

AP Chemistry builds students' understanding of the nature and reactivity of matter. After studying chemical reactions and electrochemistry, students move on to understand how the chemical and physical properties of materials can be explained by the structure and arrangements of the molecules and the forces between those molecules. Students will examine the laws of thermodynamics, molecular collisions, and the reorganization of matter in order to understand how changes in matter take place. Finally, students will explore chemical equilibria, including acid-base equilibria. The equivalent of an introductory college-level chemistry course, AP Chemistry prepares students for the AP exam and for further study in science, health sciences, or engineering.

The AP Chemistry course provides a learning experience focused on allowing students to develop their critical thinking skills and cognitive strategies. Frequent no- and low-stakes assessments allow students to measure their comprehension and improve their performance as they progress through each activity. Students regularly engage with primary source materials, allowing them to practice the critical reading and analysis skills that they will need in order to pass the AP exam and succeed in a college chemistry course. Students perform hands-on labs that give them insight into the nature of science and help them understand chemical concepts, as well as how evidence can be obtained to support those concepts. Students also complete several virtual lab studies in which they form hypotheses; collect, analyze, and manipulate data; and report their findings and conclusions. During both virtual and traditional lab investigations and research opportunities, students summarize their findings and analyze others' findings in summaries, using statistical and mathematical calculations when appropriate. Summative tests are offered at the end of each unit as well as at the end of each semester, and contain objective and constructed response items. Robust scaffolding, rigorous instruction, relevant material, and regular active learning opportunities ensure that students can achieve mastery of the skills necessary to excel on the AP exam.

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Length: Two semesters

## UNIT 1: CHEMISTRY FOUNDATIONS

### LESSON 1: CHEMICAL REACTIONS AND THE MOLE

#### **Read: Chemical Reactions and the Mole**

Read about how changes in matter are represented by chemical equations.

Duration: 3 hrs 30 mins Scoring: 0 points

#### **Quiz: Chemical Reactions and the Mole**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 25 mins Scoring: 30 points

#### **Study: Qualitative and Quantitative Analysis of Chemical Equations**

Learn how to describe the changes that rearrange atoms and form the diversity of matter.

Duration: 1 hr Scoring: 0 points

#### **Quiz: Qualitative and Quantitative Analysis of Chemical Equations**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

#### **Study: Mass Data Analysis**

Use chemical analysis to identify substances.

Duration: 1 hr Scoring: 0 points

**Quiz: Mass Data Analysis**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

**Practice: Chemical Reactions and the Mole**

Express the law of conservation of mass quantitatively and qualitatively by using symbolic representations and particulate drawings.

Duration: 1 hr Scoring: 25 points

**Lab: Gravimetric Analysis**

Interpret data from an experiment that uses gravimetric analysis to determine the concentration of an analyte in a solution.

Duration: 2 hrs 45 mins Scoring: 50 points

**Discuss: Gravimetric Analysis**

Analyze and evaluate scientific evidence, and communicate and apply the findings.

Duration: 1 hr Scoring: 15 points

**LESSON 2: STOICHIOMETRY****Read: Stoichiometry**

Read about how the conservation of atoms makes it possible to identify stoichiometric relationships in a chemical reaction.

Duration: 3 hrs 30 mins Scoring: 0 points

**Quiz: Stoichiometry**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 25 mins Scoring: 30 points

**Study: Stoichiometry Calculations**

Relate quantities to identify stoichiometric relationships for a reaction, including situations involving limiting reactants and situations in which the reaction has not gone to completion.

Duration: 1 hr Scoring: 0 points

**Quiz: Stoichiometry Calculations**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

**Study: Analyzing Chemical Reactions**

Compare quantities to identify stoichiometric relationships for a reaction, including situations involving limiting reactants.

Duration: 1 hr Scoring: 0 points

**Quiz: Analyzing Chemical Reactions**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

**Practice: Stoichiometry**

Compare moles and measured masses of substances to identify stoichiometric relationships for a reaction, including situations involving limiting reactants and situations in which the reaction has not gone to completion

Duration: 1 hr Scoring: 25 points

**Lab: Mole Ratios**

Design a plan to collect data on the synthesis or decomposition of a compound, in order to confirm the conservation of matter and the law of definite proportions.

Duration: 2 hrs 45 mins Scoring: 50 points

**Discuss: Mole Ratios**

Analyze and evaluate scientific evidence, and communicate and apply the findings.

Duration: 1 hr Scoring: 15 points

### Explore: Isotopes and Mass Spectrometry

Analyze, evaluate, and critique scientific explanations by examining scientific evidence

Duration: 1 hr 30 mins Scoring: 25 points

## LESSON 3: CHEMISTRY FOUNDATIONS WRAP-UP

### Test (CS): Chemistry Foundations Wrap-Up

Take a computer-scored test to assess what you have learned in this unit.

Duration: 1 hr Scoring: 50 points

### Test (TS): Chemistry Foundations Wrap-Up

Take a teacher-scored test to assess what you have learned in this unit.

Duration: 1 hr Scoring: 50 points

## UNIT 2: CHEMICAL REACTIONS AND ELECTROCHEMISTRY

### LESSON 1: CHEMISTRY REACTIONS

#### Read: Chemical Reactions

Read about the changes matter undergoes during chemical reactions.

Duration: 3 hrs 30 mins Scoring: 0 points

#### Quiz: Chemical Reactions

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 25 mins Scoring: 30 points

#### Study: Types of Chemical Reactions and Solution Stoichiometry

Translate an observed chemical change into a balanced chemical equation, and justify your choice of equation type (molecular, ionic, or net ionic).

Duration: 1 hr Scoring: 0 points

#### Quiz: Types of Chemical Reactions and Solution Stoichiometry

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

#### Study: Metals in Aqueous Solutions

Translate observed chemical changes involving metals in aqueous solution into balanced chemical equations.

Duration: 1 hr Scoring: 0 points

#### Quiz: Metals in Aqueous Solutions

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

#### Practice: Chemical Reactions

Identify redox reactions and explain your identification in terms of electron transfer.

Duration: 1 hr Scoring: 25 points

#### Lab: Redox Titration

Perform a redox titration to determine the concentration of a solution.

Duration: 2 hrs 45 mins Scoring: 50 points

#### Discuss: Redox Titration

Analyze and evaluate scientific evidence, and communicate and apply the findings.

Duration: 1 hr Scoring: 15 points

### LESSON 2: ELECTROCHEMISTRY

#### Read: Electrochemistry

Read about how electrochemistry shows the interconversion between chemical and electrical energy in galvanic and electrolytic cells.

Duration: 3 hrs 30 mins Scoring: 0 points

### **Quiz: Electrochemistry**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 25 mins Scoring: 30 points

### **Study: Evidence of a Chemical Reaction**

Evaluate the classification of a process as a physical change, a chemical change, or an ambiguous change, based on macroscopic observation.

Duration: 1 hr Scoring: 0 points

### **Quiz: Evidence of a Chemical Reaction**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

### **Study: Electrochemistry and Technology**

Use concepts of electrochemistry to identify the underlying problems that are preventing a battery from working properly.

Duration: 1 hr Scoring: 0 points

### **Quiz: Electrochemistry and Technology**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

### **Practice: Electrochemistry**

Analyze data regarding galvanic or electrolytic cells to identify properties of the underlying redox reactions.

Duration: 1 hr Scoring: 25 points

### **Lab: Electrochemistry: Galvanic Cells**

Analyze data regarding galvanic or electrolytic cells to identify properties of the underlying redox reactions.

Duration: 2 hrs 45 mins Scoring: 50 points

### **Explore: Redox Reactions and the Body**

Analyze, evaluate, and critique scientific explanations by examining scientific evidence.

Duration: 1 hr 30 mins Scoring: 25 points

### **Discuss: Electrochemistry: Galvanic Cells**

Analyze and evaluate scientific evidence, and communicate and apply the findings.

Duration: 1 hr Scoring: 15 points

## **LESSON 3: CHEMICAL REACTIONS AND ELECTROCHEMISTRY WRAP-UP**

### **Test (CS): Chemical Reactions and Electrochemistry**

Take a computer-scored test to assess what you have learned in this unit.

Duration: 1 hr Scoring: 50 points

### **Test (TS): Chemical Reactions and Electrochemistry**

Take a teacher-scored test to assess what you have learned in this unit.

Duration: 1 hr Scoring: 50 points

## **UNIT 3: THERMODYNAMICS**

### **LESSON 1: ENERGY CHANGES IN MATTER**

#### **Read: Energy Changes in Matter**

Read about the energy changes that take place during physical and chemical processes.

Duration: 3 hrs 30 mins Scoring: 0 points

#### **Quiz: Energy Changes in Matter**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 25 mins Scoring: 30 points

**Study: Maxwell-Boltzmann Distribution**

Generate explanations or make predictions about the transfer of thermal energy between systems that occurs due to kinetic energy from molecular collisions.

Duration: 1 hr Scoring: 0 points

**Quiz: Maxwell-Boltzmann Distribution**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

**Study: Calculating Energy Changes in Chemical and Physical Processes**

Use the law of conservation of energy to compare the magnitudes of energy changes occurring in different systems as well as to identify the systems, the types of energy changes, and the directions of energy flow.

Duration: 1 hr Scoring: 0 points

**Quiz: Calculating Energy Changes in Chemical and Physical Processes**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

**Practice: Energy Changes in Matter**

Use the law of conservation of energy to compare the magnitudes of energy changes occurring in different systems, as well as to identify the systems, the types of energy changes, and the directions of energy flow.

Duration: 1 hr Scoring: 25 points

**Lab: Enthalpy of Fusion of Ice**

Design and interpret the results of an experiment in which calorimetry is used to determine the change in enthalpy of a chemical process at constant pressure.

Duration: 2 hrs 45 mins Scoring: 50 points

**Lab: Enthalpy of Reaction**

Design and interpret the results of an experiment in which calorimetry is used to determine the change in enthalpy of a chemical process at constant pressure.

Duration: 2 hrs 45 mins Scoring: 50 points

**Discuss: Enthalpy of Fusion of Ice**

Analyze and evaluate scientific evidence, and communicate and apply the findings.

Duration: 1 hr Scoring: 15 points

**Discuss: Enthalpy of Reaction**

Analyze and evaluate scientific evidence, and communicate and apply the findings.

Duration: 1 hr Scoring: 15 points

**LESSON 2: THERMODYNAMICS****Read: Thermodynamics**

Read about how the laws of thermodynamics describe the essential role of energy and explain and predict the direction of changes in matter.

Duration: 3 hrs 30 mins Scoring: 0 points

**Quiz: Thermodynamics**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 25 mins Scoring: 30 points

**Study: Understanding Thermodynamics**

Determine whether a chemical or physical process is thermodynamically favorable by calculating the change in standard Gibbs free energy.

Duration: 1 hr Scoring: 0 points

**Quiz: Understanding Thermodynamics**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

### **Study: Applying Principles of Thermodynamics**

Use tables of standard enthalpies of formation to calculate the standard enthalpy of reactions involving the extraction of elemental metals from metal oxides.

Duration: 1 hr Scoring: 0 points

### **Quiz: Sources of Energy**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

### **Practice: Thermodynamics**

Determine whether a chemical or physical process is thermodynamically favorable by calculating the change in standard Gibbs free energy.

Duration: 1 hr Scoring: 25 points

### **Explore: Endothermic and Exothermic Processes in Nature**

Analyze, evaluate, and critique scientific explanations by examining scientific evidence.

Duration: 1 hr 30 mins Scoring: 25 points

## **LESSON 3: THERMODYNAMICS WRAP-UP**

### **Test (CS): Thermodynamics**

Take a computer-scored test to assess what you have learned in this unit.

Duration: 1 hr Scoring: 50 points

### **Test (TS): Thermodynamics Wrap-up**

Take a teacher-scored test to assess what you have learned in this unit.

Duration: 1 hr Scoring: 50 points

## **UNIT 4: ATOMIC STRUCTURE AND BONDING**

### **LESSON 1: ATOMIC STRUCTURE AND PERIODICITY**

#### **Read: Atomic Structure and Periodicity**

Read about the relationship between atomic structure and periodicity.

Duration: 3 hrs 30 mins Scoring: 0 points

#### **Quiz: Atomic Structure and Periodicity**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 25 mins Scoring: 30 points

#### **Study: The Structure of the Atom**

Analyze data relating to electron energies for patterns and relationships.

Duration: 1 hr Scoring: 0 points

#### **Quiz: The Structure of the Atom**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

#### **Study: Atomic Models**

Given information about a particular model of the atom, determine if the model is consistent with specified evidence.

Duration: 1 hr Scoring: 0 points

#### **Quiz: Atomic Models**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

#### **Practice: Atomic Structure and Periodicity**

Predict and justify trends in atomic properties based on location on the periodic table and the shell model.

Duration: 1 hr Scoring: 25 points

### **Lab: Spectroscopy**

Justify the selection of a particular type of spectroscopy to measure properties associated with vibrational or electronic motions of molecules. Interpret the results of an experiment regarding the absorption of light to determine the concentration of an absorbing species in a solution.

Duration: 2 hrs 45 mins Scoring: 50 points

### **Discuss: Spectroscopy**

Analyze and evaluate scientific evidence, and communicate and apply the findings.

Duration: 1 hr Scoring: 15 points

### **Explore: Materials and the Periodicity of Elements**

Analyze, evaluate, and critique scientific explanations by examining scientific evidence.

Duration: 1 hr 30 mins Scoring: 25 points

## **LESSON 2: BONDING**

### **Read: Bonding**

Read about the forces of attraction that hold atoms together.

Duration: 3 hrs 30 mins Scoring: 0 points

### **Quiz: Bonding**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 25 mins Scoring: 30 points

### **Study: Models of Bonding**

Predict the type of bonding present between two atoms in a binary compound, based on location in the periodic table and the electronegativity of the elements.

Duration: 1 hr Scoring: 0 points

### **Quiz: Models of Bonding**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

### **Study: Examining the Composition of Materials**

Analyze data relating to electron energies in order to identify patterns and relationships.

Duration: 1 hr Scoring: 0 points

### **Quiz: Examining the Composition of Materials**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

### **Practice: Bonding**

Use Lewis diagrams and VSEPR to predict the geometry of molecules, identify hybridization, and make predictions about polarity.

Duration: 1 hr Scoring: 25 points

### **Lab: Types of Compounds**

Design a plan to collect and interpret data needed to deduce the type of bonding in a sample of a solid.

Duration: 2 hrs 45 mins Scoring: 50 points

### **Discuss: Types of Compounds**

Analyze and evaluate scientific evidence, and communicate and apply the findings.

Duration: 1 hr Scoring: 15 points

## **LESSON 3: ATOMIC STRUCTURE AND BONDING WRAP-UP**

**Test (CS): Atomic Structures and Bonding**

Take a computer-scored test to assess what you have learned in this unit.

Duration: 1 hr Scoring: 50 points

**Test (TS): Atomic Structures and Bonding**

Take a teacher-scored test to assess what you have learned in this unit.

Duration: 1 hr Scoring: 50 points

**UNIT 5: SEMESTER 1 EXAM****LESSON 1: SEMESTER 1 EXAM****Exam: Semester 1 Exam**

Take a computer-scored exam to demonstrate your mastery of concepts and skills covered this semester.

Duration: 1 hr Scoring: 100 points

**Final Exam: Semester 1 Exam**

Take a teacher-scored exam to demonstrate your mastery of concepts and skills covered this semester.

Duration: 1 hr Scoring: 100 points

**UNIT 6: INTERMOLECULAR FORCES****LESSON 1: INTERMOLECULAR FORCES AND THE PROPERTIES OF SOLIDS AND LIQUIDS****Read: Intermolecular Forces and the Properties of Solids and Liquids**

Read about how the properties of solids and liquids are the result of intermolecular forces.

Duration: 3 hrs 30 mins Scoring: 0 points

**Quiz: Intermolecular Forces and the Properties of Solids and Liquids**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 25 mins Scoring: 30 points

**Study: Intramolecular Forces versus Intermolecular Forces**

Evaluate the classification of a process as a physical change, chemical change, or ambiguous change, based on the distinction between rearrangements of covalent interactions and noncovalent interactions.

Duration: 1 hr Scoring: 0 points

**Quiz: Intramolecular Forces versus Intermolecular Forces**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

**Study: Solubility of Ionic Compounds**

Create and interpret representations that link the concept of molarity with particle views of solutions.

Duration: 1 hr Scoring: 0 points

**Quiz: Solubility of Ionic Compounds**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

**Practice: Intermolecular Forces and the Properties of Solids and Liquids**

Predict properties of substances based on their chemical formulas, and provide explanations of their properties based on particle views.

Duration: 1 hr Scoring: 25 points

**Lab: Paper Chromatography**

Design and interpret the results of a separation experiment (filtration, paper chromatography, column chromatography, or distillation) in terms of the relative strengths of interactions among the components.

Duration: 2 hrs 45 mins Scoring: 50 points

**Explore: Intermolecular Forces and the Properties of Biological Molecules**



Analyze, evaluate, and critique scientific explanations by examining scientific evidence.

Duration: 1 hr 30 mins Scoring: 25 points

### **Discuss: Paper Chromatography**

Discussion, Chromatography

Duration: 1 hr Scoring: 15 points

## **LESSON 2: INTERMOLECULAR FORCES AND THE PROPERTIES OF GASES**

### **Read: Intermolecular Forces and the Properties of Gases**

Read about how the properties of gases are the result of intermolecular forces.

Duration: 3 hrs 30 mins Scoring: 0 points

### **Quiz: Intermolecular Forces and the Properties of Gases**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 25 mins Scoring: 30 points

### **Study: Solving Equations Involving Gases**

Apply mathematical relationships or estimation to determine macroscopic variables for ideal gases.

Duration: 1 hr Scoring: 0 points

### **Quiz: Solving Equations Involving Gases**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

### **Study: Gas Behavior**

Use the law of conservation of energy to compare the magnitudes of the energy changes occurring in two or more interacting systems.

Duration: 1 hr Scoring: 0 points

### **Quiz: Gas Behavior**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

### **Practice: Intermolecular Forces and the Properties of Gases**

Refine multiple representations of a sample of matter in the gas phase to accurately portray the effects of changes in their macroscopic properties.

Duration: 1 hr Scoring: 25 points

### **Lab: Types of Chemical Reactions**

Evaluate the classification of a process as a physical change, chemical change, or ambiguous change, based on both macroscopic observations and the distinction between rearrangements of covalent interactions and noncovalent interactions.

Duration: 2 hrs 45 mins Scoring: 50 points

### **Discuss: Types of Chemical Reactions**

Analyze and evaluate scientific evidence, and communicate and apply the findings.

Duration: 1 hr Scoring: 15 points

## **LESSON 3: INTERMOLECULAR FORCES WRAP-UP**

### **Test (CS): Intermolecular Forces Wrap-Up**

Take a computer-scored test to assess what you have learned in this unit.

Duration: 1 hr Scoring: 50 points

### **Test (TS): Intermolecular Forces Wrap-Up**

Take a teacher-scored test to assess what you have learned in this unit.

Duration: 1 hr Scoring: 50 points

## **UNIT 7: KINETICS**

## LESSON 1: REACTION RATES

### Read: Reaction Rates

Read about the rate law and its dependence on reactant concentration.

Duration: 3 hrs 30 mins Scoring: 0 points

### Quiz: Reaction Rates

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 25 mins Scoring: 30 points

### Study: Rate Laws

Use representations of the energy profile for an elementary reaction to make qualitative predictions regarding the relative temperature dependence of the reaction rate.

Duration: 1 hr Scoring: 0 points

### Quiz: Rate Laws

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

### Study: Reactions and Collisions

Analyze concentration-versus-time data to determine the rate law for a zeroth-, first-, or second-order reaction.

Duration: 1 hr Scoring: 0 points

### Quiz: Reactions and Collisions

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

### Practice: Reaction Rates

Connect the half-life of a reaction to the rate constant of a first-order reaction, and justify this connection.

Duration: 1 hr Scoring: 25 points

### Lab: The Effects of Temperature and Particle Size

Design and interpret the results of an experiment regarding the factors (i.e., temperature, concentration, surface area) that may influence the rate of a reaction.

Duration: 2 hrs 45 mins Scoring: 50 points

### Discuss: The Effects of Temperature and Particle Size

Analyze and evaluate scientific evidence, and communicate and apply the findings.

Duration: 1 hr Scoring: 15 points

## LESSON 2: REACTION MECHANISMS AND CATALYSIS

### Read: Reaction Mechanisms and Catalysis

Read about how rates of chemical reactions are determined by details of the molecular collisions.

Duration: 3 hrs 30 mins Scoring: 0 points

### Quiz: Reaction Mechanisms and Catalysis

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 25 mins Scoring: 30 points

### Study: Reaction Rates and Mechanisms

Translate among reaction energy profile representations, particulate representations, and symbolic representations (chemical equations) of a chemical reaction occurring in the presence and absence of a catalyst.

Duration: 1 hr Scoring: 0 points

### Quiz: Reaction Rates and Mechanisms

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

**Study: Reaction Kinetics**

Explain the role of enzymes in biochemical reactions.

Duration: 1 hr Scoring: 0 points

**Quiz: Reaction Kinetics**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

**Practice: Reaction Mechanisms and Catalysis**

Explain changes in reaction rates arising from the use of acid-base catalysts, surface catalysts, or enzyme catalysts, including selecting appropriate mechanisms with or without the catalyst present.

Duration: 1 hr Scoring: 25 points

**Lab: Analyzing Concentration-versus-Time Data**

Analyze concentration-versus-time data to determine the rate law for a zeroth-, first-, or second-order reaction.

Duration: 2 hrs 45 mins Scoring: 50 points

**Explore: Enzymes as Biological Catalysts**

Analyze, evaluate, and critique scientific explanations by examining scientific evidence.

Duration: 1 hr 30 mins Scoring: 25 points

**LESSON 3: KINETICS WRAP-UP****Test (CS): Kinetics Wrap-Up**

Take a computer-scored test to assess what you have learned in this unit.

Duration: 1 hr Scoring: 50 points

**Test (TS): Kinetics Wrap-Up**

Take a teacher-scored test to assess what you have learned in this unit.

Duration: 1 hr Scoring: 50 points

**UNIT 8: CHEMICAL EQUILIBRIUM****LESSON 1: GENERAL EQUILIBRIUM****Read: General Equilibrium**

Read about the details of reactions in equilibrium.

Duration: 3 hrs 30 mins Scoring: 0 points

**Quiz: General Equilibrium**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 25 mins Scoring: 30 points

**Study: Systems at Equilibrium**

Given a set of experimental observations regarding physical, chemical, biological, or environmental processes that are reversible, construct an explanation that connects the observations to the reversibility of the underlying chemical reactions or processes.

Duration: 1 hr Scoring: 0 points

**Quiz: Systems at Equilibrium**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

**Study: Solving Equilibrium Problems**

Given a manipulation of a chemical reaction or set of reactions (e.g., reversal of reaction or addition of two reactions), determine the effects of that manipulation on  $Q$  or  $K$ .

Duration: 1 hr Scoring: 0 points

**Quiz: Solving Equilibrium Problems**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

#### **Practice: General Equilibrium**

Use Le Chatelier's principle to make qualitative predictions for systems in which coupled reactions that share a common intermediate drive the formation of a product.

Duration: 1 hr Scoring: 25 points

#### **Lab: Reversible Reactions**

Use Le Chatelier's principle to design a set of conditions that will optimize a desired outcome, such as product yield.

Duration: 2 hrs 45 mins Scoring: 50 points

#### **Explore: Reversible Reactions in Nature**

Analyze, evaluate, and critique scientific explanations by examining scientific evidence.

Duration: 1 hr 30 mins Scoring: 25 points

### **LESSON 2: SOLUBILITY EQUILIBRIUM**

#### **Read: Solubility Equilibrium**

Read about the role of chemical equilibrium in the solubility of compounds in aqueous solutions.

Duration: 3 hrs 30 mins Scoring: 0 points

#### **Quiz: Solubility Equilibrium**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 25 mins Scoring: 30 points

#### **Study: Salts and Solubility**

Characterize changes in matter using visual clues, and then create representations or written descriptions.

Duration: 1 hr Scoring: 0 points

#### **Quiz: Salts and Solubility**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

#### **Study: Principles of Equilibrium**

Interpret data regarding the relative solubility of salts in terms of factors (e.g., common ions, pH) that influence the solubility.

Duration: 1 hr Scoring: 0 points

#### **Quiz: Principles of Equilibrium**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

#### **Practice: Solubility Equilibrium**

Predict the solubility of a salt, or rank the solubility of salts, given the relevant  $K_{sp}$  values.

Duration: 1 hr Scoring: 25 points

#### **Lab: Solubility Equilibrium**

Analyze the enthalpic and entropic changes associated with the dissolution of a salt, using particulate level interactions and representations.

Duration: 2 hrs 45 mins Scoring: 50 points

#### **Discuss: Solubility Equilibrium**

Analyze and evaluate scientific evidence, and communicate and apply the findings.

Duration: 1 hr Scoring: 15 points

### **LESSON 3: CHEMICAL EQUILIBRIUM WRAP-UP**

#### **Test (CS): Chemical Equilibrium**

Take a computer-scored test to assess what you have learned in this unit.

Duration: 1 hr Scoring: 50 points

### Test (TS): Chemical Equilibrium

Take a teacher-scored test to assess what you have learned in this unit.

Duration: 1 hr Scoring: 50 points

## UNIT 9: ACID-BASE EQUILIBRIA

### LESSON 1: ACID-BASE EQUILIBRIA

#### Read: Acid-Base Equilibria

Read about the role of equilibrium in acid-base chemistry.

Duration: 3 hrs 30 mins Scoring: 0 points

#### Quiz: Acid-Base Equilibria

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 25 mins Scoring: 30 points

#### Study: Solving Acid-Base Equilibrium Problems

Identify a given solution as being the solution of a monoprotic weak acid or base (including salts in which one ion is a weak acid or base), calculate the pH and concentration of all species in the solution, and infer the relative strengths of the weak acids or bases from given equilibrium concentrations.

Duration: 1 hr Scoring: 0 points

#### Quiz: Solving Acid-Base Equilibrium Problems

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

#### Study: Acids and the Body

Based on the dependence of  $K_w$  on temperature, reason that neutrality requires that  $[H^+] = [OH^-]$  as opposed to requiring that  $pH = 7$ , and also consider the applications to biological systems.

Duration: 1 hr Scoring: 0 points

#### Quiz: Acids and the Body

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

#### Practice: Acid-Base Equilibria

Generate or use a particulate representation of an acid (strong, weak, or polyprotic) and a strong base to explain the species that will have large versus small concentrations at equilibrium.

Duration: 1 hr Scoring: 25 points

#### Lab: Acid-Base Titration

Interpret data from an experiment that uses titration to determine the concentration of an analyte in a solution.

Duration: 2 hrs 45 mins Scoring: 50 points

#### Discuss: Acid-Base Titration

Analyze and evaluate scientific evidence, and communicate and apply the findings.

Duration: 1 hr Scoring: 15 points

### LESSON 2: BUFFERS

#### Read: Buffers

Read about the components and resulting properties of buffer solutions.

Duration: 3 hrs 30 mins Scoring: 0 points

#### Quiz: Buffers

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 25 mins Scoring: 30 points

**Study: Acids and Bases**

Relate the predominant form of a chemical species involving a labile proton (i.e. the protonated/deprotonated form of a weak acid) to the pH of a solution and the pKa associated with the labile proton.

Duration: 1 hr Scoring: 0 points

**Quiz: Acids and Bases**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

**Study: The Nature of Acids and Bases**

Identify a solution as being a buffer solution, and explain the buffer mechanism in terms of the reactions that would occur upon addition of acid or base.

Duration: 1 hr Scoring: 0 points

**Quiz: The Nature of Acids and Bases**

Take a quiz to assess your understanding of the material.

Duration: 0 hrs 20 mins Scoring: 20 points

**Practice: Buffers**

Identify a solution as being a buffer solution, and explain the buffer mechanism in terms of the reactions that would occur upon addition of acid or base.

Duration: 1 hr Scoring: 25 points

**Lab: Buffers**

Design a buffer solution with a target pH and buffer capacity by selecting an appropriate conjugate acid-base pair and estimating the concentrations needed to achieve the desired capacity.

Duration: 2 hrs 45 mins Scoring: 50 points

**Explore: The Importance of Buffers in the Body**

Analyze, evaluate, and critique scientific explanations by examining scientific evidence.

Duration: 1 hr 30 mins Scoring: 25 points

**LESSON 3: ACID-BASE EQUILIBRIA WRAP-UP****Test (CS): Acid-Base Equilibria Wrap-Up**

Take a computer-scored test to assess what you have learned in this unit.

Duration: 1 hr Scoring: 50 points

**Test (TS): Acid-Base Equilibria Wrap-Up**

Take a teacher-scored test to assess what you have learned in this unit.

Duration: 1 hr Scoring: 50 points

**UNIT 10: SEMESTER 2 EXAM****LESSON 1: SEMESTER 2 EXAM****Exam: Semester 2 Exam**

Take a computer-scored exam to demonstrate your mastery of concepts and skills covered this semester.

Duration: 1 hr Scoring: 100 points

**Final Exam: Semester 2 Exam**

Take a teacher-scored exam to demonstrate your mastery of concepts and skills covered this semester.

Duration: 1 hr Scoring: 100 points