical Property	Physical Property	Physical Change	Chemical Change	Element
Compound	Distillation	Filtration	Solution	Molecule	Atom

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills		Enrichment Opportunity	SA
Information, Media, & Technology Skills	SLA	Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities

Learning Activity #1 : (See Appendix A)
Density of a Regular-Shaped Object Lab
In this activity, students measure the mass and dimensions of various samples of matter to determine the density of a variety of materials. These densities are compared to the accepted, published values for the density of these materials.

Activity's Alignment	
CLE/Concept	ME1Aa, IN1Da
CONTENT	SC1
PROCESS	1.10 –Apply information, ideas, and skills 1.6 – Discover/evaluate relationships
DOK	2—Skill/Concept
INSTRUCTIONAL STRATEGIES	Generating and testing hypothesis.

Sample Assessments

Assessment #1:
Density Exit Card
Using the following data, predict which of the following objects would float in water (density = 1.00 g/mL). Justify your answer with a calculation.

Object 1: mass = 24.5 g volume = 20.9 mL
Object 2: mass = 50.0 g volume = 62.3 mL
Object 3: mass = 245 g volume = 3.05×10^2 cm^3

Answers:
Objects 2 and 3 would float because their density is less than that of water.

Assessment's Alignment	
CLE	ME1Aa
CONTENT	SC1
PROCESS	1.10 Apply information, ideas and skills 3.5 Reason logically (inductively/deductively)
DOK	2 – Skill/Concept
LEVEL OF EXPECTATION	Mastery Level – 66%

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills		Enrichment Opportunity	
Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities	Sample Assessments
Learning Activity #2 : (See Appendix B) **Percent Sugar in Beverages Lab** Students determine the density of various percent sugar solutions and construct a graph of density vs. percent sugar. Students then determine the density of various drinks and interpolate from the standard graph to determine the percent sugar in those drinks.	**Assessment #2:** **Density Exit Card** A block of iron has a mass of 125 g. What is the mass of a block of copper with the same dimensions that the block of iron? The density of iron is 7.87 g/cm^3 and the density of copper is 8.92 g/cm^3. ***Answer:*** *142 g*

Activity's Alignment	
CLE	IN1Ca, IN1Ba, IN1Aa, IN1Da
CONTENT	SC7
PROCESS	1.6 Discover/evaluate relationships 3.5 Reason logically (inductive/deductive)
DOK	3 –Strategic Thinking
INSTRUCTIONAL STRATEGIES	Generating and testing hypothesis

Assessment's Alignment	
CLE	ME1Aa
CONTENT	SC1
PROCESS	1.10 Apply information, ideas and skills 3.5 Reason logically (inductive/deductive)
DOK	3 – Strategic Thinking
LEVEL OF EXPECTATION	Mastery Level - 75 %

Student Resources	Teacher Resources
General: ● **World of Chemistry, Zumdahl, 2006** ● http://library.thinkquest.org/10429/low/lab/lab.htm **Enrichment:** ● **www.acs.org (chematters magazine)** ● **Movie: Greatest Discoveries with Bill Nye: Chemistry** ● **NOVA: Naturally Obsessed, The Making of a Scientist** **Intervention:** ● **http://www.chemtutor.com/** ● **www.yahooanswers.com** ● **www.cramster.com** ● **http://www.chemmybear.com/stdycrds.html#GenChem**	**General:** ● **Flinn ChemTopics Labs, Volume 1 & 2** ● **http://jchemed.chem.wisc.edu/** ● **http://library.thinkquest.org/10429/low/lab/lab.htm** ● **World of Chemistry, Zumdahl, 2006** **Enrichment:** **Intervention:**

NOTE: These sections will be partially completed during the curriculum writing process and finalized during the year one review process.

Content Area: Science	Course: Chemistry Honors	Unit: Atomic Structure and Radioactivity

Learner Objectives:

- Changes in properties and states of matter provide evidence of the atomic theory of matter. (ME1)
- Energy has a source, can be stored, and can be transferred but is conserved within a system (ME2)
- Many isotopes undergo radioactive decay to move towards the band of stability.
- Energy changes accompany radioactive decay
- Radioactivity has a variety of uses, including generation of electric power and radiocarbon dating.

Concepts:

A. The atomic model describes the electrically neutral atom. (ME1E)
B. Nuclear energy is a major source of energy throughout the universe. ME2E
C. Nuclear reactions occur with a conservation of mass and energy, and charge. (A)
D. People of different gender and ethnicity have contributed to scientific discoveries and the invention of technological innovations. ST2A
E. Social, political, economic, ethical and environmental factors strongly influence, and are influenced by, the direction of progress of science and technology. ST2B

Students Should Know	Students Should Be Able to
• An atom has a dense, positive nucleus surrounded by a cloud of negative electrons • The mass number is the number of protons + neutrons • The atomic number is the number of protons • The number of electrons = the atomic number in all atoms • The atomic mass can be calculated from the relative abundances of the isotopes • Fusion involves the combining of atomic nuclei. Fission involves the splitting of atomic nuclei. • There are 3 general types of radiation, alpha, beta and gamma. • Carbon-14 can be used to date archaeological artifacts • Nuclear energy can be derived from fusion of lighter elements and fission of heavier elements. • Iron is the most stable of all nuclei.	• Describe the atom as having a dense, positive nucleus surrounded by a cloud of negative electrons (ME1Ea) • Calculate the number of protons, neutrons, and electrons of an isotope, given its mass number and atomic number (ME1Eb) • Describe the information provided by the atomic number and the mass number (i.e., electrical charge, chemical stability) (ME1Ec) • Describe how changes in the nucleus of an atom during a nuclear reaction (i.e., nuclear decay, fusion, fission) result in emission of radiation ME2Ea • Identify and describe major scientific and technological challenges to society and their ramifications for public policy (e.g., global warming, limitations to fossil fuels, genetic engineering of plants, space and/or medical research) ST3Bb • Predict the products of alpha decay, beta decay, and gamma decay. (A) • Balance nuclear equations. (A) • Use half-lives to predict the amount of radioactive isotope remaining after an integer number of half-live and vice versa. (A) • Calculate the atomic mass of an element using information on the isotopic distribution of that element. (A) • Explain the nuclear reactions powering the sun and nuclear power plants. (A)

	• Contributions to science are not limited to the work of one particular group, but are made by a diverse group of scientists representing various ethnic and gender groups ST2Aa • Identify and describe how explanations (laws/principles, theories/models) of scientific phenomena have changed over time as a result of new evidence (e.g., model of the solar system, basic structure of matter, structure of an atom, Big Bang and nebular theory of the Universe) ST2Ba

Instructional Support

Student Essential Vocabulary					
Malleable	Luster	Periodicity	Ionization energy	Electronegativity	Atomic radius
Density	Atomic mass	Metal	Metalloid	Nonmetal	Noble gas / inert gas
Conductivity	Synthesis	Decomposition	Single Replacement	Double Replacement	Acid / Base Reaction
Combustion	Reactants	Products	Protons	Electrons	Neutrons
Atomic number	Mass number	Isotope	Ion	Atom	Element
Compound	Nucleus	Electron cloud			

Readiness & Equity Section

SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes	SLA	Non Fiction Reading & Writing	SLA
Learning & Innovation Skills		Enrichment Opportunity	
Information, Media, & Technology Skills		Intervention Opportunity	SA
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities	**Sample Assessments**
Learning Activity #1 (See Appendix C) **Electron Probability Activity** Students drop marbles or pennies at a target and map the target hit density as a function of radial distance to simulate the nature of the electron density around the nucleus. **Electron Probability Scoring Guide (See Appendix D)**	**Assessment #1:** **Atomic Structure Exit Card** Consider two isotopes of carbon: carbon-12 and carbon-13. Describe two similarities and two differences of these two isotopes. ***Answers:*** *<u>Similarities:</u> Both isotopes have 6 protons, both isotopes have 6 electrons* *<u>Differences:</u> Carbon-13 has one more neutron than carbon-12, and carbon-13 has a mass of 13 amu wheras carbon-12 has a mass of 12 amu.*

Activity's Alignment	
CLE	ME1Ea
CONTENT	SC1
PROCESS	1.6 Discover/evaluate relationships
DOK	3 – Strategic Thinking
INSTRUCTIONAL STRATEGIES	Nonlinguistic representations

Assessment's Alignment	
CLE	ME1Eb
CONTENT	SC1
PROCESS	1.6 Discover/evaluate relationships
DOK	2 – Skill/Concept
LEVEL OF EXPECTATION	Mastery Level - 75 %

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	SLA ?
Learning & Innovation Skills		Enrichment Opportunity	
Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Check Readiness & Equity with these two.

Sample Learning Activities

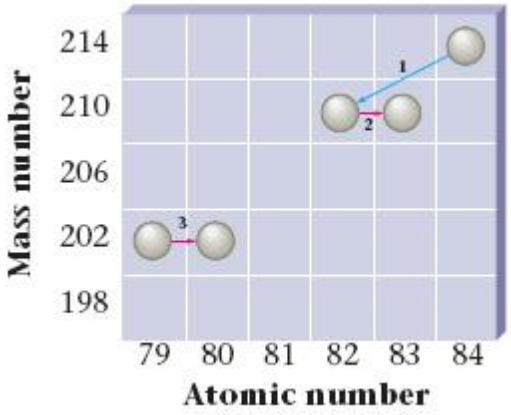
Learning Activity #2: (See Appendix E)
Carbon-14 Dating Activity
Students read an article on carbon-14 dating, summarize the article, answer several questions, and construct a cartoon strip highlighting the main aspects of radiocarbon dating.

Activity's Alignment	
CLE	ME2Ea
CONTENT	SC1, CA3
PROCESS	2.2 Revise communications 3.5 Reason logically (inductive/deductive)
DOK	4 – Extended Thinking
INSTRUCTIONAL STRATEGIES	Nonlinguistic representation

Sample Assessments

Assessment #2:
Nuclear Decay Analysis

Analyze the diagram below and describe the nuclear decay indicated by number 1 and number 2. Justify your answer.



Answers:
The decay indicated by "1" shows alpha decay because the atomic number is dropping by 2 and the mass number is dropping by 4. The decay indicated by "2" shows beta decay because the atomic number is increasing by 1 but the mass number is remaining constant.

Assessment's Alignment	
CLE	ME2Ea
CONTENT	SC1

PROCESS	3.5 Reason logically (inductive/deductive)
DOK	3 – Strategic Thinking
LEVEL OF EXPECTATION	Mastery Level - 100 %

Student Resources	Teacher Resources
General: ● **World of Chemistry, Zumdahl, 2006** **Enrichment:** ● **www.acs.org (chematters magazine)** ● **http://ie.lbl.gov/education/isotopes.htm** **Intervention:** ● **http://www.chemtutor.com/** ● **www.yahooanswers.com** ● **www.cramster.com** ● **http://www.chemmybear.com/stdycrds.html#GenChem**	**General:** ● **Flinn ChemTopics Labs, Volume 18** ● **http://jchemed.chem.wisc.edu/** ● **World of Chemistry, Zumdahl, 2006** **Enrichment:** **Intervention:**

NOTE: These sections will be partially completed during the curriculum writing process and finalized during the year one review process.

Content Area: Science	Course: Chemistry Honors	Unit: Chemical Nomenclature

Learner Objectives:

- Chemical compounds are named by a specific set of rules which vary based on composition.
- Chemical formulas represent the number and types of atoms or ions that exist in a compound.

Concepts:

A. Modern chemical nomenclature follows a distinct set of rules for determining the scientific name which depends upon the type of compound involved.
B. The chemical formula for any compound can be determined from the scientific name.
C. Students, as informed consumers, should know some compounds typically encountered in everyday use.

(Concepts?)

Students Should Know	Students Should Be Able to
• Nomenclature is an essential component of chemical literacy • There are specific rules established for naming different categories of compounds. • Students should know the names and formulas of elements and common polyatomic ions.	• Write the formulas for ionic compounds, binary covalent compounds and acids when given the name. • Name compounds using the stock naming system based upon the formula.

Instructional Support

Student Essential Vocabulary					
Sulfate	Sulfite	Nitrate	Nitrite	Ammonium	Bisulfate
Hydroxide	Cyanide	Phosphate	Hydrogen phosphate	Dihydrogen phosphate	Carbonate
Bicarbonate	Hypochlorite	Chlorite	Chlorate	Perchlorate	Acetate
Permanganate	Dichromate	Chromate	Peroxide	Cation	Anion
Ion	Polyatomic Ion	Binary			

Readiness & Equity Section
SLA = Sample Learning Activities & **SA** = Sample Assessments

21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills		Enrichment Opportunity	
Information, Media, & Technology Skills		Intervention Opportunity	SLA
Life & Career Skills	SLA	Gender, Ethnic, & Disability Equity	

Sample Learning Activities

Learning Activity #1 : (See Appendix F)
Grocery Store Chemistry
This activity requires students to construct the formula of a compound of a common household chemical based upon a variety of clues about the cation and anion which make up the compound. Students are also required to investigate a household item which contains the compound in question.

Activity's Alignment	
CLE	Concept C
CONTENT	SC 5
PROCESS	1.10 Apply information, ideas and skills 3.5 Reason logically (inductive/deductive)
DOK	3 – Strategic Thinking
INSTRUCTIONAL STRATEGIES	Homework and Practice

Sample Assessments

Assessment #1:
Ionic Naming Exit Card

Construct the correct name for the following ionic compounds:
NaBr
Fe_2O_3
$Ca(NO_3)_2$
CuOH
Formulate the correct formula of the following ionic compounds:
Silver sulfide
Titanium(IV) Selenide
Magnesium phosphate
Chromium (VI) oxide
Key:
Sodium bromide, Iron(III) oxide, Calcium nitrate, Copper(I) hydroxide
Ag_2S, $TiSe_2$, $Mg_3(PO_4)_2$, CrO_3

Assessment's Alignment	
CLE	Concepts A, B
CONTENT	SC 5
PROCESS	1.10 Apply information ideas and skills
DOK	3 – Strategic Thinking
LEVEL OF EXPECTATION	Mastery Level - 80%

Student Resources	Teacher Resources
General: ● **World of Chemistry, Zumdahl, 2006** **Enrichment:** ● **www.acs.org (chematters magazine)** ● **http://www.chemistrygeek.com/rainbow/ns6_main.htm** ● **http://nsdl.org/resource/2200/20100608202828913T** **Intervention:** ● **www.yahooanswers.com** ● **www.cramster.com** ● **http://www.chemmybear.com/stdycrds.html#GenChem**	**General:** ● **http://jchemed.chem.wisc.edu/** ● **World of Chemistry, Zumdahl, 2006** **Enrichment:** **Intervention:**

NOTE: These sections will be partially completed during the curriculum writing process and finalized during the year one review process.

Content Area: Science	Course: Chemistry Honors	Unit: Chemical Composition

Learner Objectives:
- The mole is ubiquitous in chemistry and is used in many chemical calculations
- Avogadro's number relates the mass of a substance to the number of particles of that substance.

Concepts:
A. The mole can be used to convert between mass, representative particles and volume of a gas at STP.
B. The formula can be used to determine the mass percent of a compound.
C. The empirical and molecular formulas can be determined from percent composition and/or experimental data.
D. The molecular formula can be determined from the empirical formula and molar mass of a compound.

Students Should Know	Students Should Be Able to
• The mole is a fundamental unit • The mole can be used to convert between mass, representative particle and molar volume of a gas at STP. • Percent composition by mass can be determined from the formula of a compound • Empirical formulas can be determined from the percent composition • The molar mass of a compound is the mass of one mole of that substance	• Calculate the molar mass of a given substance (A) • Convert between mass, moles, particles and volume of a gas at STP (A) • Calculate the percent composition of a compound (B) • Calculate the empirical formula of a compound from the percent composition (C) • Determine the molecular formula from the empirical formula and molar mass (D)

Instructional Support

Student Essential Vocabulary					
Mole	Avodagro's Number	Molar Mass	Empirical Formula	Molecular Formula	Percent Composition
STP	Representative particle	Formula Unit	Molar Volume	Hydrate	Empirical Mass

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills	SLA	Enrichment Opportunity	
Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities

Learning Activity #1: (See Appendix G)
Formula of a Hydrate Lab
In this experiment, students determine the mass of a hydrated crystal (in this case, hydrated copper(II) sulfate pentahydrate, $CuSO_4 \cdot nH_2O$), and heat the crystal until all the water is driven off. By determining the mass of the hydrated and anhydrous crystal and applying the concept of a mole, students can then determine the formula of the crystal.

Activity's Alignment	
CLE	A
CONTENT	SC 1
PROCESS	1.10 Apply information 3.5 Reason logically
DOK	3 – Strategic Thinking
INSTRUCTIONAL STRATEGIES	Cooperative learning

Sample Assessments

Assessment #1:
Mass/Mole/Particle Exit Card

1) Using dimensional analysis, determine the number of molecules of water contained in 36.04 grams of water?

2) Calculate the number of grams of iron that contain the same number of atoms as 2.24 g of cobalt.

Answers:
1) 1.20 x 10^{-24} molecules
2) 2.12 g Fe

Assessment's Alignment	
CLE	A
CONTENT	SC 1
PROCESS	1.10 Apply information 3.5 Reason logically
DOK	3 –Strategic Thinking
LEVEL OF EXPECTATION	Mastery Level- 80%

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills		Enrichment Opportunity	
Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Check readiness & equity for #2

Sample Learning Activities

Learning Activity #2: (See Appendix H)
Formula of a Chloride Lab
In this experiment, students determine the mass of a clean dry beaker and add some powdered zinc. Then the zinc is reacted with excess hydrochloric acid, forming zinc chloride. The excess hydrochloric acid is then driven off by gentle heating. Using the mass of the zinc and zinc chloride formed, and applying the concept of a mole, the formula of zinc chloride can be determined.

Activity's Alignment	
CLE	Concept C
CONTENT	SC 1
PROCESS	1.10 Apply information 3.5 Reason logically
DOK	3 – Strategic Thinking
INSTRUCTIONAL STRATEGIES	Cooperative learning

Sample Assessments

Assessment #2:
Empirical and Molecular Formula Exit Card

A compound is 82.63 % carbon and 17.37 % hydrogen by mass. The molar mass is 58.1 g/mole. Determine the empirical formula and molecular formula of the compound.

Answer: C_2H_5, C_4H_{10}

Assessment's Alignment	
CLE	Concept C
CONTENT	SC 1
PROCESS	1.10 Apply information 3.5 Reason logically
DOK	3 –Strategic Thinking
LEVEL OF EXPECTATION	Mastery Level - 80 %

NOTE: These sections will be partially completed during the curriculum writing process and finalized during the year one review process.

Student Resources	Teacher Resources
General: ● **World of Chemistry, Zumdahl, 2006** **Enrichment:** ● **www.acs.org (chematters magazine)** ● **http://www.moleday.org/** **Intervention:** ● **http://www.chemtutor.com/** ● **www.yahooanswers.com** ● **www.cramster.com** ● **http://www.chemmybear.com/stdycrds.html#GenChem**	**General:** ● **http://jchemed.chem.wisc.edu/** ● **http://edubakery.com/Bingo-Cards/Mole-Conversion-Bingo-v6-Bingo-Cards** ● **World of Chemistry, Zumdahl, 2006** **Enrichment:** **Intervention:**

Content Area: Science	Course: Chemistry Honors	Unit: Chemical Reactions

Learner Objectives:

- Changes in properties and states of matter provide evidence of the atomic theory of matter. (ME1)
- All chemical reactions can be classified as one of three types: precipitation, acid-base and oxidation-reduction (redox).
- Products of reactions can be predicted from knowledge of reaction type.

Concepts:

A. Reactions are driven by four potential forces: production of a gas, electron transfer, production of a covalent compound, and production of a solid.
B. Due to conservation of mass, the numbers and types of atoms on the reactants side is exactly equal to the numbers and types of atoms on the product side of a balanced reaction.
C. Chemical bonding is the combining of different pure substances (elements, compounds) to form new substances with different properties. (ME1H)
D. Mass is conserved during any physical or chemical change. (ME1I)
E. Specific symbols are used to indicate the state of a substance in a chemical reaction

Students Should Know	Students Should Be Able to
• The reaction of a strong acid and strong base results in water and a salt • Combustion reactions involve oxygen as a reactant and carbon dioxide and water as typical products • Metals can combine with oxygen to form metal oxides • The numbers and types of atoms have to be the same on reactants and products side • Reactions can be classified as one of three types: precipitation, acid-base and oxidation-reduction. • The solubility rules can be used to predict the products of precipitation reactions • The activity series for metals and halogens can be used to predict when certain types of oxidation-reduction reactions will occur • A base can neutralize an acid to produce an ionic compound (a salt) and water • Redox reactions are electron transfer reactions	• Predict the products of an acid/base (neutralization), oxidation (rusting), and combustion (burning) reaction (ME1Hd) • Compare the mass of the reactants to the mass of the products in a chemical reaction or physical change as support for the Law of Conservation of Mass (ME1Ia) • Determine whether an ionic compound will be soluble or insoluble in water based on the solubility rules (A) • Balance a chemical reaction (B, ME1I) • Predict the product of a precipitation reaction (A) • Use appropriate symbols to indicate the state ((s), (l), (g), (aq) etc…)of a reactant or product (D) • Recognize the role of a catalyst in a chemical reaction (D) • Predict when single replacement reactions will occur (A) • Assign oxidation numbers to elements in a compound (A) • Identify the elements oxidized and reduced in a redox reaction. (A) • Write the molecular, ionic and net ionic reactions (A)

Instructional Support

Student Essential Vocabulary					
Soluble	Insoluble	Precipitate	Combustion	Single Replacement	Decomposition
Synthesis	Salt	Aqueous	Redox	Oxidation Number	Oxidation
Reduction	Spectator Ion	Molecular Equation	Net Ionic Reaction	Complete Ionic Reaction	Catalyst

Readiness & Equity Section
SLA = Sample Learning Activities & **SA** = Sample Assessments

21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills		Enrichment Opportunity	
Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities

Learning Activity #1: (See Appendix I)
Solubility Rules Lab
Student mix different chemicals in a matrix, and observe the products (if any) that form. Students then apply the solubility rules to determine the likely identity and formula of the precipitate.

Activity's Alignment	
CLE	A
CONTENT	SC 1
PROCESS	3.5 Reason logically (inductive/deductive)
DOK	3 –Strategic Thinking
INSTRUCTIONAL STRATEGIES	Similarities and differences

Sample Assessments

Assessment #1:
Solubility Rules Quiz (See Appendix 2) Is this in the appendix?

Directions: Fill in the grid with the precipitate that forms when aqueous solution of the following are mixed. If no precipitate forms, place a dash (-) in the box.

	NaCl (aq)	**Ag_2SO_4 (aq)**
$Pb(NO_3)_2$ (aq)		
NH_4OH (aq)		

Answer Key:

	NaCl (aq)	**Ag_2SO_4 (aq)**
$Pb(NO_3)_2$ (aq)	***$PbCl_2$***	***$PbSO_4$***
NH_4OH (aq)	*-*	***AgOH***

Assessment's Alignment	
CLE	A
CONTENT	SC 1
PROCESS	1.10 Apply information 3.5 Reason logically (inductive/deductive)
DOK	3 – Strategic Thinking
LEVEL OF EXPECTATION	Mastery Level- 75%

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills		Enrichment Opportunity	
Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities

Learning Activity #2: (See Appendix J)
Activity Series of Metals
Students combine various metals with different solutions. Based on whether a reaction occurs or not, students are able to construct an activity series of various metals, along with hydrogen from both water and acids.

Activity's Alignment	
CLE	Concept A
CONTENT	SC 1
PROCESS	1.6 Discover/evaluate relationships
DOK	3 –Strategic Thinking
INSTRUCTIONAL STRATEGIES	Generating and testing hypotheses

Sample Assessments

Assessment #2:
Reactions Exit Card

Analyze the following reactants and predict the products (including states). Then balance each reaction.

$HNO_3(aq) + KOH(aq) \rightarrow$

$Na(s) + H_2O(l) \rightarrow$

$Mg(s) + O_2(g) \rightarrow$

Answers:

$HNO_3(aq) + KOH(aq) \rightarrow KNO_3(aq) + H_2O(l)$
$2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$
$2Mg(s) + O_2(g) \rightarrow 2MgO(s)$

Assessment's Alignment	
CLE	Concept A
CONTENT	SC 1
PROCESS	1.10 Apply information, ideas and skills 3.5 – Reasoning logically (inductive or deductive)
DOK	3 – Strategic Thinking
LEVEL OF EXPECTATION	Mastery Level - 80 %

NOTE: These sections will be partially completed during the curriculum writing process and finalized during the year one review process.

Student Resources	Teacher Resources
General: ● **World of Chemistry, Zumdahl, 2006** **Enrichment:** ● **www.acs.org (chematters magazine)** **Intervention:** ● **http://www.chemtutor.com/** ● **www.yahooanswers.com** ● **www.cramster.com** ● **http://www.chemmybear.com/stdycrds.html#GenChem**	**General:** ● **Flinn ChemTopics Labs, Volume 6** ● **http://jchemed.chem.wisc.edu/** ● **World of Chemistry, Zumdahl, 2006** **Enrichment:** **Intervention:**

Content Area: Science	Course: Chemistry Honors	Unit: Chemical Stoichiometry

Learner Objectives:

- Stoichiometry is the branch of chemistry that is used to relate the amounts of reactants and products.
- Changes in properties and states of matter provide evidence of the atomic theory of matter ME1
- Scientific understanding is developed through the use of science process skills, scientific knowledge, scientific investigation, reasoning and critical thinking IN1

Concepts:

A. Mass is conserved through any physical or chemical change ME1I
B. Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigative methods in order to obtain evidence relevant to the explanation IN1A
C. Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations IN1B
D. Scientific inquiry includes the evaluation of explanations (laws/principles, theories/models) in light of evidence (data) and scientific principles (understandings) IN1C
E. The balanced reaction provided the framework for determining the amounts of reactants and products in a chemical reaction.
F. There is a discrepancy between a theoretical yield and the amount actually obtained in an experiment.
G. When more than one reactant is used, the reactant that runs out first limits how much product is made.

Check the concepts in red below to make sure they are still correct

Students Should Know	Students Should Be Able to
• The number of atoms of the reactants and products in a chemical are balanced (ME1Ib) • The balanced reaction is needed to provide stoichiometric ratios. • The limiting reactant is the reactant that runs out first and produces the least amount of product. • The actual yield is the amount produced in an experiment. • The theoretical yield is the calculated amount that would be produced in a reaction. • The percent yield is the ratio of actual yield to the theoretical yield. • There are a variety of reasons why the % yield is less than 100 % in most chemical reactions.	• Compare the mass of the reactants to the mass of the products in a chemical reaction or physical change as support for the Law of Conservation of Mass (ME1Ia) • Evaluate the design of an experiment and make suggestions for reasonable improvements IN1Ag • Identify the possible effects of errors in observations, measurements, and calculations, on the validity and reliability of data and resultant explanations (conclusions) IN1Cc • Calculate the range, average/mean, percent, and ratios for sets of data IN1Be • Predict various stoichiometric relationships (to be locally assessed) (E) • Calculate the mass of the products in a chemical reaction from the mass of the reactants (A) • Calculate the limiting reagent in a chemical reaction (G) • Calculate the percent yield from the theoretical yield and the experimental yield (F)

Instructional Support

Student Essential Vocabulary					
Reagent	Reactant	Experimental yield	Theoretical yield	Percent Yield	Limiting Reactant
Stoichiometry	Mole Ratio	Excess Reactant			

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills		Enrichment Opportunity	SLA

Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities	Sample Assessments
Learning Activity #1: (See Appendix K) w/ Lab Scoring Guide **Synthesis of Sodium Chloride** In this experiment, baking soda (sodium bicarbonate, $NaHCO_3$) is combined with excess hydrochloric acid (HCl) and an aqueous solution of sodium chloride is formed. By gently heating the mixture, the excess HCl and water are driven away, leaving pure NaCl. By measuring the mass of NaCl formed and comparing this value to the theoretical yield, a percent yield can be determined.	**Assessment #1:** **Mass to Mass Stoichiometry Exit Card** How many grams of oxygen would be required to react with 24.31 g of magnesium metal? Use the balanced reaction below. $2Mg(s) + O_2(g) \rightarrow 2MgO(s)$ ***Answer:*** *16.00 grams of O_2*

Activity's Alignment	
CLE	ME1Ia, IN1Be, IN1Cc; Concepts E, F
CONTENT	SC1, SC7
PROCESS	1.6 Discover/evaluate relationships
DOK	3 – Strategic Thinking
INSTRUCTIONAL STRATEGIES	Similarities and differences

Assessment's Alignment	
CLE	ME1Ia; Concept E
CONTENT	SC1
PROCESS	1.10 Apply information, ideas and skills
DOK	2 – Skill/Concept
LEVEL OF EXPECTATION	Mastery Level - 80 %

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills		Enrichment Opportunity	SLA

Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities	Sample Assessments
Learning Activity #2: (See Appendix L) w/ Lab Scoring Guide **Copper(II) Chloride and Iron Lab** In this experiment, an iron nail is reacted with an aqueous solution of copper(II) chloride, $CuCl_2$, and copper is metal is produced. This copper metal is dried and weighed, and a limiting reagent, theoretical yield, and percent yield is determined.	**Assessment #2:** **Theoretical Yield / Percent Yield Exit Card** If 25.0 g of magnesium is combined with 37.5 grams of nitrogen producing 30.0 grams of magnesium nitride, then what is the limiting reagent, theoretical yield and percent yield of the reaction? How many grams of excess reagent remain at the end of the reaction? $3Mg(s) + N_2(g) \rightarrow Mg_3N_2(s)$ ***Answer**: Mg, 31.1 g, 96.5 % yield, 27.9 g of N_2 remain when the reaction is complete*

Activity's Alignment	
CLE	ME1Ia, IN1Cc; Concept G
CONTENT	SC1, SC7
PROCESS	1.6 Discover/evaluate relationships
DOK	3 – Strategic Thinking
INSTRUCTIONAL STRATEGIES	Generating and testing hypotheses

Assessment's Alignment	
CLE	ME1Ia; Concept G
CONTENT	SC1
PROCESS	1.6 Discover/evaluate relationships
DOK	3 – Strategic Thinking
LEVEL OF EXPECTATION	Mastery Level - 80 %

Student Resources	Teacher Resources
General: ● **World of Chemistry, Zumdahl, 2006** **Enrichment:** ● **www.acs.org (chematters magazine)** **Intervention:** ● **http://www.chemtutor.com/** ● **www.yahooanswers.com** ● **www.cramster.com** **http://www.chemmybear.com/stdycrds.html#GenChem**	**General:** ● **Flinn ChemTopics Labs, Volume 7** ● **World of Chemistry, Zumdahl, 2006** **Enrichment:** **Intervention:**

NOTE: These sections will be partially completed during the curriculum writing process and finalized during the year one review process.

Content Area: Science	Course: Chemistry Honors	Unit: Energy and Phase Changes

Learner Objectives:

- Energy has a source, can be stored, and can be transferred but is conserved within a system. ME2
- Changes in properties and states of matter provide evidence of the atomic theory of matter ME1

Concepts:

A. Physical changes in states of matter due to thermal changes in materials can be explained by the Kinetic Theory of Matter. (ME1D)
B. Forms of energy have a source, a means of transfer (work and heat), and a receiver. ME2A
C. Mechanical energy comes from the motion (kinetic energy) and/or relative position (potential energy) of an object. ME2B
D. Chemical reactions involve changes in the bonding of atoms with the release or absorption of energy. ME2D
E. Energy can be transferred within a system as the total amount of energy remains constant (i.e., Law of Conservation of Energy). ME2F
F. The specific heat capacity of a substance is the amount of energy required to raise 1 g of the substance by 1 °C.

Students Should Know	Students Should Be Able to
• During a phase change, the temperature of the substance remains constant as the distance between atom/molecules changes • A phase diagrams show the relationship between temperature and pressure and the resulting state of matter • Thermal energy is the total energy of a substance which is dependent upon mass. Heat is thermal energy that transfers from one object to another due to a difference in temperature. Temperature is the measure of the average kinetic energy of molecules or atoms in a substance. • Exothermic reactions produce an increase in temperature. Endothermic reactions produce a decrease in temperature. • The Law of Conservation of Energy state that energy cannot be created or destroyed. Energy can be classified as chemical, nuclear, thermal, mechanical, electromagnetic, kinetic and potential energies. • The specific heat capacity is the amount of energy it takes to raise 1g of the substance by 1 °C • The heat transferred to a system can be calculated by the equation: $q = mc\Delta T$.	• Using the Kinetic Theory model, explain the changes that occur in the distance between atoms/molecules and temperature of a substance as energy is absorbed or released during a phase change (ME1Da) • Predict the effect of a temperature change on the properties (e.g., pressure, density) of a material (solids, liquids, gases) (ME1Db) • Predict the effect of pressure changes on the properties (e.g., temperature, density) of a material (solids, liquids, gases) (ME1Dc) • Describe evidence of energy transfer and transformations that occur during exothermic and endothermic chemical reactions ME2Da • Classify the different ways to store energy (i.e., chemical, nuclear, thermal, mechanical, electromagnetic) and describe the transfer of energy as it changes from kinetic to potential, while the total amount of energy remains constant, within a system (e.g., using gasoline to move a car, photocell generating electricity, biochemical reaction, energy generated by nuclear reactor) ME2Fc • Differentiate between thermal energy (the total internal energy of a substance which is dependent upon mass), heat (thermal energy that transfers from one object or system to another due to a difference in

	temperature), and temperature (the measure of average kinetic energy of molecules or atoms in a substance) ME2Aa ● Calculate the energy transferred to or from a system by knowing its specific heat capacity and change in temperature (F)

Instructional Support

Student Essential Vocabulary					
Phase Diagram	Kinetic Theory	Thermal Energy	Temperature	Specific Heat Capacity	Heat
Temperature	Joule	Calorie	Exothermic	Endothermic	Melting
Freezing	Sublimation	Condensation	Deposition	Vaporization	Triple Point
Absolute Zero	Critical Point	Kelvin	Vapor Pressure	Boiling Point	Normal Boiling Point

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	

Learning & Innovation Skills		Enrichment Opportunity	SLA
Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities

Learning Activity #1: (Appendix M)
Heat Capacity of Metal
Students place hot metal into a styrofoam cup containing a known amount of water at a known temperature. Students measure the final temperature of the water/metal combination, and use this information to determine the specific heat capacity of the metal. This value is compared to the accepted value.

Activity's Alignment	
CLE	ME2Aa
CONTENT	SC1
PROCESS	1.6 Discover/evaluate relationships 1.10 Apply information, ideas and skills
DOK	3 – Strategic Thinking
INSTRUCTIONAL STRATEGIES	Generating and testing hypothesis

Sample Assessments

Assessment #1:
Specific Heat Capacity Exit Card
When 90.0 grams of a metal at 100.0 °C is added to 245 mL of water at 25.0 °C, the water/metal mixture reaches a final temperature of 30.5 °C. If the specific heat capacity of water is 4.18 J/g°C, then what is the identity of the metal? Choose from the list below, and justify your answer.

Metal	Specific Heat Capacity (J/g°C)
Aluminum	**0.900**
Copper	**0.385**
Steel	**0.460**
Tin	**0.228**
Zinc	**0.388**

Answer: *Aluminum, because the specific heat capacity of the metal, according to the experimental results, must be 0.90 J/g°C.*

Assessment's Alignment	
CLE	ME1Db, ME1Dc
CONTENT	SC1
PROCESS	1.10 Apply information, ideas and skills 3.5 Reason logically (inductive/deductive)
DOK	3 – Strategic Thinking
LEVEL OF EXPECTATION	Mastery Level - 80 %

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills	SLA	Enrichment Opportunity	
Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities

Learning Activity #2: (See Appendix N)
Heat of Combustion of Candle Wax
In this experiment, students use a wax candle to heat a measured amount of water. By measuring the temperature increase and specific heat capacity of the water, and by measuring the mass of candle wax burned, the heat of combustion of candle wax in kilojoules per mole is determined.

Activity's Alignment	
CLE	ME2Da
CONTENT	SC1
PROCESS	1.6 Discover/evaluate relationships 1.10 Apply information, ideas and skills
DOK	3 – Strategic Thinking
INSTRUCTIONAL STRATEGIES	Generating and testing hypotheses.

Sample Assessments

Assessment #2:
Heat of Combustion Exit Card
Suppose a student does an experiment to determine the heat of combustion of propane, a compound with the formula of C_3H_8. A small propane tank is used to heat 750.0 mL of water. Use this experimental data to determine the heat of combustion of propane in kJ/mol.

Initial mass of propane tank	408.1 g
Final mass of propane tank	397.6 g
Initial temperature of water	23.0 ˚C
Final temperature of water	84.6 ˚C
Mass of water heated	750.0 grams

Answer: *811 kJ/mol*

Assessment's Alignment	
CLE	ME2Da
CONTENT	SC1
PROCESS	3.5 Reason logically (inductive/deductive)
DOK	3 – Strategic Thinking
LEVEL OF EXPECTATION	Mastery Level – 75%

Student Resources	Teacher Resources

General: • **World of Chemistry, Zumdahl, 2006** **Enrichment:** • **www.acs.org (chematters magazine)** • **NOVA: Absolute Zero http://teachbiofuels.org/Biodiesel%20Lessons%20&%20Labs.html** **Intervention:** • **http://www.chemtutor.com/** • **www.yahooanswers.com** • **www.cramster.com** • **http://www.chemmybear.com/stdycrds.html#GenChem**	**General:** • **Flinn ChemTopics Labs, Volume 11** • **http://jchemed.chem.wisc.edu/** • **World of Chemistry, Zumdahl, 2006** **Enrichment:** **Intervention:**

NOTE: These sections will be partially completed during the curriculum writing process and finalized during the year one review process.

Content Area: Science	**Course: Chemistry Honors**	**Unit: Gas Laws**

Learner Objectives:

- Gases behave very differently than liquids and solids due to their compressibility.
- There exists a relationship between the pressure, temperature and volume of a gas.
- Scientific understanding is developed through the use of science process skills, scientific knowledge, scientific investigation, reasoning and critical thinking IN1

Concepts:

A. Gases are assumed to behave ideally, and have properties (such as pressure, temperature, volume and moles) that are governed by several mathematical laws.
B. Pressure is a direct result of collisions of the gas particles with the sides of the container.
C. Unlike liquids and solids, the volume of a gas will change due to changes in pressure and temperature.
D. The behavior of gases can be interpreted by analyzing appropriate graphs.
E. Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigative methods in order to obtain evidence relevant to the explanation IN1A

Students Should Know	Students Should Be Able to
• Temperature, pressure, volume and moles can be solved by using the appropriate equation, including the Combined Gas Law, Ideal Gas Law and Dalton's Law of Partial Pressure. • Conversion of pressure and temperature data to appropriate units. • Collection of a gas can be achieved by water displacement • The balanced reaction and stoichiometry applies to gaseous reactants and products	• Calculate pressure, volume, moles or temperature of a gas using the Ideal Gas Law, the Combined Gas Law, and Dalton's Law of Partial Pressure. (A) • Explain using Kinetic Theory the effect of changes in volume, temperature, or moles of gas on the pressure. (B) • Predict the effect on the volume of a gas when pressure and/or temperature are changed. (C) • Construct and interpret appropriate graphs. (D) • Use the balanced reaction to determine amount of gaseous reactants or products (A) • Design and conduct a valid experiment IN1Ac

Instructional Support

Student Essential Vocabulary

Combined Gas Law	Charles Law	Boyle's Law	Gay-Lussac's Law	Dalton's law	Avogadro's law
Ideal Gas law	Barometer	Atmosphere	Gas Collection Tube	Partial Pressure	Mole Fraction

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills	SLA	Enrichment Opportunity	SLA
Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities

Learning Activity #1: (See Appendix O)
Air Bag Lab
Students are presented with the challenge of inflating a zip-lock bag with dilute acetic acid and sodium bicarbonate. Students must use the balanced reaction, stiochiometry, and the appropriate gas law to determine the correct amount of reagents needed to inflate the bag.

Activity's Alignment	
CLE	IN1Ac, Concept A, B
CONTENT	SC1, SC7
PROCESS	1.10 Apply information, ideas and skills 3.5 Reason logically (inductive/deductive)
DOK	4 – Extended Thinking
INSTRUCTIONAL STRATEGIES	Generating and testing hypotheses

Sample Assessments

Assessment #1:
Gas Law/Stoichiometry Exit card
Air bags are activated when a severe impact causes a steel ball to compress a spring and electrically ignite a detonator cap. This causes sodium azide (NaN_3) to decompose explosively according to the following unbalanced reaction:

$$NaN_3(s) \rightarrow Na(s) + N_2(g)$$

What mass of NaN_3 must be reacted in order to inflate an air bag to
70.0 L at 0°C and 1.0 atm?
Answer: *117 g*

Assessment's Alignment	
CLE	A
CONTENT	SC1
PROCESS	1.10 Apply information, ideas and skills
DOK	3 – Strategic thinking
LEVEL OF EXPECTATION	Mastery Level - 75 %

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills	SLA	Enrichment Opportunity	
Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities

Learning Activity #2: (See Appendix P)
Molar Mass of Butane Lab
Students are presented with the challenge of determining the molar mass of butane, the liquid inside lighters. Students are provided with lighters, a tub of water, a thermometer, a digital balance, a graduated cylinder, and the barometric pressure and must design and conduct an experiment to determine the molar mass of butane.

Activity's Alignment	
CLE	IN1Ac; Concept A
CONTENT	SC1, SC7
PROCESS	1.10 Apply information, ideas and skills 3.5 Reason logically (inductive/deductive)
DOK	4 – Extended Thinking
INSTRUCTIONAL STRATEGIES	Generating and testing hypotheses

Sample Assessments

Assessment #2:

Molar Mass of an Unknown Gas exit card

A small canister of propane has a mass of 27.305 g. The canister releases some propane gas, which is collected over water at 25 °C. 500.0 mL of the propane gas is collected. Afterward, the canister has a mass of 26.478 g. The vapor pressure of water at 25 °C is 23.8 torr. If the barometric pressure that day is 755.9 torr. Use this information to determine the molar mass of propane.

Answer: *42.0 g/mol*

Assessment's Alignment	
CLE	Concept A
CONTENT	SC1
PROCESS	1.10 Apply information, ideas and skills
DOK	3 – Strategic Thinking
LEVEL OF EXPECTATION	Mastery Level -75 %

NOTE: These sections will be partially completed during the curriculum writing process and finalized during the year one review process.

Student Resources	Teacher Resources
General: ● **World of Chemistry, Zumdahl, 2006** **Enrichment:** ● **www.acs.org (chematters magazine)** ● **NOVA: The Death Zone** ● **http://intro.chem.okstate.edu/1314F00/Laboratory/GLP.htm** **Intervention:** ● **http://www.chemtutor.com/** ● **www.yahooanswers.com** ● **www.cramster.com** ● **http://www.chemmybear.com/stdycrds.html#GenChem**	**General:** ● **Flinn ChemTopic Lab, Volumes 8 & 9** ● **http://jchemed.chem.wisc.edu/** ● **World of Chemistry, Zumdahl, 2006** **Enrichment:** **Intervention:**

Content Area: Science	Course: Chemistry Honors	Unit: Electronic Structure and Periodic Trends

Learner Objectives:

- A wave can be described in terms of frequency, wavelength and energy.
- The wave mechanical model of an atom can be used to predict the location of an electron
- When the atoms are arranged in order of increasing atomic number, repeating, periodic properties occur.
- Energy has a source, can be stored, and can be transferred but is conserved within a system. ME2
- Changes in properties and states of matter provide evidence of the atomic theory of matter ME1
- Science and technology affect, and are affected by, society ST3

Concepts:

A. Objects, and the materials they are made of, have properties that can be used to describe and classify them ME1A
B. The periodic table organizes the elements according to their atomic structure and chemical reactivity. (ME1F)
C. Forms of energy have a source, a means of transfer (work and heat), and a receiver. ME2A
D. Electromagnetic energy from the Sun (solar radiation) is a major source of energy on Earth. ME2C
E. The product of the wavelength and frequency of a wave equals the speed the wave. The product of the frequency and planck's constant equals the energy of a photon.
F. Social, political, economic, ethical and environmental factors strongly influence, and are influenced by, the direction of progress of science and technology ST3B

Students Should Know	Students Should Be Able to
• Elements can be classified according to reactivity, the number of valence electrons, malleability, luster and conductivity • Elements with common properties are arranged in vertical groups/families • Elements can have periodic properties such as ionization energy, atomic radius and electronegativity • Elements are classified as metals, metalloids and nonmetals based upon their position on a Periodic Table • The reactivity of an element can be determined from an element's electronegativity • Very high and very low electronegativities indicate high reactivity • Electron configurations can be used to determine the number of valence electrons	• Compare and contrast the common properties of metals, nonmetals, metalloids (semi-conductors), and noble gases (ME1Ad) • Explain the structure of the periodic table in terms of the elements with common properties (groups/families) and repeating properties (periods) (ME1Fa) • Classify elements as metals, nonmetals, metalloids (semi-conductors), and noble gases according to their location on the Periodic Table (ME1Fb) • Predict the chemical reactivity of elements, and the type of bonds that may result between them, using the Periodic Table (ME1Fc) • Construct an electron configuration for an element • Describe how the valence electron configuration determines how atoms interact and may bond (ME1Ha)

• Wavelength is inversely proportional to frequency. E = hv where E is energy, h is Planck's constant and v is frequency. • As frequency increases so does the damaging effects on the Earth and living organisms. • Ozone absorbs UV radiation. • The atomic model has evolved from Dalton's atomic theory to the current Quantum Mechanical model. • The ionization energy patterns are reflective of the atomic structure. • Atoms will change size when forming ions • Some elements will exhibit configurations that violate the Aufbau principle. • Each electron can be assigned four unique quantum numbers.	• Describe the relationship among wavelength, energy, and frequency as illustrated by the electromagnetic spectrum ME2Ab • Calculate wavelength, energy or frequency using: E=hv • Describe the effect of different frequencies of electromagnetic waves on the Earth and living organisms (e.g., radio, infrared, visible, ultraviolet, gamma, cosmic rays) ME2Ad • Analyze the roles of science and society as they interact to determine the direction of scientific and technological progress (e.g., prioritization of and funding for new scientific research and technological development is determined on the basis of individual, political and social values and needs; understanding basic concepts and principles of science and technology influences debate about the economics, policies, politics, and ethics of various scientific and technological challenges) ST3Ba • Explain trends in ionization patterns using atomic structure. • Write a set of four acceptable quantum numbers for any electron. • Write configurations of ions and those elements that violate the Aufbau principle.

Instructional Support

Student Essential Vocabulary					
Frequency	Wavelength	Lambda	Nu	Planck's constant	Photon
Quantized	Electromagnetic spectrum	Nanometer	Ionization Energy	Atomic size	Ionic Size
Electron Configuration	Sublevel	Orbital	Aufbau principle	Hund's Rule	Pauli Exclusion Principle
Exceptional Configuration	Configuration of Ions	s-orbital	p-orbital	d-orbital	f-orbital
Alkali metals	Alkaline Earth metals	Halogens	Noble gas	Transition Metal	Inner transition
Lanthanides	Actinides	Ground state	Excited state	Bohr model	Period

Group	Representative Element	Group A Element	Group B Element	spin	Quantum numbers
Valence electrons	Shielding	Isoelectronic	Electronegativity	Principle Energy Level	Metalloid

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills		Enrichment Opportunity	SLA
Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities

Learning Activity #1: (See Appendix Q)
Periodic Table Activity

Students are given list of clues about the placement of elements on a periodic table, and must place the elements accordingly.

Activity's Alignment	
CLE	ME1F, Concept B
CONTENT	SC1
PROCESS	1.6 Discover and evaluate relationships
DOK	3 – Strategic Thinking
INSTRUCTIONAL STRATEGIES	Nonlinguistic representations

Sample Assessments

Assessment #1:
Electronic Structure Exit Card

Write the full electronic configuration for arsenic. State the number of valence electrons, and give an acceptable set of four quantum numbers for the last electron in this element.

Answer: *$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^3$, 5 valence electrons, 4, 1, -1, +1/2*

Assessment's Alignment	
CLE	ME1F, Concept B
CONTENT	SC1
PROCESS	1.10 Apply information, ideas and skills
DOK	2 – Skill/Concept
LEVEL OF EXPECTATION	Mastery Level - 80 %

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills		Enrichment Opportunity	
Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities

Learning Activity #2: (See Appendix R)
Atomic Trends Activity

In this activity, students are given an abbreviated periodic table along with coded elements. Then students are given elementary physical property data of the coded elements and build their own periodic table with the clues given. Additional data is given to the students which can be used to refine their constructed periodic table. Finally, students write a report to justify the placement of the elements on their constructed periodic table.

Activity's Alignment	
CLE	ME1F
CONTENT	SC1
PROCESS	1.6 Discover / evaluate relationships
DOK	4 – Extended Thinking
INSTRUCTIONAL STRATEGIES	Similarities and Differences

Sample Assessments

Assessment #2:
Periodic Trends exit card

Suppose an element is discovered that has 120 protons. Based on your knowledge of the periodic table, predict the following:

(a) Would the element be a metal or non-metal?
(b) How many valence electrons would the element have?
(c) Suppose the element were given the symbol X. What would be the formula of the compound that results when X is reacted with chlorine?
(d) Would the element likely be a solid, liquid or gas at room temperature?

Answers:
(a) metal
(b) 2
(c) XCl_2
(d) solid

Assessment's Alignment	
CLE	ME1F
CONTENT	SC1
PROCESS	1.6 Discover / evaluate relationships

	DOK	3 – Strategic Thinking
	LEVEL OF EXPECTATION	Mastery Level - 75 %

NOTE: These sections will be partially completed during the curriculum writing process and finalized during the year one review process.

Student Resources	Teacher Resources
General: ● **World of Chemistry, Zumdahl, 2006** **Enrichment:** ● **www.acs.org (chematters magazine)** ● **NOVA: Dimming the Sun** ● **http://acswebcontent.acs.org/games/pt.html** ● **http://www.shodor.org/chemviz/ionization/students/background.html** **Intervention:** ● **http://www.chemtutor.com/** ● **www.cramster.com** ● **http://www.chemmybear.com/stdycrds.html#GenChem**	**General:** ● **Flinn ChemTopic Lab, Volume 4** ● **Flinn ChemTopics Labs, Volume 3** ● **http://jchemed.chem.wisc.edu/** ● **World of Chemistry, Zumdahl, 2006** **Enrichment:** **Intervention:**

Content Area: Science	Course: Chemistry Honors	Unit: Chemical Bonding

Learner Objectives:

- Atoms gain, lose, or share electrons to achieve chemical stability.
- Changes in properties and states of matter provide evidence of the atomic theory of matter ME1

Concepts:

A. Chemical bonding is the combining of different pure substances (elements, compounds) to form new substances with different properties. (ME1H)
B. Ionic bonds are formed when electrons are transferred; covalent bonds are formed when electrons are shared.
C. The arrangement of electrons around the central atom determines the molecular geometry of a molecule, and affects its polarity.
D. The Lewis dot diagram determines the arrangement of electrons around the central atom.
E. Covalent bonds can be polar (unequal sharing of electrons) or nonpolar (equal sharing of electrons) based upon differences in electronegativity.

Students Should Know	Students Should Be Able to
• Atoms with 3 or fewer valence electrons are likely to form ionic bonds • Atoms with 4 or more valence electrons are likely to form covalent bonds or accept electrons from those with 3 or fewer valence electrons • Ionic bonds result in a transfer of electrons and an electrostatic attraction • Covalent bonds result in the sharing of electrons • Lewis structures are useful in determining bonding and molecular shape in conjunction with the Valence Shell Electron Pair Repulsion Theory. • Polar bonds occur between atoms with different electronegativities • In general, a metal + nonmetal results in an ionic bond • In general, two nonmetals result in a covalent bond • Molecule polarity is caused by both bond polarity and asymmetry of the molecule. • Resonance can be used to explain the discrepancies between the Lewis diagram and actual behavior of the molecule. • Some molecules violate the octet rule, such as Be, B, species with an odd number of electrons, and molecules that exhibit an expanded octet	• Determine simple molecular shapes using the Valence Shell Electron Repulsion Theory (C) • Compare and contrast the types of chemical bonds (i.e., ionic, covalent) (ME1Hc) • Use VSEPR along with bond polarity to determine the polarity of a molecule (C) • Draw the Lewis diagram for any molecule, including those that violate the octet rule (D) • Determine bond polarity using the Pauling scale (E)

Instructional Support

Student Essential Vocabulary					
Single Covalent Bond	Double Covalent Bond	Triple Covalent Bond	Ionic Bond	Ionic Crystal	Octet Rule
Tetrahedral	Trigonal Pyramidal	Trigonal Planar	Linear	Bent	Lewis diagram
Resonance	Lone Electron Pair	VSEPR	Bond Angle	Bond Polarity	Molecule Polarity
Pauling Scale	Expanded Octet	Asymmetry	Symmetry	Electron Pairs	

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills		Enrichment Opportunity	
Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills	SLA	Gender, Ethnic, & Disability Equity	

Sample Learning Activities

Learning Activity #1:
Molecular Models: (See Appendix S)

Students draw the Lewis dot diagram for a variety of molecules. Students then build the molecules with their molecular model kits, and draw and describe the 3-dimensional shape that results.

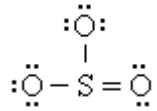
Activity's Alignment	
CLE	Concepts C, D
CONTENT	SC1
PROCESS	1.6 Discover/ evaluate relationships
DOK	3 – Strategic Thinking
INSTRUCTIONAL STRATEGIES	Similarities and differences

Sample Assessments

Assessment #1:
VSEPR Exit Card

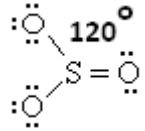
For the molecule SO_3, do the following:

(a) Draw the Lewis dot diagram
(b) State the name of the shape of the molecule
(c) Draw the molecule, including angles



(a)

(b) trigonal planar



(c)

Assessment's Alignment	
CLE	Concepts C, D
CONTENT	SC1
PROCESS	1.10 Apply information, ideas and skills

	DOK	2 – Skills/Concept
	LEVEL OF EXPECTATION	Mastery Level - 80 %

NOTE: These sections will be partially completed during the curriculum writing process and finalized during the year one review process.

Student Resources	Teacher Resources
General: ● **World of Chemistry, Zumdahl, 2006** **Enrichment:** ● **www.acs.org (chematters magazine)** **Intervention:** ● **http://www.chemtutor.com/** ● **www.yahooanswers.com** ● **www.cramster.com** ● **http://www.chemmybear.com/stdycrds.html#GenChem**	**General:** ● **Flinn ChemTopics Labs, Volume 5** ● **http://jchemed.chem.wisc.edu/** ● **World of Chemistry, Zumdahl, 2006** **Enrichment:** **Intervention:**

Content Area: Science	Course: Chemistry Honors	Unit: Aqueous Solutions

Learner Objectives:

- Aqueous solutions are ubiquitous in chemistry and biology.
- The type of solute particle affects the properties of the solution.
- Concentration can be expressed in a variety of ways.
- Changes in properties and states of matter provide evidence of the atomic theory of matter (ME1)

Concepts:

A. The nature of the solute particle affects the solubility of the particle as well as the physical properties of the solution.
B. Concentration is expressed as a ratio of solute to solvent.
C. Properties of mixtures depend upon the concentrations, properties, and interactions of particles. (ME1B)

Students Should Know	Students Should Be Able to
• Polar solvents dissolve polar solutes; non-polar solvents dissolve non-polar solutes • Changes in temperature, surface area, particle size and agitation can affect the rate of solubility • Solutions can be described according to the following terms: dilute, concentrated, saturated, unsaturated and supersaturated. • A solubility curve shows the relationship between temperature and solubility • Stoichiometry can be used for aqueous solutions • Solubility is affected by temperature only. • Differences in polarity can be used to separate mixtures. • Beer's law relates Absorbance, path length, molar absorbtivity and molarity of a solution • Molarity is a term used to specify concentration of a solution • Water is an important solvent in the environment as it relates to acid rain and water pollution (ES1Ba)	• Classify solutions as either dilute or concentrated; as either saturated, unsaturated, or supersaturated (ME1Ba) • Predict the effects of solvent and solute polarity on solubility ("like dissolves like"); and predict the effects of temperature, surface area, particle size, and agitation on rates of solubility (ME1Bc) • Calculate molarity of a solution (B) • Perform paper chromatography and calculate Rf values for resultant color bands (ME1B) • Determine the appropriate tools and techniques to collect, analyze, and interpret data IN1Bc • Evaluate a given source for its scientific credibility (e.g., articles in a new periodical quoting an "eye witness," a scientist speaking within or outside his/her area of expertise) ST3Da • Use molarity to do stoichiometric calculations (B) • Make a solution of a pre-determined molarity (B) • Use a spectrophotometer to make a graph of Absorbance vs. Molarity to determine the concentration of an unknown solution (A)

Instructional Support

Student Essential Vocabulary					
Solution	Dilute	Concentrated	Saturated	Unsaturated	Supersaturated
Solute	Solvent	Solubility	“Like dissolves like”	Solubility curve	Molarity
R_f	Rate of Solubility	Absorbance	Beer’s Law	Transmittance	Molar Absorbtivity
Spectrophotometer	Cuvette	Path Length	Chromatography	Mobile Phase	Stationary Phase
Titration	Indicator	End point	Standard solution	Titrant	

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills	SLA	Enrichment Opportunity	
Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities

Learning Activity #1: (See Appendix T)
Vitamin C Lab

In this laboratory, students prepare a standard vitamin C solution, and titrate with a dilute Lugol's iodine solution with starch as an indicator. Students then titrate various common beverages (orange juice, apple juice, etc…) to determine the concentration of vitamin C in these beverages.

Activity's Alignment	
CLE	Concept B
CONTENT	SC1
PROCESS	1.10 Apply information, ideas and skills
DOK	3 – Strategic Thinking
INSTRUCTIONAL STRATEGIES	Generating and testing hypotheses

Sample Assessments

Assessment #1:
Concentration Exit Card

What volume in mL of a 0.25 M Na_2SO_4 solution is needed to precipitate all the barium as $BaSO_4$ (s) from 12.5 mL of 0.15 M $Ba(NO_3)_2$ solution:

$Ba(NO_3)_2$ (aq) + Na_2SO_4 (aq) → $BaSO_4$ (s) + 2$NaNO_3$ (aq)

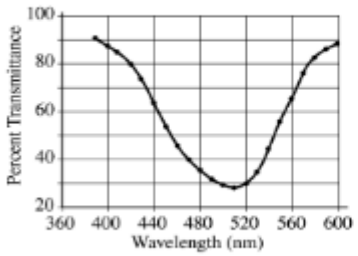
Answer: 7.5 mL

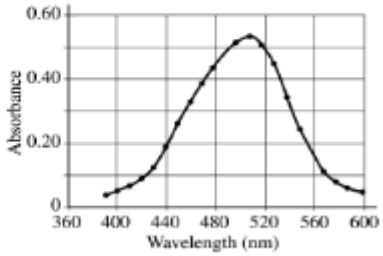
Assessment's Alignment	
CLE	Concept B
CONTENT	SC1
PROCESS	1.10 Apply information, ideas and skills 3.5 Reason logically inductive/deductive
DOK	3 – Strategic Thinking
LEVEL OF EXPECTATION	Mastery Level – 80%

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA =** Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills		Enrichment Opportunity	
Information, Media, & Technology Skills	SLA	Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

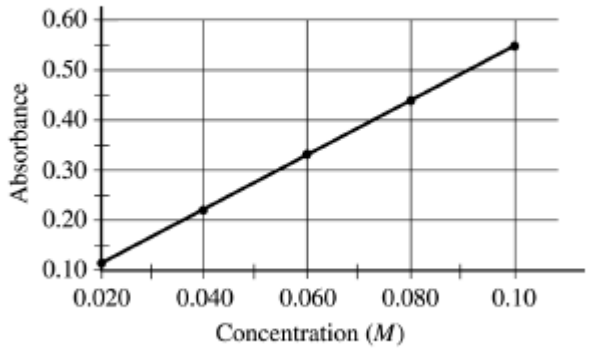
Sample Learning Activities	Sample Assessments
Learning Activity #2: (See Appendix U) **Beer's Law Lab** In this experiment, students prepare several solutions of varying molarity of cobalt using a serial dilution technique. The spectrophotometer is then used to measure the absorbance of each solution, and Excel is used to make a graph of the effect of molarity on absorbance (Beer's Law). The students then test a solution of unknown molarity and determine its absorbance. Using their constructed graph and interpolation, students determine the molarity of the unknown solution.	**Assessment #2:** **Molarity by Absorbance Exit Card** 1) A solution of cobalt is analyzed using a spectrophotometer. Graphs of %Transmittance vs Wavelength, and Absorbance vs Wavelength were obtained as shown below. Identify the optimal wavelength for analysis. Justify your answer.

Activity's Alignment	
CLE	Concepts B, C
CONTENT	SC1
PROCESS	1.6 Discover/evaluate relationships
DOK	3 – Strategic Thinking
INSTRUCTIONAL STRATEGIES	Generating and testing hypotheses





2) A graph of absorbance vs molarity for various cobalt solutions was constructed as shown below. An unknown cobalt solution was tested, and had an absorbance of 0.40. What was the molarity of the cobalt solution? Justify your answer.



Answers:

1) 510 nm. At this wavelength, cobalt shows maximum absorbance.

2) Approximately 0.72 M obtained by interpolating from the graph.

Assessment's Alignment	
CLE	Concepts B, C
CONTENT	SC1
PROCESS	1.10 Apply information, ideas and skills
DOK	3 – Strategic Thining

	LEVEL OF EXPECTATION: Mastery Level - 80 %

NOTE: These sections will be partially completed during the curriculum writing process and finalized during the year one review process.

Student Resources	Teacher Resources
General: ● **World of Chemistry, Zumdahl, 2006** **Enrichment:** ● **www.acs.org (chematters magazine)** **Intervention:** ● **http://www.chemtutor.com/** ● **www.yahooanswers.com** ● **www.cramster.com** ● **http://www.chemmybear.com/stdycrds.html#GenChem**	**General:** ● **Flinn ChemTopics Labs, Volume 12** ● **http://jchemed.chem.wisc.edu/** ● **World of Chemistry, Zumdahl, 2006** **Enrichment:** **Intervention:**

Content Area: Science	Course: Chemistry Honors	Unit: Acids and Bases

Learner Objectives:

- There are a variety of ways of classifying acids and bases
- Acids and bases are omnipresent in chemistry, biology and earth science.
- The pH scale is a way of commonly quantifying the acidity of a solution.

Concepts:

A. Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations. IN1B
B. Acids increase the concentration of H^+ ions in a solution, whereas bases increase the OH^- concentration.
C. Acids and bases vary in strength and concentration which is reflected in their percent ionization and pH.
D. There are several ways to classify acids and bases.
E. People of different gender and ethnicity have contributed to scientific discoveries and the invention of technological innovations (ST2A)
F. Scientific information is presented through a number of credible sources, but is at times influenced in such a way to become non-credible (ST3D)
G. Properties of mixtures depend upon the concentrations, properties, and interactions of particles ((ME1B)

Students Should Know	Students Should Be Able to
• Acids have a pH <7, bases have a pH >7 and a pH of 7 is considered neutral • Contributions to science are not limited to the work of one particular group, but are made by a diverse group of scientists representing various ethnic and gender groups ST2Aa • Acids and bases can be classified by one of three methods: Arrhenius, Bronsted-Lowry and Lewis. • Water self ionizes to produce $[H^+] = [OH^-] = 1.0 \times 10^{-7}$ M at 25 °C. • In aqueous solutions $[H^+] \times [OH^-] = 1.00 \times 10^{-14}$ at 25 °C • Phenolphthalein is a commonly used acid-base indicator which is colorless in acidic solutions and pink in basic solutions	• Compare and contrast the properties of acidic, basic, and neutral solutions (ME1Bb) • Calculate pH, pOH and concentration from the equation: pH = -log [H+] (C) • Determine the concentration of an unknown acid or base by titration (A) • Explain why accurate record-keeping, openness, and replication are essential for maintaining an investigator's credibility with other scientists and society ST3Db • Classify acids and bases as Arrhenius, Bronsted-Lowry or Lewis. (D) • Perform an acid-base titration using phenolphthalein as an indicator (A)

• There are seven strong acids and many weak acids. • Group I and Group II metal hydroxides are strong bases. • When a weak acid ionizes, the resulting anion is known as the conjugate base • When a weak base hydrolyzes, the resulting compound is known as the conjugate acid of that base	

Instructional Support

Student Essential Vocabulary					
Acid	Base	Arrhenius	Bronsted-Lowry	Lewis	pH
pOH	Hydronium	Hydrolyze	Monoprotic	Diprotic	Triprotic
Protonate	Phenolphthalein	Buret	Neutral solution	K_w	Conjugate acid
Conjugate base	Strong acid	Weak acid	Metal hydroxide	Auto ionization	Litmus
Logarithm	Antilog				

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills		Enrichment Opportunity	SLA
Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities

Learning Activity #1: (See Appendix V) **Ans Key or Scoring Guide??**
Percent Acetic Acid in Vinegar Lab

In this laboratory, students standardized a solution of approximately 0.1 M NaOH with KHP. The students then use this standardized solution of NaOH to titrate 10.00 mL of commercial vinegar to determine the percent by mass of acetic acid in vinegar. Phenolphthalein is used as an indicator.

Activity's Alignment	
CLE	IN1B, Concept A
CONTENT	SC1
PROCESS	1.10 Apply information, ideas and skills 3.5 – Reason logically 9inductive/deductive)
DOK	3 – Strategic Thinking
INSTRUCTIONAL STRATEGIES	Cooperative learning

Sample Assessments

Assessment #1:
pH exit card

What volume of 0.500 M NaOH solution is needed to neutralize 45.0 mL of 0.400 M HCl? What was the pH of the HCl solution before the titration?

Answer: 36.0 mL**,** 0.398

Assessment's Alignment	
CLE	Concepts A, C
CONTENT	SC1
PROCESS	1.10 Apply information, ideas and skills
DOK	3 – Strategic Thinking
LEVEL OF EXPECTATION	Mastery Level - 75 %

Readiness & Equity Section			
SLA = Sample Learning Activities & **SA** = Sample Assessments			
21st Century Themes		Non Fiction Reading & Writing	
Learning & Innovation Skills	SLA	Enrichment Opportunity	
Information, Media, & Technology Skills		Intervention Opportunity	
Life & Career Skills		Gender, Ethnic, & Disability Equity	

Sample Learning Activities

Learning Activity #2: (See Appendix W)
Molar Mass of an Unknown Acid Lab

In this experiment, students are given a sample of a solid, monoprotic acid. Students must perform a titration of the student's design to determine the molar mass of the unknown acid.

Of the concepts you added, what concept will this activity go with? B and / or C???

Activity's Alignment	
CLE	IN1B
CONTENT	SC1
PROCESS	1.10 Apply information, ideas and skills
DOK	4 – Extended Thinking
INSTRUCTIONAL STRATEGIES	Generating and testing hypotheses

Sample Assessments

Assessment #2:
Molar Mass of an Unknown Acid

When an unknown, monoprotic acid is titrated with a standard solution of sodium hydroxide, the following data is obtained. Use this data to determine the molar mass of the unknown acid.

Initial buret reading	**2.4 mL**
Final buret reading	**13.6 mL**
Empty Erlenmeyer Flask	**125.662 g**
Erlenmeyer Flask + acid	**125.887 g**
Molarity of NaOH	**0.114 M**

Answer: 176 g/mol

Assessment's Alignment	
CLE	Concepts B, C
CONTENT	SC1
PROCESS	1.10 Apply information, ideas and skills
DOK	3 – Strategic Thinking

	LEVEL OF EXPECTATION: Mastery Level - 80 %

NOTE: These sections will be partially completed during the curriculum writing process and finalized during the year one review process.

Student Resources	Teacher Resources
General: ● **World of Chemistry, Zumdahl, 2006** **Enrichment:** ● **www.acs.org (chematters magazine)** ● **http://nsdl.org/resource/2200/20061003161305200T** **Intervention:** ● **http://www.chemtutor.com/** ● **www.yahooanswers.com** ● **www.cramster.com** ● **http://www.chemmybear.com/stdycrds.html#GenChem**	**General:** ● **Flinn ChemTopics Labs, Volume 13** ● **http://jchemed.chem.wisc.edu/** ● **World of Chemistry, Zumdahl, 2006** **Enrichment:** **Intervention:**

Appendix
Learning Activities and Assessments

A	Density of a Regular-Shaped Object Lab
B	Percent Sugar in Beverages Lab
C	Electron Probability Activity
D	Electron Probability Scoring Guide
E	Carbon-14 Dating Activity
F	Grocery Store Chemistry
G	Formula of a Hydrate Lab
H	Formula of a Chloride Lab
I	Solubility Rules Lab
J	Activity Series of Metals
K	Synthesis of Sodium Chloride w/ Scoring Guide
L	Copper (II) Chloride and Iron Lab w/ Scoring Guide
M	Heat Capacity of Metal
N	Heat of Combustion of Candle Wax
O	Air Bag Lab
P	Molar Mass of Butane Lab
Q	Periodic Table Activity
R	Atomic Trends Activity
S	Molecular Models
T	Vitamin C Lab
U	Beer's Law Lab
V	Percent Acetic Acid in Vinegar Lab
W	Molar Mass of an Unknown Acid Lab