AP Chemistry

Brief Description of Course

This course has been designed to provide a college level chemistry program in high school. The program is comparable to a college classroom with regards to content, assessment, and atmosphere. Each class period runs 41 minutes. Grades are based upon test/quiz scores, homework, lab reports, and projects. The grading scale is a basic 90-80-70-60 scale. Each experiment is completed with a lab report. The lab report consists of a purpose, objectives, materials, procedures, data, calculations, results, and conclusions. All reports are graded and returned for the purpose of a student portfolio used for test prep. Each student must submit an individual report. However, individual students and lab groups are encouraged to collaborate with other groups. Within each unit, emphasis is placed on problem solving. Whenever possible, information is presented both qualitatively and quantitatively to expand the students' knowledge base and derive chemical principles using mathematics.

Textbook

Title: Chemistry: The Central Science 12th Edition w/e-text
Author: Brown, LeMay, et al
Publisher: Pearson Publishing
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Course Curriculum

The entire curriculum has been designed to encompass the six "Big Ideas". They include the following:

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

Chapter to "Big Ideas" Correlation

Chapter Title	Big Ideas
Matter and Measurement	1
Atoms, Molecules, and Ions	1
Stoichiometry: Calculations with Chemical Formulas and Equations	1,3
Aqueous Reactions and Solution Stoichiometry	2,3
Thermochemistry	3,5
Electronic Structure of Atoms	1
Periodic Properties of the Elements	1
Basic Concepts of Chemical Bonding	2,5
Molecular Geometry and Bonding Theories	2
Gases	2
Intermolecular Forces, Liquids, and Solids	2
Properties of Solutions	2
Chemical Kinetics	4
Chemical Equilibrium	6
Acid/Base Equilibria	2,3,6
Additional Aspects of Aqueous Equilibria	6
Chemical Thermodynamics	5,6
Electrochemistry	3
Nuclear Chemistry	
Organic Chemistry	

Curriculum Breakdown

Chapter 1: Mater and Measurement

Time for Completion: Summer Assignment

Content and/or Skills Taught:

The students will be expected to know the following:

-classification of matter
-properties of matter
-units of measurement
-significant figures
-problem solving (dimensional analysis)

Major Assignments and/or Assessments:

chapter test
problem assignment

Activities: -Construct / Interpret diagrams of different types of matter for the purpose of classification as a mixture (hetero or home) or pure substance (element or compound). **(Learning Objective 1.1)**

Chapter 2: Atoms, Molecules, and Ions
Time for Completion: Summer Assignment
Content and/or Skills Taught:

The students will be expected to know the following:

-atomic theory
-atomic structure
-periodic table
-ionic and molecular compounds
-nomenclature and formula writing

Major Assignments and/or Assessments:

chapter test
problem assignment
formula writing activities

Activities: -Students will complete an activity that requires them to identify by name and formula a variety of ionic / molecular compounds and acids. Students must also predict certain properties based upon compound type. **(Learning Objective 2.1)**

Chapter 3: Stoichiometry
Time for Completion: Summer Assignment
Content and/or Skills Taught:

The students will be expected to know the following:

-equation writing
-atomic and molecular mass
-the mole concept
-empirical formulas
-limiting reactants
-stoichiometric problem solving

Major Assignments and/or Assessments:

chapter test
problem assignment

Activities: -Use molecular models to illustrate the role and interpretation of coefficients in a chemical equation and the stoichiometry process. **(Learning Objective 3.4)**

Chapter 4: Aqueous Reactions
Time For Completion: 2 weeks
Content and/or Skills Taught:

The students will be expected to know the following:

-properties of aqueous solutions
-types of reactions
-expressing concentration
-solution stoichiometry and titrations

Major Assignments and/or Assessments:

chapter test
problem assignment
equation writing

Activities: -Students will investigate the electrolytic / non-electrolytic character of various solutions by testing for conductivity. **(Learning Objective 2.15)**

Chapter 5: Thermochemistry
Time for Completion: 1 week
Content and/or Skills Taught:
The students will be expected to know the following:
-transferring energy
-First Law of Thermodynamics
-enthalpy
-enthalpies of reaction
-calorimetry
-Hess's law
-enthalpies of formation
Major Assignments and/or Assessments:
chapter test
problem assignment
calorimetry activity
Activities: -Design a calorimetry procedure to calculate the change in enthalpy for a given reaction and apply hypothetical data to calculate the ΔH value. **(Learning Objective 5.7)**

Chapter 6: Electronic Structure
Time for Completion: 1 week
Content and/or Skills Taught:
The students will be expected to know the following:
-wave nature of light
-photon concept
-Bohr's model of hydrogen
-wave properties of matter
-quantum mechanics
-orbitals
-electron configuration representations
Major Assignments and/or Assessments:
chapter test
problem assignment
Activities: -Construct an orbital map of the sodium atom. **(Learning Objective 1.5)**

Chapter 7: Periodic Properties of the Elements
Time for Completion: 1 week
Content and/or Skills Taught:
The students will be expected to know the following:
-history of the Periodic Chart
-atomic radius
-ionization energy
-electron affinity
-group trends
Major Assignments and/or Assessments:
chapter test
problem assignment

student presentations

Activities: -Construct a classroom presentation for a specific group of elements. The presentation must account for properties and periodic trends (electron affinity, electronegativity, ionization energy). **(Learning Objective 1.10)**

Chapter 8: Chemical Bonding

Time for Completion: 1 week

Content and/or Skills Taught:

The students will be expected to know the following:

-octet rule
-ionic bonding
-covalent bonding
-role of electronegativity in bonding
-construction of Lewis dot structures
-exceptions to the Octet rule
-bond enthalpies

Major Assignments and/or Assessments:

chapter test
problem assignment

Activities: -Construct Lewis dot structure models and use them to predict geometry and hybridization. **(Learning Objective 2.21)**

Chapter 9: Molecular Geometry and Bonding Theories

Time for Completion: 1 week

Content and/or Skills Taught:

The students will be expected to know the following:

-molecular shapes
-VSEPR Theory
-orbital overlap
-hybridization
-molecular orbitals

Major Assignments and/or Assessments:

chapter test
problem assignment
molecular model activity

Activities: -Apply molecular model kits to predict both domain geometries and molecular geometries. **(Learning Objective 2.21)**

Chapter 10: Gases

Time for Completion: 1 week

Content and/or Skills Taught:

The students will be expected to know the following:

-units of pressure
-gas laws
-ideal gas law

-gas density and molar mass
-partial pressures
-kinetic molecular theory
-effusion and diffusion
-van der Waals equation

Major Assignments and/or Assessments:
chapter test
problem assignment

Activities: -Interpret representations that show the relationships between kinetic energy and forces of attraction that determine physical state. **(Learning Objective 2.5)**

Chapter 11: Intermolecular Forces, Liquids, and Solids

Time for Completion: 2 weeks

Content and/or Skills Taught:

The students will be expected to know the following:

-comparison of liquids and solids
-intermolecular forces
-properties of liquids
-phase Change
-heating curve
-vapor pressure
-phase diagram
-structure of solids

Major Assignments and/or Assessments:
chapter test
problem assignment

Activities: -Construct and apply models and other representations to express an understanding of molecular solids, ionic solids, and covalent network solids. **(Learning Objective 2.3)**

Chapter 13: Properties of Solutions

Time for Completion: 2 weeks

Content and/or Skills Taught:

The students will be expected to know the following:

-the solution process (thermodynamics)
-factors that affect solubility
-expressions of concentration
-colligative properities
-colloids

Major Assignments and/or Assessments:
chapter test
problem assignment
freezing point depression activity

Activities: -Interpret diagrams that explain the process of solution formation and the thermodynamics involved. **(Learning Objective 2.8)**

Chapter 14: Chemical Kinetics
Time for Completion: 2 weeks
Content and/or Skills Taught:

The students will be expected to know the following:

-calculating average and instantaneous rate
-rate law
-change in concentration vs. time
-first/second order reactions
-temperature and rate (energy of activation)
-reaction mechanisms

Major Assignments and/or Assessments:

chapter test
problem assignment
graphing for instantaneous rate and energy of activation

Activities: -Translate hypothetical experimental data into a rate law. **(Learning Objective 4.2)**

Chapter 15: Chemical Equilibrium
Time for Completion: 1 week
Content and/or Skills Taught:

The students will be expected to know the following:

-the equilibrium concept
-the equilibrium constant
-calculating equilibrium concentrations
-reaction quotient
-Le'Chatelier's principle

Major Assignments and/or Assessments:

chapter test
problem assignment

Activities: -Interpret animations that visualize Le'Chatelier's Principle **(Learning Objective 6.8)**

Chapter 16: Acid/Base Equilibria
Time for Completion: 2 weeks
Content and/or Skills Taught:

The students will be expected to know the following:

-acid/base definitions
-conjugate acid base pairs
-autoionization of water
-pH scale
-strong acids/bases
-weak acids/bases
-acid/base character of salts
-acid/base character and structure

Major Assignments and/or Assessments:

chapter test
problem assignment

Activities: -Interpret experimental data to standardize a solution through titration and calculate the purity of a given sample. **(Learning Objective 6.13)**

Chapter 17: Additional Aspects of Equilibrium
Time for Completion: 2 weeks
Content and/or Skills Taught:

The students will be expected to know the following:

-common ion effect
-buffer solutions
-buffering capacity
-acid/base titrations
-Ksp and solubility
-factors that affect solubility
-precipitation of ions

Major Assignments and/or Assessments:

chapter test
problem assignment

Activities: -Design a procedure by which the pH of a buffer solution can be calculated after the addition of an acid / base. **(Learning Objective 6.20)**

Chapter 18: Environmental Chemistry
Time for Completion: 1 week
Content and /or Skills Taught:

The students will be expected to know the following:

-natural components in air and the major pollutants
-mechanisms by which sulfur oxides and nitrogen oxides are produced
-harmful effects of acid rain
-Chapman steady state cycle for ozone
-role of CFC's in ozone breakdown
-chemistry of the greenhouse effect

Major Assignments and/or Assessments:

chapter test
environmental portfolio
research paper

Activities: -Construct a procedure by which an average volume of air breathed over a period of 20 years can be calculated.
-Construct an advertising campaign for a hydrogen powered automobile.
-Write a research paper on the topic of alternative fuels.

Chapter 19: Chemical Thermodynamics
Time for Completion: 1 week
Content and/or Skills Taught:

The students will be expected to know the following:

-concept of entropy
-2nd Law of Thermodynamics
-calculating changes in standard entropies
-Gibbs free energy
-predicting spontaneous reactions

Major Assignments and/or Assessments:

chapter test

problem assignment

Activities: -Solve problems to predict reaction spontaneity using Gibb's free energy values.
(Learning Objective 5.14)

Chapter 20: Electrochemistry

Time for Completion: 2 weeks

Content and/or Skills Taught:

The students will be expected to know the following:

-identification of oxidation-reduction reactions
-how to balance redox reactions
-voltaic cells
-calculation of standard and non-standard potential.
-relationship of Gibbs Free Energy and cell potential
-electrolysis

Major Assignments and/or Assessments:

chapter test
problem assignment
construction of a working electrochemical cell

Activities: -Diagram, label, explain, and construct a working electrochemical cell.
(Learning Objective 3.12)

Chapter 21: Nuclear Chemistry

Time for Completion: 1 week

Content and/or Skills Taught:

The students will be expected to know the following:

-radioactivity and nuclear decay equations
-patterns of nuclear stability
-nuclear transmutation
-rate of decay
-energy changes in nuclear reactions
-nuclear fission and fusion
-nuclear binding energy

Major Assignments and/or Assessments:

chapter test
problem assignment

Activities: -Illustrate and explain diagrams of fission and fusion.

Chapter 25: Organic Chemistry

Time for Completion: 1 week

Content and/or Skills Taught:

The students will be expected to know the following:

-the structure of alkanes
-structural isomers
-naming alkanes
-naming alkenes

-reactions of alkanes and alkenes
-functional groups.

Major Assignments and/or Assessments:
chapter test
problem assignment
molecular model activity

Activities: -Illustrate the mechanisms necessary for addition and substitution reactions.
-Construct representations of isomers.

Laboratory Description

The laboratory program for this course meets twice a week for a total of 82 minutes (approx. 29% of total time). As per the College Board requirements, a minimum of 16 experiments will be completed. ***All 16 of the experiments will be inquiry based.*** As mentioned in the course description, lab reports are required for each experiment. The following experiments will be completed:

Experiment Title	Primary Learning Objective(s)	Science Practices
Analysis of Food Dyes in Beverages	1.15	2.2, 5.1, 4.1, 4.2, 6.4
Percent Copper in Brass	1.16	2.2, 4.1, 4.2, 5.1, 6.4
Gravimetric Analysis of Calcium and Hard Water	1.19	1.5, 2.2, 4.2, 5.1, 5.3 6.4, 6.6, 7.1, 7.2
Acidity of Beverages	1.20	1.1, 2.2, 3.1, 4.2, 5.1, 6.4, 7.1
Separation of Dyes Using Chromatography	2.10	1.4, 4.2, 4.3, 5.1, 5.2, 5.3, 6.4
Qualitative Analysis of Chemical Bonding	2.22	1.1, 4.2, 6.2, 6.4, 7.1
Green Chemistry Analysis of a Mixture	3.5 3.3	2.1, 2.2, 4.2, 5.1, 5.2, 6.1, 6.4
Analysis of Hydrogen Peroxide	3.9	2.1, 2.2, 4.2, 6.1, 6.4
Separating a Synthetic Pain Reliever	3.10	1.4, 4.4, 6.1
Rate of Decomposition of Calcium Carbonate	4.1	3.1, 3.2, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 7.1, 7.2
Kinetics of Crystal Violet Fading	4.2	1.4, 2.1, 2.2, 4.2, 5.1, 6.4
Designing a Hand Warmer	5.7	1.4, 2.2, 2.3, 4.2, 5.1, 6.4, 7.2
Applications of Le'Chatelier's Principle	6.9	4.1, 4.2, 4.3, 5.1, 6.2, 6.4
Acid/Base Titration	6.13	1.1, 1.2, 1.4, 2.1, 2.2, 3.1, 3.3, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3, 6.1, 6.2, 7.2
Buffers in Household Products	6.20	4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 6.4
Properties of Buffer Solutions	6.18	1.4, 2.2, 2.3, 4.2, 4.3, 4.4, 5.2, 5.3, 6.4, 7.1