Pearson

Chemistry

Semester A Summary:

In this first of two courses that comprise Chemistry, the student will explore the fundamental concepts of chemistry, while engaging in hands-on and virtual lab experiments, and interdisciplinary problem-solving activities.
The student will build on prior knowledge to learn how to model the structure of an atom, analyze the periodic table of elements, identify simple chemical reactions and investigate particulate electrical forces. The course provides many opportunities for the student to apply these concepts to real-world situations.

Semester A Outline

1. **Course Overview**
    1. Chemistry A Course Overview
2. **Introduction to Chemistry**
    1. Introduction to Chemistry
    2. Physical vs. Chemical Change
        - In this section, you will learn how to identify the physical and chemical properties of different substances. This will ultimately help you figure out if a physical or chemical change has occurred.
        - In this section, you will learn how to tell if something is a pure substance or a mixture.
    3. Accuracy vs. Precision
        - In this section, you will analyze and evaluate data to differentiate between accuracy and precision of measurements.
        - In this section, you will differentiate between accuracy and precision of measurements.
    4. Mixtures
        - In this section, you will learn how to identify physical and chemical properties of different substances. This will ultimately help you figure out if a physical or chemical change has occurred and how to separate the components.
        - In this section, you will assess the evidence and credibility of scientific and technical information.
    5. Atomic Composition of Molecules
        - In this section, you will use a model to describe the atomic composition of simple molecules and extended structures.
        - In this lesson, you will learn the VSEPR theory and will explain molecular geometry using a PhET® simulation.
    6. Introduction to Chemistry Apply
    7. Introduction to Chemistry Review

8. Introduction to Chemistry Unit Test

3. **The Periodic Table**
    1. The Periodic Table Introduction
    2. Atomic Number
        - In this section, you will use information embedded in the structure of the periodic table to help you predict the relative properties of elements.
    3. Stable Ions
        - In this section, you will discover more information embedded in the structure of the periodic table regarding each atom's protons, neutrons, and electrons.
    4. Valence Electrons 1
        - In this section, you will describe electrons in the outermost energy level of atoms in the periodic table that are helpful in making predictions.
    5. Protons and Isotopes
        - In this lesson, you will predict the number of protons, neutrons, and electrons using elements of the periodic table.
        - In this lesson, you will explore isotope structure and stability using a PhET® simulation.
    6. Historical Understandings
        - In this section, you will examine historical experiments that led scientists to determine the structure of the atom and analyze the patterns in the periodic table.
        - In this lesson, you will explore Rutherford scattering in detail using a PhET® simulation.
    7. Element Groupings
        - In this section, you will describe how the arrangement of the main groups of the periodic table reflects the pattern of the outermost electrons.
    8. Element Arrangement
        - In this section, you will describe how the number of protons in an atom of an element is related to the element’s position on the periodic table.
    9. Reactivity
        - In this section, you will use the periodic table to predict the reactivity of atoms based on their outermost electrons.
    10. Bonds
        - In this section, you will use the periodic table to predict the number and types of chemical bonds that atoms of elements can form.
    11. Ions
        - In this lesson, you will examine energy level diagrams and the periodic table to make predictions about the ions that are likely to form from specific atoms.
    12. Naming Compounds
        - In this section, you will explain how substances are named based on the number of atoms and the type of interactions between atoms.
    13. The Periodic Table Apply
    14. The Periodic Table Review
    15. The Periodic Table Unit Test
4. **Solutions, Acids, and Bases**
    1. Solutions, Acids, and Bases Introduction
    2. Solutes and Solvents

- In this section, you will use models to explain how solutes dissolve in solvents.
- In this section, you will explore how temperature and pressure affect the solubility of different solutes.
- In this lesson, you will explore concentration of solutes in solvents using a PhET® simulation.

3. Ions in Polar Solvents
    - In this section, you will construct a model that shows how ionic substances dissolve in polar solvents.
4. Solutions, Acids and Bases Portfolio 1
    - In this section, you'll observe and ask questions about the conductivity of a solution.
5. Solutions, Acids and Bases Portfolio 2
    - In this section, you will design and explain the concepts behind an experiment to predict the conductivity of different solutions.
    - In this section, you will carry out the experiment that you designed to test the conductivity of various solutions.
    - In this section, you will analyze data to optimize a design.
6. Solutions, Acids and Bases Portfolio 3
    - In this section, you will evaluate and conclude your investigation by explaining the data as evidence of the conductivity of common ionic and covalent substances in solution.
7. Ph, Acids and Bases
    - In this section, you will use the concept of pH as a model to predict the relative properties of strong, weak, concentrated, and dilute acids and bases.
    - In this section, you will comment on the strengths of two acids or two bases with similar composition.
    - In this lesson, you will explore the pH scale using a PhET® simulation to make adjustments to the pH of a solution.
    - In this section, you will explain how pH and pOH quantify acid and base dissociation.
8. Acid Base Solutions
    - In this lesson, you will explore acids and bases using a PhET® simulation to identify strong and weak acids and bases.
    - In this lesson, you will explore acid strength using a PhET® simulation.
    - In this lesson, you will explore base strength using a PhET® simulation.
9. Solutions, Acids, and Bases Apply
10. Solutions, Acids, and Bases Review
11. Solutions, Acids, and Bases Unit Test

5. **Gases**
    1. Gases Introduction
    2. Gases Under Pressure
        - In this section, you will describe the relationships among pressure, temperature, and volume of an enclosed gas when the amount of gas is constant.
        - In this lesson, you will explore pressure, volume, and temperature variables of the Ideal Gas law using a PhET® simulation.
        - In this section, you will determine molar quantities using computational thinking based on the ideal gas law.

3. Gases Portfolio Day 1
    - In this section, you will ask questions about the behavior of ideal gases.
4. Gases Portfolio Day 2
    - In this section, you will design an investigation to explain the behavior of ideal gases.
    - In this section, you will examine design and implementation of investigations to explain the behavior of ideal gases.
    - In this section, you will generate a hypothesis that specifies what happens to a dependent variable when an independent variable is manipulated.
5. Gases Portfolio Day 3
    - In this section, you will evaluate and conclude investigations to explain the behavior of ideal gases.
6. Gases Apply
7. Gases Review
8. Gases Unit Test

6. **Simple Chemical Reactions**
    1. Simple Chemical Reactions Introduction
    2. Patterns of Properties
        - In this section, you will use knowledge of the periodic table, patterns of chemical properties, and understanding of electron energy levels to better understand chemical reactions.
    3. Balance of Atoms
        - In this section, you will explain the fact that the total number of atoms of each element is the same in the reactants and the products of a chemical reaction.
        - In this lesson, you will explore chemical reactions using a PhET® simulations. You will manipulatae products, reactants, and leftovers in a number of chemical reactions.
    4. Covalent and Ionic Bonding
        - In this section, you will use valence electron states and electronegativity to explain a simple chemical reaction, including the numbers and types of bonds that each atom forms.
    5. Molecular Geometry
        - In this section, you will describe how molecular geometry is predictive of physical and chemical properties.
    6. Valence Electrons
        - In this section, you will explain how the outcome of a simple chemical reaction is based on the valence electron state of the atoms involved and their position in the periodic table.
    7. Patterns of Attraction
        - In this section, you will construct an explanation of how patterns of attraction between atoms can allow the prediction of the type of reaction that occurs.
    8. Chemical Equations
        - In this section, you will identify and describe the valence electrons and chemical formulas of the reactants and products of chemical reactions.
    9. Balanced Reactions
        - In this section, you will explain a chemical reaction by identifying that both the number and types of atoms are present before and after the reaction.
    10. Bonding of Atoms in Reactions

- In this section, you will identify the number and types of bonds in reactants and products of chemical reactions.

11. Patterns of Reactivity
    - In this section, you will use the periodic table to explain patterns of reactivity in simple chemical reaction outcomes.
12. Relative Electronegativity
    - In this section, you will explain how the configuration of valence electrons and the electronegativity of atoms in reactants and products of chemical reactions are related to their position in the periodic table.
13. Chemical Reaction Predictions
    - In this section, you will explain, using evidence-based reasoning, how the patterns of valence electrons and electronegativity of elements are used to predict the number and types of bonds each element forms and that these patterns operate the same today as in the past and as they will in the future.
14. Explaining Reactions
    - In this section, you will construct a revised or expanded explanation about the outcome of a chemical reaction and use evidence to justify the revision.
15. Simple Chemical Reactions Apply
16. Simple Chemical Reactions Review
17. Simple Chemical Reactions Unit Test

7. **Oxidation**
    1. Oxidation Introduction
    2. Oxidation Reduction Reaction Model
        - In this section, you will predict the products in an oxidation-reduction reaction.
    3. Oxidation Electron Transfer
        - In this section, you will examine the mechanism of redox reactions and the tools used to analyze them.
        - In this section, you will examine how redox processes are harnessed to generate electricity.
    4. Oxidation Portfolio 1
        - In this section, you will develop questions that will help identify whether a redox equation occurred.
        - In this section, you will plan an investigation to determine whether rusting is a redox reaction.
    5. Oxidation Portfolio 2
        - In this section, you will conduct an investigation to determine whether rusting is a redox reaction.
    6. Oxidation Portfolio 3
        - In this section, you will evaluate the results of your investigation to determine if a redox reaction occurred.
    7. Oxidation Apply
    8. Oxidation Review
    9. Oxidation Unit Test
8. **Particulate Electrical Forces**
    1. Particulate Electrical Forces Introduction
    2. Electrical Bonding Investigation

- In this section, you will describe the relationship between electrical forces and measurable properties of a substance, such as melting point, boiling point, vapor pressure, and surface tension.

3. Electrical Bonding Investigation Plan
    - In this section, you will plan an investigation to provide data to use as evidence supporting an inference about the electrical forces between particles in substances.
4. Electrical Bonding Investigation Data
    - In this section, you will give reasons for choosing substances to compare and describe the composition of the substances at the atomic molecular level.
5. Electrical Bonding Investigation Evidence
    - In this section, you will describe the data, number of trials, experimental setup, and equipment needed to perform an investigation of properties affected by particulate molecular forces.
6. Electrical Bonding and Kinetic Energy
    - In this section, you will learn that when thermal energy is added to a substance, it causes an increase in the kinetic energy of the particles in that substance. This increased kinetic energy makes it more difficult for the attractive electrical forces to keep the particles close together.
7. Electrical Bonding: Multiple Scales
    - In this section, you will understand how a causal relationship between microscopic phenomena and macroscopic phenomena is established.
8. Electrical Bonding Investigation: Refining
    - In this lesson, you will refine the design of experiments by evaluating the results of an initial investigation.
9. Electrical Forces Portfolio 1
    - In this lesson, you will learn how to ask questions to compare bulk properties of different substances to infer the strength of electrical forces between molecules in each substance.
    - In this lesson, you will learn how to plan an investigation for comparing the relative strength of electrical forces between molecules in two different substances by making measurements of bulk properties.
10. Electrical Forces Portfolio 2
    - In this lesson, you will conduct your investigation, record data, and identify and eliminate sources of error while gathering evidence to infer the strength of electrical forces between particles.
11. Electrical Forces Portfolio 3
    - In this lesson, you will evaluate your investigation comparing the structure of substances and the strength of electrical forces between particles to learn how scientific results are interpreted within the scientific community.
12. Particulate Electrical Forces Apply
13. Particulate Electrical Forces Review
14. Particulate Electrical Forces Unit Test

9. **Chemistry A Semester Review and Exam**
    1. Chemistry A Semester Review
    2. Chemistry A Semester Exam

Semester B Summary:

In this second of two courses that comprise Chemistry, the student will explore the fundamental concepts of chemistry, while engaging in hands-on and virtual lab experiments, and interdisciplinary problem-solving activities.
The student will build on prior knowledge to learn about how energy is transformed in chemical reactions, construct explanations of how energy and matter are related, apply the conversation of mass to calculate and compare quantities of substances in reactions, and develop models of nuclear processes.

Semester B Outline

1. **Course Overview**
    1. Chemistry B Course Overview
2. **Energy In Chemical Reactions I**
    1. Energy In Chemical Reactions I Introduction
    2. Total Bond Energy
        - In this section, you will develop a model to illustrate that the release or absorption of energy from a chemical reaction depends upon the changes in total bond energy.
    3. The Reaction System
        - In this section, you will develop a model of a chemical reaction system that identifies the chemical reaction, the system, and the surroundings.
    4. Broken Bonds
        - Create a model of a chemical reaction system illustrating the substances present at the beginning and end of a specific reaction, as well as the events that take place during the reaction that result in the transformation.
    5. Forming Bonds
        - In this section, you will develop a model of a chemical reaction system that identifies the bonds that are formed during the reaction.
    6. Energy Transfer 1
        - In this section, you will develop a model of a chemical reaction system that identifies the energy transfer between the system and its components or the system and its surroundings.
    7. Potential and Kinetic Energy
        - In this section, you will analyze the transformation between potential and kinetic energies and the interface between a system and its surroundings.
    8. Relative Potential Energy 1
        - In this section, you will develop a model of a chemical reaction system that describes the relative potential energies of the reactants and the products.
    9. Energy In Chemical Reactions I Apply
    10. Energy In Chemical Reactions I Review
    11. Energy in Chemical Reactions I Unit Test
3. **Energy In Chemical Reactions II**
    1. Energy In Chemical Reactions II Introduction
    2. Changes in Bond Energy
        - In this section, you will describe the changes in bond energies during reactions.
    3. Energy Transfer 2

- In this section, you will use molecular collisions to describe chemical reaction energy transfers between the system and surroundings.

4. Equal and Opposite Energy
    - In this section, you will explain how the total energy change of the chemical reaction system is matched by an equal but opposite change of energy in the surroundings.
5. Relative Potential Energy 2
    - In this section, you will describe how the release or absorption of energy from a chemical reaction depends on the changes in total bond energy and whether the relative potential energies of the reactants and products decrease or increase.
6. Modeling Energy Change
    - In this section, you will explain that the energy change within a system is based on the change in the bond energies of the reactants and products.
7. Reactant and Product Energy Change
    - In this section, you will see that breaking bonds requires an input of energy from the system or surroundings, and forming bonds releases energy to the system and the surroundings.
8. Transfer Between Systems
    - In this section, you will show that the energy transfer between systems and surroundings is the difference between the bond energies of the reactants and the product.
9. Energy Conservation
    - In this section, you will show that the overall energy of a system and surroundings is unchanged (conserved) during a reaction.
10. Molecular Collision
    - In this section, you will see how energy transfer occurs during molecular collisions.
11. Total Potential Energy
    - In this section, you will see that the relative total potential energies of reactants and products can be accounted for by the changes in bond energy.
12. Energy In Chemical Reactions II Apply
13. Energy In Chemical Reactions II Review
14. Energy in Chemical Reactions II Unit Test

4. **Reaction Rates**
    1. Reaction Rates Portfolio 1
        - In this section, you will use evidence to explain the effects of changing the temperature or concentration of chemical reaction rates, including the idea that as the kinetic energy of colliding particles increases and the number of collisions increases, the reaction rate increases.
        - In this section, you will evaluate evidence to explain how increasing the concentration of reactants causes an increase in the rate of a chemical reaction.
    2. Reaction Rates Portfolio 2
        - In this section, you will evaluate evidence to explain how increasing the temperature of reactants causes an increase in the rate of a chemical reaction.
    3. Reaction Rates Portfolio 3

- In this section, you will describe how changing the concentration or temperature of reactants affects the rate of a chemical reaction.

5. **Chemical Reaction Systems**
    1. Chemical Reaction Systems Introduction
    2. Concentrations at Equilibrium
        - In this section, you will describe changes in a chemical reaction system that will affect the concentrations of a chemical species at equilibrium.
    3. Changing One Component
        - In this section, you will use Le Chatelier's principle to explain how product quantities in a chemical reaction system change when any of the components change.
    4. Changing Reaction Rates
        - In this section, you will discover how Le Chatelier's principle can be used to predict the impacts on a chemical reaction of changes in temperature, pressure, or concentration leading to a return to dynamic equilibrium.
    5. Equilibrium and Stability
        - In this section, you will explore how a reaction at equilibrium changes at the molecular level when it seems to be stable and unchanging at the macroscopic level.
    6. Chemical Technology
        - In this section, you will use information to explain how the use of chemistry-related technologies has had positive and negative implications.
    7. Forces and Function
        - In this section, you will describe the attractive and repulsive forces that determine how a material will function.
    8. Designing a Chemical System
        - In this section, you will describe criteria and constraints to refine a design for a chemical system.
    9. Evaluating Design
        - In this section, you will evaluate refinements to the design of a chemical system based on criteria and constraints.
    10. Using Organic Compounds
        - In this section, you will evaluate the design and function of products and processes that meet specific needs in relation to the molecular structures and functional groups of organic compounds.
    11. Refining Design
        - In this section, you will refine a designed system by making tradeoffs to optimize the system to increase the amount of product, and provide reasoning for the design decision.
    12. Chemical Reaction Systems Apply
    13. Chemical Reaction Systems Review
    14. Chemical Reaction Systems Unit Test
6. **Conservation of Mass**
    1. Conservation of Mass Introduction
    2. Balanced Chemical Equations
        - In this section, you will see how a chemical reaction is represented mathematically to indicate that the mass, or number of atoms, is conserved during a chemical reaction.
    3. Claiming Conservation

- In this section, you will support the claim that the number of atoms of elements in a reaction, and, therefore, the mass of those elements, does not change when reactants are converted to products.

4. Mathematical Representations
    - In this section, you will examine mathematical representations of a chemical equation to support the claim that atoms, and thus mass, are conserved during chemical reactions.
5. Use the Mole
    - In this section, you will convert between moles and grams.
6. Reactants vs. Products
    - In this section, you will predict relative numbers of atoms in reactants versus products for chemical reactions.
7. Calculating Mass
    - In this section, you will calculate the unknown masses of parts of a chemical reaction using the known mass of one part of that reaction.
8. Specific Mass Conversions
    - In this section, you will describe how mathematical representations support a claim that atoms, and therefore mass, are conserved during a chemical reaction.
9. Mass and Atoms
    - In this section, you will convert the mass of a substance from the macroscopic to the atomic scale using moles and Avogadro's number.
10. Conservation of Mass Apply
11. Conservation of Mass Review
12. Conservation of Mass Unit Test

7. **Nuclear Processes**
    1. Nuclear Processes Introduction
    2. Energy Release
        - In this section, you will describe parts of a model that shows the composition of the nucleus of the atom.
    3. Modeling Nuclear Processes
        - In this section, you will develop models that show the relationships between components that underlie several nuclear processes.
    4. Modeling Fusion
        - In this section, you will develop a model that shows a process called nuclear fusion in which two nuclei merge to form a single, larger nucleus.
    5. Modeling Fission
        - In this section, you will develop a model that shows a process called nuclear fission in which a nucleus splits into two or more parts.
    6. Radioactive Decay Energy
        - In this section, you will develop models of radioactive decay that show the differences in the types of energy and/or particles released.
    7. Alpha Particle Emission
        - In this section, you will develop a radioactive decay model that classifies alpha decay as a type of nuclear fission and beta and gamma decays as not nuclear fission.
    8. Nuclear Processes Apply
    9. Nuclear Processes Review
    10. Nuclear Processes Unit Test

8. **Ecology Chemistry**
    1. Ecology Chemistry Introduction
    2. Greenhouse Gases
        - In this section, you will identify the impact of greenhouse gases on Earth's climate by analyzing their molecular structure during energy absorption.
    3. Water and Air Chemistry
        - In this lesson you'll examine the causes and severity of problems related to water and air quality.
    4. Ecology Chemistry Portfolio 1
        - In this section, you'll explain methods and measurements used to determine contaminant levels in water.
    5. Ecology Chemistry Portfolio 2
        - In this section, you'll explain determinants of limits of contaminants in water over time.
    6. Ecology Chemistry Portfolio 3
        - In this section, you'll learn to judge the effectiveness of regulations and why they must be consistently monitored.
    7. Remediate Chemical Pollution
        - In this section, you will describe why it is necessary to remediate and treat problems related to air and water quality.
    8. Impact of Chemical Processes
        - In this lesson you'll research and critique claims by various stakeholders concerning impacts on local environments by mining and other industrial operations. You will also analyze the pre-approval and review processes, evaluate proposed mitigations, and assess the fairness of any settlement actions.
    9. Ecology Chemistry Apply
    10. Ecology Chemistry Review
    11. Ecology Chemistry Unit Test
9. **Chemistry B Semester Review and Exam**
    1. Chemistry B Semester Review
    2. Chemistry B Semester Exam