Course Content

Big Ideas

The big ideas serve as the foundation of the course and allow students to create meaningful connections among concepts. They are often abstract concepts or themes that become threads that run throughout the course. Revisiting the big ideas and applying them in a variety of contexts allows students to develop deeper conceptual understanding. Below are the big ideas of the course and a brief description of each.

BIG IDEA 1: SCALE, PROPORTION, AND QUANTITY (SPQ)

Quantities in chemistry are expressed at both the macroscopic and atomic scale. Explanations, predictions, and other forms of argumentation in chemistry require understanding the meaning of these quantities, and the relationship between quantities at the same scale and across scales.

BIG IDEA 2: STRUCTURE AND PROPERTIES (SAP)

Properties of substances observable at the macroscopic scale emerge from the structures of atoms and molecules and the interactions between them. Chemical reasoning moves in both directions across these scales. Properties are predicted from known aspects of the structures and interactions at the atomic scale. Observed properties are used to infer aspects of the structures and interactions.

BIG IDEA 3: TRANSFORMATIONS (TRA)

At its heart, chemistry is about the rearrangement of matter. Understanding the details of these transformations requires reasoning at many levels as one must quantify what is occurring both macroscopically and at the atomic level during the process. This reasoning can be as simple as monitoring amounts of products made or as complex as visualizing the intermolecular forces among the species in a mixture. The rate of a transformation is also of interest, as particles must move and collide to initiate reaction events.

BIG IDEA 4: ENERGY (ENE)

Energy has two important roles in characterizing and controlling chemical systems. The first is accounting for the distribution of energy among the components of a system and the ways that heat exchanges, chemical reactions, and phase transitions redistribute this energy. The second is in considering the enthalpic and entropic driving forces for a chemical process. These are closely related to the dynamic equilibrium present in many chemical systems and the ways in which changes in experimental conditions alter the positions of these equilibria.

continued on next page

UNITS

The course content is organized into commonly taught units. The units have been arranged in a logical sequence frequently found in many college courses and textbooks.

The nine units in AP Chemistry, and their weighting on the multiple-choice section of the AP Exam, are listed below.

TOPICS

Each unit is broken down into teachable segments called topics. The topic pages contain the required content for each topic.

Units	Exam Weighting
Unit 1: Atomic Structure and Properties	**7–9%**
Unit 2: Molecular and Ionic Compound Structure and Properties	**7–9%**
Unit 3: Intermolecular Forces and Properties	**18–22%**
Unit 4: Chemical Reactions	**7–9%**
Unit 5: Kinetics	**7–9%**
Unit 6: Thermodynamics	**7–9%**
Unit 7: Equilibrium	**7–9%**
Unit 8: Acids and Bases	**11–15%**
Unit 9: Applications of Thermodynamics	**7–9%**

Spiraling the Big Ideas

The following table shows how the big ideas spiral across units.

Big Ideas	Unit 1 Atomic Structure and Properties	Unit 2 Molecular and Ionic Compound Structure and Properties	Unit 3 Intermolecular Forces and Properties	Unit 4 Chemical Reactions	Unit 5 Kinetics	Unit 6 Thermodynamics	Unit 7 Equilibrium	Unit 8 Acids and Bases	Unit 9 Applications of Thermodynamics
Scale, Proportion, and Quantity SPQ	✓		✓	✓					✓
Structure and Properties SAP	✓	✓	✓					✓	✓
Transformations TRA				✓	✓		✓		
Energy ENE					✓	✓			✓

Return to Table of Contents

Course at a Glance

Plan

The Course at a Glance provides a useful visual organization of the AP Chemistry curricular components, including:

- Sequence of units, along with approximate weighting and suggested pacing. Please note, pacing is based on 45-minute class periods, meeting five days each week for a full academic year.
- Progression of topics within each unit.
- Spiraling of the big ideas and science practices across units.

Teach

SCIENCE PRACTICES

Science practices spiral throughout the course.

- 1 Models and Representations
- 2 Question and Method
- 3 Representing Data and Phenomena
- 4 Model Analysis
- 5 Mathematical Routines
- 6 Argumentation

BIG IDEAS

Big ideas spiral across topics and units.

- SPQ Scale, Proportion, and Quantity
- SAP Structure and Properties
- TRA Transformations
- ENE Energy

Assess

Assign the Personal Progress Checks—either as homework or in class—for each unit. Each Personal Progress Check contains formative multiple-choice and free-response questions. The feedback from the Personal Progress Checks shows students the areas where they need to focus.

UNIT 1 Atomic Structure and Properties

~9–10 Class Periods | **7–9%** AP Exam Weighting

- SPQ 5 — 1.1 Moles and Molar Mass
- SPQ 5 — 1.2 Mass Spectroscopy of Elements
- SPQ 2 — 1.3 Elemental Composition of Pure Substances
- SPQ 5 — 1.4 Composition of Mixtures
- SAP 1 — 1.5 Atomic Structure and Electron Configuration
- SAP 4 — 1.6 Photoelectron Spectroscopy
- SAP 4 — 1.7 Periodic Trends
- SAP 4 — 1.8 Valence Electrons and Ionic Compounds

Personal Progress Check 1

Multiple-choice: ~20 questions
Free-response: 2 questions
- Short-answer
- Short-answer

UNIT 2 Molecular and Ionic Compound Structure and Properties

~12–13 Class Periods | **7–9%** AP Exam Weighting

- SAP 6 — 2.1 Types of Chemical Bonds
- SAP 3 — 2.2 Intramolecular Force and Potential Energy
- SAP 4 — 2.3 Structure of Ionic Solids
- SAP 4 — 2.4 Structure of Metals and Alloys
- SAP 3 — 2.5 Lewis Diagrams
- SAP 6 — 2.6 Resonance and Formal Charge
- SAP 6 — 2.7 VSEPR and Bond Hybridization

Personal Progress Check 2

Multiple-choice: ~15 questions
Free-response: 1 question
- Long-answer

continued on next page

UNIT 3 Intermolecular Forces and Properties

~14–15 Class Periods | 18–22% AP Exam Weighting

- SAP 4 — 3.1 Intermolecular Forces
- SAP 4 — 3.2 Properties of Solids
- SAP 3 — 3.3 Solids, Liquids, and Gases
- SAP 5 — 3.4 Ideal Gas Law
- SAP 4 — 3.5 Kinetic Molecular Theory
- SAP 6 — 3.6 Deviation from Ideal Gas Law
- SPQ 5 — 3.7 Solutions and Mixtures
- SPQ 3 — 3.8 Representations of Solutions
- SPQ 2 — 3.9 Separation of Solutions and Mixtures Chromatography
- SPQ 4 — 3.10 Solubility
- SAP 4 — 3.11 Spectroscopy and the Electromagnetic Spectrum
- SAP 5 — 3.12 Photoelectric Effect
- SAP 2 — 3.13 Beer-Lambert Law

Personal Progress Check 3

Multiple-choice: ~30 questions
Free-response: 2 questions
- Short-answer
- Short-answer

UNIT 4 Chemical Reactions

~14–15 Class Periods | 7–9% AP Exam Weighting

- TRA 2 — 4.1 Introduction for Reactions
- TRA 5 — 4.2 Net Ionic Equations
- TRA 3 — 4.3 Representations of Reactions
- TRA 6 — 4.4 Physical and Chemical Changes
- SPQ 5 — 4.5 Stoichiometry
- SPQ 3 — 4.6 Introduction to Titration
- TRA 1 — 4.7 Types of Chemical Reactions
- TRA 1 — 4.8 Introduction to Acid-Base Reactions
- TRA 5 — 4.9 Oxidation-Reduction (Redox) Reactions

Personal Progress Check 4

Multiple-choice: ~20 questions
Free-response: 1 question
- Long-answer

UNIT 5 Kinetics

~13–14 Class Periods | 7–9% AP Exam Weighting

- TRA 6 — 5.1 Reaction Rates
- TRA 5 — 5.2 Introduction to Rate Law
- TRA 5 — 5.3 Concentration Changes Over Time
- TRA 5 — 5.4 Elementary Reactions
- TRA 6 — 5.5 Collision Model
- TRA 3 — 5.6 Reaction Energy Profile
- TRA 1 — 5.7 Introduction to Reaction Mechanisms
- TRA 5 — 5.8 Reaction Mechanism and Rate Law
- TRA 5 — 5.9 Steady-State Approximation
- TRA 3 — 5.10 Multistep Reaction Energy Profile
- ENE 6 — 5.11 Catalysis

Personal Progress Check 5

Multiple-choice: ~25 questions
Free-response: 2 questions
- Short-answer
- Long-answer

continued on next page

UNIT 6 Thermodynamics

~10–11 Class Periods | 7–9% AP Exam Weighting

ENE 6	6.1	Endothermic and Exothermic Processes
ENE 3	6.2	Energy Diagrams
ENE 6	6.3	Heat Transfer and Thermal Equilibrium
ENE 2	6.4	Heat Capacity and Calorimetry
ENE 1	6.5	Energy of Phase Changes
ENE 4	6.6	Introduction to Enthalpy of Reaction
ENE 5	6.7	Bond Enthalpies
ENE 5	6.8	Enthalpy of Formation
ENE 5	6.9	Hess's Law

Personal Progress Check 6

Multiple-choice: ~20 questions
Free-response: 2 questions
- Short-answer
- Short-answer

UNIT 7 Equilibrium

~14–16 Class Periods | 7–9% AP Exam Weighting

TRA 6	7.1	Introduction to Equilibrium
TRA 4	7.2	Direction of Reversible Reactions
TRA 3	7.3	Reaction Quotient and Equilibrium Constant
TRA 5	7.4	Calculating the Equilibrium Constant
TRA 6	7.5	Magnitude of the Equilibrium Constant
TRA 5	7.6	Properties of the Equilibrium Constant
TRA 3	7.7	Calculating Equilibrium Concentrations
TRA 3	7.8	Representations of Equilibrium
TRA 6	7.9	Introduction to Le Châtelier's Principle
TRA 5	7.10	Reaction Quotient and Le Châtelier's Principle
SPQ 5	7.11	Introduction to Solubility Equilibria
SPQ 2	7.12	Common-Ion Effect
SPQ 2	7.13	pH and Solubility
SPQ 4	7.14	Free Energy of Dissolution

Personal Progress Check 7

Multiple-choice: ~30 questions
Free-response: 2 questions
- Short-answer
- Long-answer

UNIT 8 Acids and Bases

~14–15 Class Periods | 11–15% AP Exam Weighting

SAP 5	8.1	Introduction to Acids and Bases
SAP 5	8.2	pH and pOH of Strong Acids and Bases
SAP 5	8.3	Weak Acid and Base Equilibria
SAP 5	8.4	Acid-Base Reactions and Buffers
SAP 5	8.5	Acid-Base Titrations
SAP 6	8.6	Molecular Structure of Acids and Bases
SAP 2	8.7	pH and pK_a
SAP 6	8.8	Properties of Buffers
SAP 5	8.9	Henderson-Hasselbalch Equation
SAP 6	8.10	Buffer Capacity

Personal Progress Check 8

Multiple-choice: ~30 questions
Free-response: 1 question
- Long-answer

continued on next page

UNIT 9 Applications of Thermodynamics

~10–13 Class Periods | 7–9% AP Exam Weighting

ENE 6	9.1	Introduction to Entropy
ENE 5	9.2	Absolute Entropy and Entropy Change
ENE 6	9.3	Gibbs Free Energy and Thermodynamic Favorability
ENE 6	9.4	Thermodynamic and Kinetic Control
ENE 6	9.5	Free Energy and Equilibrium
ENE 4	9.6	Coupled Reactions
ENE 2	9.7	Galvanic (Voltaic) and Electrolytic Cells
ENE 5	9.8	Cell Potential and Free Energy
ENE 6	9.9	Cell Potential Under Nonstandard Conditions
ENE 5	9.10	Electrolysis and Faraday's Law

Personal Progress Check 9

Multiple-choice: ~30 questions
Free-response: 2 questions
- Short-answer
- Long-answer