Radnor High School
Course Overview

Advanced Chemistry 2 (College Prep)
Course #362

General Information

Credits: 1.0
Weighted: N/A
Pre-requisite: Advanced Chemistry and Algebra II — Length: Full Year
Co-requisite: None — Format: Meets Daily

Course Description

This course is an opportunity for students to continue learning chemistry in depth through a second year course. Topics will include a review from Chemistry I with additional new content, such as, but not limited to: solutions, acids and bases, equilibrium, thermo-dynamics, kinetics, redox, biochemistry, organic chemistry, and environmental chemistry along with a laboratory component. Emphasis will be placed on real world applications of chemistry. Students interested in this course may consider majoring in Biological or Chemical Sciences, Medicine, or Nursing and would benefit from a second year Chemistry course.

Materials & Texts

Essential:

Chemistry: Principles and Reactions
by William L. Masterton and Cecile N. Hurley (Brooks/Cole, 2009)

Additional:

Scientific calculator
Laboratory notebook

Assessment & Grading

Student grade is based on homework, lab reports, quizzes and tests. Homework is assigned daily along with weekly lab reports. The midterm and final exam are cumulative assessments that each comprises 10% of the course grade. The Radnor High School grading system and scale will be used to determine letter grades.

Common Core Standards

Key Ideas and Details

1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks attending to special cases or exceptions defined in the text.

Craft and Structure

4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 9–10 texts and topics*.
5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*).
6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

Integration of Knowledge and Ideas

7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

Range of Reading and Level of Text Complexity

10. By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

Text Types and Purposes

1. Write arguments focused on *discipline-specific content.*
    a. Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence.
    b. Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns.
    c. Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
    d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
    e. Provide a concluding statement or section that follows from or supports the argument presented.

2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
    a. Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
    b. Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
    c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts.
    d. Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.
    e. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
    f. Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).

Production and Distribution of Writing

4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
5. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

MARKING PERIOD ONE

- ***Chapter 1: Matter, Change, Measurements, and Chemistry Review***
- ***Chapter 2: Chemical Names and Formulas***
- ***Chapter 2: Periodic Table and Atomic Structure***
- ***Chapter 6: Electrons in Atoms (Quantum Theory)***
- ***Chapter 6: Chemical Periodicity***

Keystone Connections:

CHEM.A.1.1 Identify and describe how observable and measurable properties can be used to classify and describe matter and energy.

- **CHEM.A.1.1.1** Classify physical or chemical changes within a system in terms of matter and/or energy.
- **CHEM.A.1.1.2** Classify observations as qualitative and/or quantitative.
- **CHEM.A.1.1.3** Utilize significant figures to communicate the uncertainty in a quantitative observation.

CHEM.A.1.2 Compare the properties of mixtures.

- **CHEM.A.1.2.2** Differentiate between homogeneous and heterogeneous mixtures (e.g., how such mixtures can be separated).

CHEM.A.2.1 Explain how atomic theory serves as the basis for the study of matter.

- **CHEM.A.2.1.1** Describe the evolution of atomic theory leading to the current model of the atom based on the works of Dalton, Thomson, Rutherford, and Bohr.
- **CHEM.A.2.1.2** Differentiate between the mass number of an isotope and the average atomic mass of an element.

CHEM.A.1.1 Identify and describe how observable and measurable properties can be used to classify and describe matter and energy.

- **CHEM.A.1.1.5** Apply a systematic set of rules (IUPAC) for naming compounds and writing chemical formulas (e.g., binary covalent, binary ionic, ionic compounds containing polyatomic ions).
- **CHEM.A.1.1.4** Relate the physical properties of matter to its atomic or molecular structure.

CHEM.A.1.2 Compare the properties of mixtures.

- **CHEM.A.1.2.1** Compare properties of solutions containing ionic or molecular solutes (e.g., dissolving, dissociating).
- **CHEM.A.1.2.3** Describe how factors (e.g., temperature, concentration, surface area) can affect solubility.
- **CHEM.A.1.2.5** Describe how chemical bonding can affect whether a substance dissolves in a given liquid.

CHEM.A.2.1 Explain how atomic theory serves as the basis for the study of matter.

- **CHEM.A.2.1.1** Describe the evolution of atomic theory leading to the current model of the atom based on the works of Dalton, Thomson, Rutherford, and Bohr.

CHEM.A.2.2 Describe the behavior of electrons in atoms.

- **CHEM.A.2.2.1** Predict the ground state electronic configuration and/or orbital diagram for a given atom or ion.
- **CHEM.A.2.2.2** Predict characteristics of an atom or an ion based on its location on the periodic table (e.g., number of valence electrons, potential types of bonds, reactivity).
- **CHEM.A.2.2.3** Explain the relationship between the electron configuration and the atomic structure of a given atom or ion (e.g., energy levels and/or orbitals with electrons, distribution of electrons in orbitals, shapes of orbitals).
- **CHEM.A.2.2.4** Relate the existence of quantized energy levels to atomic emission spectra.

CHEM.A.2.3 Explain how periodic trends in the properties of atoms allow for the prediction of physical and chemical properties.

- **CHEM.A.2.3.1** Explain how the periodicity of chemical properties led to the arrangement of elements on the periodic table.
- **CHEM.A.2.3.2** Compare and/or predict the properties (e.g., electron affinity, ionization energy, chemical reactivity, electronegativity, atomic radius) of selected elements by using their locations on the periodic table and known trends.

Pennsylvania Standards, Anchors, and Eligible Content

3.2.C.A1.

- Differentiate between physical properties and chemical properties.
- Differentiate between pure substances and mixtures; differentiate between heterogeneous and homogeneous mixtures.
- Explain the relationship of an element's position on the periodic table to its atomic number, ionization energy, electronegativity, atomic size, and classification of elements.
- Use electronegativity to explain the difference between polar and nonpolar covalent bonds.

3.2.C.A2.

- Compare the electron configurations for the first twenty elements of the periodic table.
- Relate the position of an element on the periodic table to its electron configuration and compare its reactivity to the reactivity of other elements in the table.
- Explain how atoms combine to form compounds through both ionic and covalent bonding.
- Predict chemical formulas based on the number of valence electrons.
- Draw Lewis dot structures for simple molecules and ionic compounds.
- Predict the chemical formulas for simple ionic and molecular compounds

3.2.C.A4.

- Predict how combinations of substances can result in physical and/or chemical changes.
- Interpret and apply the laws of conservation of mass, constant composition (definite proportions), and multiple proportions.

3.2.C.A5.
MODELS

- Recognize discoveries from Dalton (atomic theory), Thomson (the electron), Rutherford (the nucleus), and Bohr (planetary model of atom), and understand how each discovery leads to modern theory.
- Describe Rutherford's "gold foil" experiment that led to the discovery of the nuclear atom. Identify the major components (protons, neutrons, and electrons) of the nuclear atom and explain how they interact.

ANCHORS

- **S11.C.1.1** Explain the relationship between the structure and properties of matter.
- **S11.C.2.1** Analyze energy sources and transfer of energy, or conversion of energy.

ELIGIBLE CONTENT

- **S11.C.1.1.1** Explain that matter is made of particles called atoms and that atoms are composed of even smaller particles (e.g., protons, neutrons, electrons).
- **S11.C.1.1.2** Explain the relationship between the physical properties of a substance and its molecular or atomic structure.
- **S11.C.1.1.4** Explain how the relationships of chemical properties of elements are represented in the repeating patterns within the periodic table.
- **S11.C.2.1.1** Compare or analyze waves in the electromagnetic spectrum (e.g., ultraviolet, infrared, visible light, Xrays, microwaves) as well as their properties, energy levels, and motion.

Student Objectives:

At the conclusion of this quarter, students should be able successfully to complete the following:

Chapter 1: Matter, Change, and Chemistry Review

- Identify element symbols and names
  - new elements discovered
  - uses of elements
- Describe uses and properties of the most commonly used elements
- Differentiate between an element and a compound
- Identify, differentiate, and give examples of the four states of matter
- Using knowledge of a balanced chemical reaction and stoichiometry, develop a logical argument that matter cannot be created nor destroyed
- Apply the Law of Conservation of Mass

- State and identify the properties of and differences among mixtures (heterogeneous and homogeneous mixtures)
- Differentiate between mixtures vs. substances
- Differentiate among solutions, colloids, suspensions
- Identify, classify, compare and contrast properties and changes of various elements and compounds with examples
- Convert numbers between standard and scientific notation
- Evaluate the number of significant figures in a value or a calculation
- Compute quantities using the appropriate number of significant figures
- Explain the reasoning for the number of significant figures used
- Show, through examples, when, why and how significant figures are used to calculate percent error
- Categorize a measurement/value as to its accuracy and/or precision
- Calculate density
- Convert metric units of length, volume, and mass
- Convert to and from various scales of temperature
- Construct a way to perform calculations using dimensional analysis

Chapter 2: Chemical Names and Formulas

- Write chemical formulas and names for metal vs. non-metal binary compounds.
- Recognize and use prefixes.
- Write chemical formulas and names for ternary compounds.
- Write chemical formulas and names for acid compounds.
- Write chemical formulas and names for hydrate compounds.
- Identify whether a given element forms a cation or anion.
- Use both the stock and older naming system for variable charged cations.
- Show cations and anions correctly written in chemical formulas.
- Create chemical formulas from names using correctly written elements and ions.
- Create names from chemical formulas using correctly written elements and ions.
- Identify and list the diatomic elements (N_2, O_2, F_2, Cl_2, Br_2, I_2, and H_2).

Chapters 2: Periodic Table and Atomic Structure

- On the periodic table, identify and label the alkali metals, the alkaline earth elements, the halogens, the noble gases, lanthanides and actinides (rare earth elements), and transuranium elements; groups and families vs. periods
- On the periodic table, identify and label the section and elements that are metals, nonmetals, and metalloids; solid, liquid, and gas
- Compare and contrast the differences between metals, nonmetals, and metalloids
- Identify the differences between atoms, compounds, and molecules
- List and critique Dalton's Atomic Theory Postulates
- Explain the atomic theory in terms of the discovery of the parts of the atom (Thomson, Millikan, Rutherford, Chadwick)

- Compare and contrast the five models of the atom (Democritus' model, Thomson's plum pudding model, Rutherford's model, Bohr's Model, Modern Quantum Mechanical Model)
- Compare and contrast laws of definite and multiple proportions
- Given relative abundances of its isotopes, calculate the average atomic mass of an element

Chapter 6: Electrons in Atoms (Quantum Theory)

- Compare and contrast the various parts of the electromagnetic spectrum
- Calculate wavelength, frequency or energy with the Energy-frequency relationship equation
- Critique the flaws in the original physical theories (Blackbody radiation, Bohr's model)
- Calculate the Bohr mathematical equation
- Explain the theories of Max Planck and Albert Einstein (photoelectric effect)
- Make historical connections between the physical and the quantum worlds
- Explain the Quantum Theories
    - Bohr's Atomic Model and calculations
    - Louis de Broglie - wave-particle duality
    - Werner Heisenberg - Heisenberg's Uncertainty Principle
    - Erwin Schrödinger - Schrödinger's Quantum Wave Equation
- Use the knowledge of the placement of the element on the periodic table and the electron configuration to understand the quantum number values
- Predict the various electron configurations for a number of elements
    - Aufbau Principle
    - Friedrich Hund – Hund's Rule
    - Wolfgang Pauli - Pauli exclusion principle
- Distinguish and predict the exceptions to the usual electron configuration
- Relate ground vs. excited states to electron configurations and orbitals
- Assess the differences between cations and anions using electron configuration
- Relate the quantum numbers and the electron configuration and notation

Chapter 6: Chemical Periodicity

- Appraise the various patterns to explain the periodicity and order of the periodic table.
- Identify the patterns developed by John Newlands (Law of Octaves), Johann Dobereiner (triads), Stanislao Cannizzaro (standardized atomic masses), Julius Lothar Meyer (Periodic Table), Dmitri Mendeleev (Periodic Table), Henry Moseley (Modern Periodic Law)
- Identify, apply, interpret graphs of and explain patterns from the periodic table.
- Identify properties and describe trends of metals and nonmetals using the periodic table.
- Interpret group trends in atomic radii, ionic radii, ionization energies, and electronegativities.
- Interpret period trends in atomic radii, ionic radii, ionization energies, and

electronegativities.
- Identify properties and describe trends of all the element groups using the periodic table.

Activities, Assignments, & Assessments

Common Core Labs

- Chromatography Lab
- Density Lab
- Chemical Changes Lab
- Periodic Trends Lab
- Identification of Chemical Substances Lab

Assignments

- Approximately 2-4 hours of independent work per week.
- Associated chapter exercises and worksheets.

Assessments

- Chapter tests and quizzes
- Lab reports

Terminology

Essential:

- Element symbols, Element names, Element, Compound, States of matter (solid, liquid, gas, plasma), Law of Conservation of Mass, Mixture (heterogeneous, homogeneous), Substance, Solution, Colloids, Suspensions, Physical properties, Chemical properties, Physical changes, Chemical changes, Scientific notation, Significant figures, Percent error, Accuracy, Precision, Density, Metric system, Units of temperature, Dimensional analysis, Ion, Cation, Anion, Polyatomic ion, Variable Charge, IUPAC Name, Diatomic element, Chemical formula, Molecule, Compound, Salt, Oxidation Numbers, Atom, Molecule, Groups or families, Alkali, Alkaline earth, Halogens, Noble gases, Period, Lanthanides, Actinides, Metals, Nonmetals, Metalloids, Diatomic Elements, Electron, Proton, Neutron, JJ Thomson, Cathode ray tube, Robert Millikan, Oil Drop Experiment, Ernest Rutherford, Gold Foil Experiment, James Chadwick, Atomic Models (atomos, plum pudding, nuclear, orbit, cloud), Law of Definite and Law of Multiple Proportions, Dalton's Atomic Theory, Isotopes, Atomic mass, Average atomic mass, Atomic mass units (amu), mass number, Electromagnetic Spectrum, Energy, Frequency, Wavelength, Speed of light, Planck's constant, Photoelectric effect, Blackbody radiation, Niels Bohr, Ground and excited states, Louis de Broglie's wave-particle duality theory, Werner Heisenberg's Uncertainty Principle, Schrödinger's Quantum Wave Equation, Orbits vs. orbitals, Quantum theory, Quantum numbers, Electron configuration, Electron notation, Electron dot notation, Shorthand notation, Aufbau Principle, Hund's Rule, Pauli Exclusion Principle, Law of Octaves, Triads, Periodic Law, Modern Periodic Law, Atomic masses, Atomic Radius Trends, Ionic Radius Trends, Ionization Energy Trends,

Electronegativity Trends, Shielding Effect, Nuclear Charge Effect.

Media, Technology, Web Resources

Teacher developed PowerPoint presentations
Polyatomic Ion Chart
Electromagnetic Spectrum
Atomic Radius, Ionic Radius, Ionization Energy, and Electronegativity Trends Charts

The element song

a. http://www.youtube.com/watch?v=GFIvXVMbII0
b. http://www.youtube.com/watch?v=DYW50F42ss8

1. Power Point Presentation - Good overview of naming compounds
   http://www.chalkbored.com/lessons/chemistry-11/naming-ionic-covalent.ppt#286,1
2. Online lectures
   a. University of Houston, Professor Geanangel, Fundamentals of Chemistry; Chem 1331, lecture 4 (1/28/09)
   http://www.youtube.com/watch?v=J0il31Bgk9E
   b. University of Houston, Professor Geanangel, Fundamentals of Chemistry; Chem 1331, lecture 5 (9/5/08) http://www.youtube.com/watch?v=nGr3JBeympI
   c. University of Houston, Professor Geanangel, Fundamentals of Chemistry; Chem 1331, lecture 2 (1/23/09) http://www.youtube.com/watch?v=l2uNW1_0qpY
   University of Houston, Professor Geanangel, Fundamentals of Chemistry; Chem 1331, lecture 3 (1/27/10) http://www.youtube.com/watch?v=zpvekttvJYA
   d. University of Houston, Professor Geanangel, Fundamentals of Chemistry; Chem 1331, lecture 24 (3/23/09)
   Review Rutherford (time 6:56), Classic physics problem atom decay (time 8:33), new model (time 9:46), Electromagnetic spectrum – *good explanation* (time 10:45), Blackbody radiation – *good explanation* (time 23:40), Photoelectric effect – *good explanation* (time 35:00), Bohr and Hydrogen spectrum (time 48:13)
   http://www.youtube.com/watch?v=4sxJRlMDy4g&feature=PlayList&p=0A7E99956F33E97D&index=23
   e. University of Houston, Professor Geanangel, Fundamentals of Chemistry; Chem 1331, lecture 25 (3/25/09)
   Rydberg (time 1:32), Bohr – hydrogen atom and calculations (time 7:46), Wave particle duality (time 37:40)
   http://www.youtube.com/watch?v=tKf1artzP6g&feature=PlayList&p=0A7E99956F33E97D&index=24
   f. University of Houston, Professor Geanangel, Fundamentals of Chemistry; Chem 1331, lecture 26 (3/27/09)
   deBroglie (time 0:00), Heisenberg (time 5:17), Schrödinger (time 7:14), Quantum numbers and orbitals (time 16:00)
   http://www.youtube.com/watch?v=ne0dZqMk9Xk&feature=PlayList&p=0A7E99956F33E97D&index=25

g. University of Houston, Professor Geanangel, Fundamentals of Chemistry; Chem 1331, lecture 27 (4/1/09)
   Spin quantum number experiment (time 8:00), Paul exclusion principle and configuration (time 12:00), Lithium (time 18:14), Coulomb's law (time 21:22), configuration and notation examples (time 42:39), Hund's rule (time 52:00)
   http://www.youtube.com/watch?v=p-O2gOGIHbY&feature=PlayList&p=0A7E99956F33E97D&index=26
h. University of Houston, Professor Geanangel, Fundamentals of Chemistry; Chem 1331, lecture 28 (4/3/09)
   Group configuration (time 10:28), Period 4 (time 14:34), Chromium exception (time 19:18), Examples (time 29:50), inner and outer shell (time 30:30), Examples (time 34:54), ions configurations (time 46:20)
   http://www.youtube.com/watch?v=LmsLWYue8-c&feature=PlayList&p=0A7E99956F33E97D&index=27
i. University of Houston, Professor Geanangel, Fundamentals of Chemistry; Chem 1331, lecture 29 (4/6/09)
   Atomic radius (time 5:00), Ionization Energy (time 22:00), Electron affinity – skip (time 38:00)
   http://www.youtube.com/watch?v=uscYKFcLHXA&feature=PlayList&p=0A7E99956F33E97D&index=28
j. University of Houston, Professor Geanangel, Fundamentals of Chemistry; Chem 1331, lecture 30 (4/8/09)
   Ions (and charges) (time 5:00), paramagnetic and diamagnetic – skip (time 18:10), ionic size (36:00), electron dot diagrams – skip for now (time 48:25)
   http://www.youtube.com/watch?v=bQOL53iMJjk&feature=related

MARKING PERIOD TWO

- ***Chapter 7: Chemical Bonding***
- ***Chapter 4: Chemical Reactions***
- ***Chapter 3: Chemical Quantities and Stoichiometry***

Keystone Connections:

CHEM.B.1.3 Explain how atoms form chemical bonds.

- **CHEM.B.1.3.1** Explain how atoms combine to form compounds through ionic and covalent bonding.
- **CHEM.B.1.3.2** Classify a bond as being polar covalent, non-polar covalent, or ionic.
- **CHEM.B.1.3.3** Use illustrations to predict the polarity of a molecule.

CHEM.B.1.4 Explain how models can be used to represent bonding.

- **CHEM.B.1.4.1** Recognize and describe different types of models that can be used to illustrate the bonds that hold atoms together in a compound (e.g., computer models, ball-and-stick models, graphical models, solid-sphere models, structural formulas, skeletal formulas, Lewis dot structures).
- **CHEM.B.1.4.2** Utilize Lewis dot structures to predict the structure and bonding in simple compounds.

CHEM.A.1.2 Compare the properties of mixtures.

- **CHEM.A.1.2.4** Describe various ways that concentration can be expressed and calculated (e.g., molarity, percent by mass, percent by volume).

CHEM.B.1.1 Explain how the mole is a fundamental unit of chemistry.

- **CHEM.B.1.1.1** Apply the mole concept to representative particles (e.g., counting, determining mass of atoms, ions, molecules, and/or formula units).

CHEM.B.1.2 Apply the mole concept to the composition of matter.

- **CHEM.B.1.2.1** Determine the empirical and molecular formulas of compounds.
- **CHEM.B.1.2.2** Apply the law of definite proportions to the classification of elements and compounds as pure substances.
- **CHEM.B.1.2.3** Relate the percent composition and mass of each element present in a compound.

CHEM.B.2.1 Predict what happens during a chemical reaction.

- **CHEM.B.2.1.3** Classify reactions as synthesis, decomposition, single replacement, double replacement, or combustion.
- **CHEM.B.2.1.4** Predict products of simple chemical reactions (e.g., synthesis, decomposition, single replacement, double replacement, combustion).
- **CHEM.B.2.1.5** Balance chemical equations by applying the Law of Conservation of Matter.

CHEM.B.2.1 Predict what happens during a chemical reaction.

- **CHEM.B.2.1.1** Describe the roles of limiting and excess reactants in chemical reactions.
- **CHEM.B.2.1.2** Use stoichiometric relationships to calculate the amounts of reactants and products involved in a chemical reaction.

Pennsylvania Standards, Anchors, and Eligible Content

3.2.C.A1.

- Use electronegativity to explain the difference between polar and nonpolar covalent bonds.

3.2.C.A2.

- Explain how atoms combine to form compounds through both ionic and covalent bonding.
- Use the mole concept to determine number of particles and molar mass for elements and compounds.
- Determine percent compositions, empirical formulas, and molecular formulas.
- Predict chemical formulas based on the number of valence electrons.
- Draw Lewis dot structures for simple molecules and ionic compounds.
- Predict the chemical formulas for simple ionic and molecular compounds

3.2.C.A4.

- Balance chemical equations by applying the laws of conservation of mass.
- Classify chemical reactions as synthesis (combination), decomposition, single displacement (replacement), double displacement, and combustion.

ANCHORS

- **S11.C.1.1** Explain the relationship between the structure and properties of matter.
- **S11.C.2.1** Analyze energy sources and transfer of energy, or conversion of energy.

ELIGIBLE CONTENT

- **S11.C.1.1.3** Explain the formation of compounds (ionic and covalent) and their resulting properties using bonding theories.
- **S11.C.2.1.2** Describe energy changes in chemical reactions.

Student Objectives:

At the conclusion of this quarter, students should be able successfully to complete the following:

Chapter 7: Chemical Bonding

- Distinguish the three types of chemical bonding
  - Ionic bonding
  - Covalent bonding
  - Metallic bonding

- Describe the role of electron configuration in chemical bond formation.
- Describe the role of electronegativity in the types of chemical bonding
- Use the characteristics of ionic compounds to explain the electrical conductivity of ionic compounds when melted or in aqueous solution.
- Use the theory of metallic bonds to explain the physical properties of metals Lewis Structures
- Draw appropriate Lewis Structures
- Draw and explain resonance and resonance structures
- Give an example of a coordinate covalent bond
- Relate electron configuration to bonding structures
- Distinguish the exceptions to the octet rule - non-octet structures
- Describe and use the VSEPR Theory
- Distinguish among the various types of bonding (linear, trigonal planar, tetrahedral, trigonal pyramidal, bent, T-shaped, see-saw, trigonal bipyramidal, square pyramidal, square planar, octahedral)
- Draw various shapes of molecules in both two-dimensional and three-dimensional perspectives.
- Relate shapes of molecules to their bond angles.
- Create examples of molecules using both the proper geometric shape and angles.
- Recognize bond angles for the various types of bonding.
- Know how to decide the Electron Pair Geometry and differentiate from Molecular Geometry.
- Relate polarity to electronegativity and dipole moment
- Know the difference between Intra vs. Intermolecular forces
- Recognize the three intermolecular forces
    - Hydrogen bonds
    - London (or van der Waals) dispersion forces
    - Dipole-dipole interactions

Chapter 4: Chemical Reactions

- Write balanced chemical equations using appropriate symbols when given the names of the reactants and products.
- Identify the parts of a chemical equation: reactants, products, yields, coefficients, symbols for the states of matter.
- Identify a reaction as synthesis, decomposition, single replacement, double replacement, or combustion.
- Use the type of reaction to predict the products of that reaction according to the activity series and solubility rules.
- Write ionic and net ionic equations

Chapter 3: Chemical Quantities and Stoichiometry

- Calculate formula mass and percent composition
- Distinguish between empirical formulas and molecular formula

- Find empirical and molecular formulas from chemical analysis information
- Describe the Mole and Avogadro's number
- Perform Mole conversions – grams, moles, and Avogadro's number relationships
- Calculate the amount of reactants required or product formed.
- Interpret balanced chemical equations in terms of interacting moles and masses.
- Construct mole ratios from balanced chemical equations and apply these ratios.
- Solve mole to mole, mole to gram, gram to mole, and gram to gram problems.
- Calculate stoichiometric quantities from balanced equations.
- Identify and use the limiting reagent to calculate the maximum amount of product(s).
- Calculate theoretical, actual, and percent yield from a balanced chemical equation.

Activities, Assignments, & Assessments

Common Core Labs

Periodic Law Elements Solutions Lab
Single and Double Displacement Chemical Reactions Lab
Percent Composition and Empirical Formulas Lab
Stoichiometry Lab

Assignments

- Approximately 2-4 hours of independent work per week.
- Associated chapter exercises and worksheets.

Assessments

- Chapter tests and quizzes
- Lab reports
- Common Midterm Exam

Terminology

- Chemical Bonding, Ionic Bonding, Covalent Bonding, Metallic Bonding, Electron Configuration, Lewis Structures, Resonance Structures, Coordinate Covalent Bond, Octet Rule, Non-octet Rule, VSEPR Theory, Various shapes (Linear, Trigonal Planar,Tetrahedral, Pyramidal, Bent, T-shaped, See-saw, Trigonal bipyramidal, Square pyramidal, Square planar, Octahedral), Two- and Three-dimensional modeling, Bond angles, Electron Pair Geometry, Molecular Geometry, Polarity, Electronegativity (nonpolar covalent bonding, polar covalent bonding, ionic bonding), Dipole Moment, Intra- and Intermolecular Forces (Hydrogen Bonding, London Dispersion forces, Dipole-dipole interactions), Element symbols, Proper chemical formulas, Reactants, Products, Yields, Coefficients, Symbols for states of matter (gas, liquid, solid, precipitate, aqueous solution), Balanced Chemical Equation, Types of Balanced Chemical Equations (Synthesis, Decomposition, Single displacement, Double displacement, Combustion), Ionic and net ionic equations, Activity series, Solubility rules, Formula mass, Percent Composition, Empirical Formulas, Molecular Formulas, Moles and grams conversions, Avogadro's number, Stoichiometry, Mole ratio, Limiting Reactant, Percent Yield, Actual Yield, Theoretical Yield

Media, Technology, Web Resources

Teacher developed PowerPoint presentations
VSEPR Geometry Shapes Handout
Electronegativity Table Handout
Activity List for single displacement reactions
Solubility Rules for double displacement reactions

1. Mole Music
2. Online lectures
    a. University of Houston, Professor Geanangel, Fundamentals of Chemistry; Chem 1331, lecture 31 (4/13/09)
    Covalent bonds and Lewis structure examples (time 9:00-23:00)
    http://www.youtube.com/watch?v=ZYp1HucuLLE&feature=PlayList&p=0A7E99956F33E97D&index=30
    b. University of Houston, Professor Geanangel, Fundamentals of Chemistry; Chem 1331, lecture 32 (4/15/09)
    Polar bonds and electronegativity (time 11:30), metals (time 39:30)
    http://www.youtube.com/watch?v=jVzHGhWKwsc&feature=PlayList&p=0A7E99956F33E97D&index=31
    c. University of Houston, Professor Geanangel, Fundamentals of Chemistry; Chem 1331, lecture 33 (4/17/09)
    Lewis structures and resonance (time starts 4:40)
    http://www.youtube.com/watch?v=iGlDaeOeYII&feature=PlayList&p=0A7E99956F33E97D&index=32
    d. University of Houston, Professor Geanangel, Fundamentals of Chemistry; Chem 1331, lecture 34 (4/20/09)
    Resonance (time 1:00), formal charge – skip (time 11:10-32:30), Nonoctet (time 32:30)
    http://www.youtube.com/watch?v=VnFcqQ81RsU&feature=PlayList&p=0A7E99956F33E97D&index=33
    e. University of Houston, Professor Geanangel, Fundamentals of Chemistry; Chem 1331, lecture 35 (4/22/09)
    VSEPR Theory with good animations (time 7:55)
    http://www.youtube.com/watch?v=Npt6sbpNKtg&feature=PlayList&p=0A7E99956F33E97D&index=34
    f. University of Houston, Professor Geanangel, Fundamentals of Chemistry; Chem 1331, lecture 36 (4/24/09) VSEPR (time 5:45); Bond polarity and dipole moment (time 13:00); good videos of polarity (time 21:30 to 26:00); more examples (time 26:13); bond properties (time 30:13)
    http://www.youtube.com/watch?v=ypnfRl7tviY&feature=PlayList&p=0A7E99956F33E97D&index=35
    g. University of Houston, Professor Geanangel, Fundamentals of Chemistry; Chem

1331, lecture 37 (4/27/09)
Valence Bond Theory and Orbital Hybridization (time starts 3:43)
http://www.youtube.com/watch?v=zCipEOLtsns&feature=PlayList&p=0A7E99956F33E97D&index=36

h. University of Houston, Professor Geanangel, Fundamentals of Chemistry; Chem 1331, lecture 38 (4/29/09)
Not need hybridization (time 8:00); Valence Bond for Multiple Bonds (time 10:38); Molecular Orbital Model (time 41:20)
http://www.youtube.com/watch?v=w5rB7ZSRYs0&feature=PlayList&p=0A7E99956F33E97D&index=37

i. University of Houston, Professor Geanangel, Fundamentals of Chemistry; Chem 1331, lecture 8 (2/6/09)
Balancing video (time 5:00-6:30), Balancing equations (time 7:13-19:45)
http://www.youtube.com/watch?v=bg_98QqpDbk&feature=PlayList&p=0A7E99956F33E97D&index=7

j. University of Houston, Professor Geanangel, Fundamentals of Chemistry; Chem 1331, lecture 6 (2/2/09)
Grams, moles, Avogadro's number and calculations (time 10:40)
http://www.youtube.com/watch?v=N3gU2VmQuuw&feature=PlayList&p=0A7E99956F33E97D&index=5

k. University of Houston, Professor Geanangel, Fundamentals of Chemistry; Chem 1331, lecture 7 (2/4/09)
Mole calculations (time 2:47), mass percent composition (time 5:32), empirical formulas (time 16:00), molecular formula (time 27:00)

l. http://www.youtube.com/watch?v=-qorYDPm7cQ
University of Houston, Professor Geanangel, Fundamentals of Chemistry; Chem 1331, lecture 8 (2/6/09)
Stoichiometry calculations (time 19:45)
http://www.youtube.com/watch?v=bg_98QqpDbk&feature=PlayList&p=0A7E99956F33E97D&index=7

m. University of Houston, Professor Geanangel, Fundamentals of Chemistry; Chem 1331, lecture 9 (2/9/09)
Limiting reactant calculations (time 6:18), Percent yield (time 35:46)
http://www.youtube.com/watch?v=_kmsQ_SXTmw&feature=PlayList&p=0A7E99956F33E97D&index=8

MARKING PERIOD THREE

- ***Chapter 4: Reactions in Aqueous Solutions***
- ***Chapters 9 & 10 : Solutions***
- ***Chapters 4 and 13: Acids and Bases***

Keystone Connections:

CHEM.A.1.2 Compare the properties of mixtures.

- **CHEM.A.1.2.1** Compare properties of solutions containing ionic or molecular solutes (e.g., dissolving, dissociating).
- **CHEM.A.1.2.3** Describe how factors (e.g., temperature, concentration, surface area) can affect solubility.
- **CHEM.A.1.2.4** Describe various ways that concentration can be expressed and calculated (e.g., molarity, percent by mass, percent by volume).

Pennsylvania Standards, Anchors, and Eligible Content

STANDARDS

3.2.C.A3.

- Describe the three normal states of matter in terms of energy, particle motion, and phase transitions.

ANCHORS

- **S11.C.1.1** Explain the relationship between the structure and properties of matter.
- **S11.C.2.1** Analyze energy sources and transfer of energy, or conversion of energy.

ELIGIBLE CONTENT

- **S11.C.1.1.6** Describe factors that influence the frequency of collisions during chemical reactions that might affect the reaction rates (e.g., surface area, concentration, catalyst, temperature).
- **S11.C.2.1.2** Describe energy changes in chemical reactions.

Student Objectives:

At the conclusion of this quarter, students should be able successfully to complete the following:

Chapter 4: Reactions in Aqueous Solutions

Chapters 9 & 10 : Solutions

- Know the differences among unsaturated, saturated, and supersaturated solutions
- Explain the differences between a suspension, colloid, and a solution
- Perform calculations involving molarity
- Prepare solutions of a given molarity using dilution calculations
- Calculate parts per million (ppm) and parts per billion (ppb)
- Calculate volume percentage and mass percentage and understand the difference

- Calculate mole fraction
- Calculate molality and use it to understand colligative properties (freezing point depression, boiling point elevation)
- Calculate normality and understand its use.
- Calculate osmotic pressure and vapor pressure lowering
- Understand the factors of Henry's Law and how it affects solubility in the solution process

Chapters 4 and 13: Acids and Bases

- Use molarity in calculations of pH, pOH for acids and bases
- Explain the difference between an acid and a base and give examples
- Define and identify acids and bases
- Define the strengths of acids and bases in terms of pH and pOH.
- Define and explain the three most common acid/base theories (Arrhenius, Bronsted-Lowry, and Lewis)
- Write acid-base reactions and identify a neutralization reaction
- Write net ionic equations for acid-base reactions
- Explain and identify conjugate acids and conjugate bases
- Explain the difference between anhydrides and amphoteric materials
- Identify strong vs. weak acids and strong vs. weak bases

Activities, Assignments, & Assessments

Common Core Labs

Solubility Curves Lab
Antacids Lab
Titration Lab

Assignments

- Approximately 2-4 hours of independent work per week.
- Associated chapter exercises and worksheets.

Assessments

- Chapter tests and quizzes
- Lab reports

Terminology

Essential:

Solutions, unsaturated, saturated, supersaturated, colloids, suspensions, molarity, molality, mole fraction, normality, volume percent, mass percent, ppm, ppb, colligative properties, freezing point depression, boiling point elevation, osmotic pressure, vapor pressure lowering, Henry's Law, acids, bases, acid/base theories (Arrhenius, Bronsted-Lowry, Lewis), anhydrides, conjugate acids and bases, amphoteric, strong vs. weak acids and bases, pH, pOH,

neutralization, titration

Media, Technology, Web Resources
Teacher developed PowerPoint presentations Solubility Curves Graph Concentration Units Colligative Properties Principles of solubility

MARKING PERIOD FOUR

- ***Chapters 13, 14, 16: Equilibrium***
- ***Chapter : Thermochemistry***
- ***Chapter : Reduction/Oxidation Reactions***
- ***Chapter : Organic Chemistry***
- ***Chapter: States of Matter***
- ***Chapter : Gas Behavior***

Pennsylvania Standards, Anchors, and Eligible Content

STANDARDS

3.2.C.A3.

- Describe the three normal states of matter in terms of energy, particle motion, and phase transitions.
- Use stoichiometry to predict quantitative relationships in a chemical reaction.

ANCHORS

- **S11.C.1.1** Explain the relationship between the structure and properties of matter.
- **S11.C.2.1** Analyze energy sources and transfer of energy, or conversion of energy.

ELIGIBLE CONTENT

- **S11.C.1.1.5** Predict the behavior of gases through the application of laws (e.g., Boyle's law, Charles' law, or ideal gas law).
- **S11.C.1.1.6** Describe factors that influence the frequency of collisions during chemical reactions that might affect the reaction rates (e.g., surface area, concentration, catalyst, temperature).

Student Objectives:

At the conclusion of this quarter, students should be able successfully to complete the following:

Chapters 13, 14, 16: Equilibrium

Acid Equilibrium Constant, K_a.
Base Equilibrium Constant, K_b.
Titrations

Calculate pH and pOH for complete ionization of strong acids and bases.
Identify the species likely to behave as weak acids and weak bases.
Given the K_a of a weak acid and its original concentration, calculate H^+.
Given the K_b of a weak base and its original concentration, calculate OH^-
Given K_a or K_b, calculate pK_a or pK_b.
Describe the relationship between K_a and K_b.
Describe the relationship between percent ionization and the $[H^+]$ at equilibrium.
Calculate the pH during a strong acid-strong base titration.
Choose the proper indicator for an acid base titration.
Calculate the equivalence point for strong acid-strong base titrations.
Describe the differences in titrations involving weak acids and/or bases.
Define the purpose of buffers and select appropriate buffers based on pH and pK_a values

Equivalence Point

Indicators
buffers
ICE problems
Equilibrium Constant Expressions
Equilibrium Constant, K
Rule of Multiple Equilibria
Reciprocal Rule
Homogeneous and heterogeneous

Chapter : Thermochemistry

definition of Thermodynamics
First Law of Thermodynamics (heat and work)
Second Law of Thermodynamics
Third Law of Thermodynamics
Hess's Law
- Calorimetry
- specific heat capacity
- Enthalpy Calculations
- Entropy Calculations
- Gibbs Free Energy Calculations
Activation Energy
Endothermic and Exothermic graph relationships

SKILLS
Differentiate the system and the surroundings as related to work and enthalpy.
Identify and apply the laws of thermodynamics
Calculations
Apply and calculate Hess's Law, calorimetry, and Gibbs Free Energy.
Understand enthalpy, entropy, and free energies to spontaneity and applications by using Gibbs free energy equation.
Understanding the relationship of thermochemistry to equilibrium and reaction rates.

Chapter : Reduction/Oxidation Reactions
oxidation
reduction
oxidizing agent
reducing agent
oxidation number

determine oxidation numbers
identify oxidizing and reducing agents
balance half reactions
balance redox

Balancing redox reactions
Voltaic Cells vs. Electrolytic Cells
EMF (Standard Reduction Potentials) and Activity Series
- reducing agent
- oxidizing agents
commercial voltaic cells

SKILLS
Understand the basic nature of redox reactions, the method for balancing them, and their use in electrochemistry
Voltaic Cells vs. Electrolytic Cells
Compare and contrast theory and applications of electrochemical and electrolytic cells.
Explain the use of Faraday's Law, Nernst equation, and standard electrode potentials in electrochemistry to practical examples (electroplating, corrosion, and batteries).
Relate redox reactions to spontaneity, concentration, standard cell voltage, Gibbs Free Energy, and equilibrium

Chapter : Organic Chemistry
two dimensional drawings, such as Neumann Projections and sawhorses
- Three dimensional perspectives, such as drawings and molecular models
- Isomers
- chirality
Functional Groups
Synthesis reactions

SKILLS
Understand the basic functional groups of organic chemistry, their reactions, and nomenclature.
Identify organic terminology, such as saturated, cyclic, IUPAC and common names, isomers, and chiral molecules.

Chapter: States of Matter
vapor pressure
States of Matter
- Solid
- Liquid
- gas
Phase Diagrams
- for water
- for a other chemicals
Heating/Cooling Curves
Solubility Graphs

SKILLS

identify the difference between vapor pressure and boiling point
- state the differences among solids, liquids, and gases
- draw a picture representing characteristics of each state of matter
- graph a phase diagram
- identify the various parts of a typical phase diagram
- draw the difference for a water phase diagram and a typical phase diagram
- diagram a heating or cooling curve
- label the parts of a heating or cooling curve
- distinguish the differences between the solubility of a typical solid and a typical gas in water
- interpret the solubility graph for solubility values, including saturation and unsaturation of the solute in water

Chapter : Gas Behavior

characteristics of gases
Kinetic Molecular Theory of Gases
- pressure
- pressure conversions
- STP conditions
- manometer
- barometers

PV relationship (Boyle's Law)
PT relationship (Gay-Lussac's Law)
VT relationship (Charles's Law)
Combined Gas Law

Ideal Gas Law

Real vs. Ideal Gases (van der Waals equation)
- molar mass
- gas Densities

Stoichiometric Gas Calculations
vapor pressure
Osmotic Pressure
Dalton's Law of Partial Pressures – collecting gases over water
- Effusion
- Diffusion
- Graham's Law

SKILLS

identify various physical characteristics and properties of gases
explain the kinetic theory of gases
- compare and calculate the pressure of a substance in mm Hg, atmospheres, torr, and

kilopascal units
- identify the standard units of pressure and temperature
- explain the differences between a manometer and barometer
- calculate the pressure of a gas in an open arm manometer
calculate the relationship of pressure and volume, where temperature is held constant
calculate the relationship of pressure and temperature, where volume is held constant
calculate the relationship of volume and temperature where pressure is held constant
calculate the relationship among pressure, temperature, and volume
- calculate the relationship of pressure, volume, temperature, and moles of a gas
- identify and use the appropriate units for the Gas Law Constant (R) depending on the units of pressure, volume, and temperature
- identify the differences between a real gas and an ideal gas
- explain how an ideal gas calculation can be used in place of a real gas value
- calculate the value for a real gas using van der Waals equation
using the ideal gas law equation, calculate for the molar mass or density of a gas
using a balanced chemical equation, calculate for another substance
using Dalton's Law of Partial Pressures, calculate for a dry gas given a gas collected over water
- define the difference between effusion and diffusion
- describe the use of Graham's Law

Activities, Assignments, & Assessments

Common Core Labs

Equilibrium Lab
Freezing Point Depression Lab
Enthalpy of a Reaction Lab
Aspirin Lab
Esters Lab

ASSESSMENTS

Unit Test
Laboratory Work
Common Final Exam

Terminology

Essential:

Additional:

Media, Technology, Web Resources

Essential:

N/A