



# COVINGTON LATIN SCHOOL

*Achieve here. Excel here. Belong here.*

## AP CHEMISTRY

### **Textbook:**

Brown, Theodore L., LeMay, H. Eugene JR., Bursten, Bruce E., Murphy, Catherine J., and Patrick M. Woodward. Chemistry: The Central Science. AP Edition. 12th Edition. Boston: Prentice Hall, 2012.

### **Prerequisites:**

Form III Chemistry, Algebra I, and Geometry.

### **Course Description:**

Students enrolled in this course will master the following topics: matter and measurement; the structure of atoms, elements, and molecules; stoichiometry; gases; thermochemistry; electronic structure of atoms; periodicity of the periodic table; chemical bonding; intermolecular forces; liquids; solids; molecular geometry; bonding theories; chemical kinetics; chemical equilibrium; acids and bases; chemical thermodynamics; electrochemistry; nuclear chemistry; transition metals; organic chemistry; biochemistry. All quizzes and examinations are tailored to prepare the student for the AP Chemistry examination. A substantial portion of the course (one double period per week) will require the student to perform hands-on laboratory experiments and submit a formal Laboratory Report detailing the experiment every week.

### **Course Goals:**

1. to achieve a passing score on the official AP Chemistry exam
2. to increase the students' knowledge of the principles of chemistry
3. to build upon knowledge gained from Form III Chemistry
4. to ensure passage of all college-level chemistry courses
5. to equip the student with hands-on laboratory skills
6. to train the students to write scientific laboratory reports

### **Course Objectives:**

1. to determine chemical formulas and stoichiometry experimentally
2. to determine chemical formulas and stoichiometry theoretically
3. to introduce the student to thermochemistry and thermodynamics
4. to introduce the student to organic chemistry
5. to introduce the student to biochemistry
6. to introduce the student to complex laboratory experiments where unknown compounds are identified

### **Course Sequence:**

## Semester 1/Quarter 1

### 1. **Matter and Measurement**

- Classifications of matter
- Properties of matter
- Significant figures
- Units of measurement

### 2. **Atoms, Molecules, and Ions**

- Atomic structure: Discovery and modern view
- Atomic weights
- The periodic table
- Molecular compounds
- Naming inorganic compounds
- Introduction to organic compounds

### 3. **Stoichiometry**

- Chemical equations and balancing
- Chemical reactivity
- Avogadro's number
- Empirical formulas
- Limiting reactants

### 4. **Solution Stoichiometry**

- Precipitation reactions
- Oxidation-reduction reactions
- Aqueous solutions
- Acids and bases
- Concentrations of solutions

### 5. **Gases and Gaseous Equilibrium**

- Pressure
- The gas laws
- Ideal gas equation
- Kinetic-molecular theory of gases
- Effusion and diffusion
- Real gases

### 6. **Thermochemistry**

- Laws of thermodynamics
- Enthalpy
- Calorimetry
- Hess's Law
- Enthalpies of reaction
- Enthalpies of formation
- Fuels and food

## Quarter 2

### 7. **Electronic Structure of Atoms, Periodicity**

- Wave nature of light
- Line spectra
- Quantized energy and photons
- Quantum mechanics and atomic orbitals
- Many-electron atoms
- Electron configurations

- Effective nuclear charge
  - Sizes of atoms and ions
  - Ionization energy
  - Electron affinities
  - Trends of the periodic table
- 8. Chemical Bonding**
- Ionic bonding
  - Bond polarity and electronegativity
  - Covalent bonds
  - Lewis symbols and octet rule
- 9. Molecular Geometry/Bonding Theories**
- Molecular shapes
  - VSEPR model
  - Molecular polarity
  - Multiple bonds
  - Period 2 diatomic molecules
- 10. Liquids and Intermolecular Forces**
- Intermolecular forces
  - Phase changes
  - Vapor pressure
  - Phase diagrams
  - Liquid crystals

Semester 2/Quarter 3

- 11. Properties of Solutions**
- Solution process
  - Factors affecting solubility
  - Colligative properties
- 12. Chemical Kinetics**
- Reaction rates
  - Change of concentration with time
  - Temperature and rate
  - Catalysis
  - Reaction mechanisms
- 13. Chemical Equilibrium**
- Concept of equilibrium
  - La Châtelier's Principle
  - Calculating equilibrium constants
  - Heterogeneous equilibria
- 14. Acid-Base Equilibrium**
- Brønsted-Lowry Acids and Bases
  - The pH scale
  - Weak acids
  - Weak bases
  - Relationship between  $K_a$  and  $K_b$
  - Acid-base behavior and chemical structure
- 15. Aqueous Equilibria: Additional Aspects**
- Buffered solutions
  - The common-ion effect

- Acid-base titrations
  - Solubility Equilibria
  - Qualitative analysis for metallic elements
- 16. Chemical Thermodynamics**
- Spontaneous processes
  - Molecular interpretation of entropy
  - Entropy changes in chemical reactions
  - Gibbs free energy
- 17. Electrochemistry**
- Voltaic cells
  - Cell potentials under standard conditions
  - Batteries and fuel cells
  - Corrosion
  - Electrolysis
  - Balancing redox equations
- 18. Nuclear Chemistry**
- Patterns of nuclear stability
  - Energy changes in nuclear reactions
  - Fission
  - Radioactivity
  - Rates of radioactive decay
- 19. Solids**
- Metallic solids
  - Metallic bonding
  - Ionic solids
  - Covalent-Network solids
  - Polymeric solids

#### Quarter 4

- 20. Chemistry of the Nonmetals**
- Periodic trends and chemical reactions
  - The Noble Gases
  - The Halogens
  - Other group 5A elements
- 21. Transition Metals**
- Transition metal complexes
  - Common ligands in coordination chemistry
  - Nomenclature and isomerism in coordination chemistry
  - Crystal-Field Theory
- 22. Organic Chemistry**
- General characteristics of organic molecules
  - Introduction to hydrocarbons
  - Alkenes, alkynes, and aromatic hydrocarbons
  - Chirality in organic chemistry
  - Bonding in organic compounds
  - Organic synthesis reactions (synthesis of aspirin)
  - Spectroscopy of organic compounds
- 23. Biochemistry**
- The building blocks of life

- Amino acids
- Proteins and Enzymes
- Carbohydrates
- Lipids
- Nucleic acids (DNA, RNA, etc.)
- Catalytic RNA
- Chemical basis for diseases (focus on prions, cancer from genetic mutations, and neurodegenerative diseases)
- Chromatography

**Evaluation:**

Homework, Laboratory Reports, Quizzes, Tests, Exams

**Supplemental Materials**

ChemSketch Freeware from ACD Labs, Videos, Educational Websites