

Introduction to Chemistry and Physics

UNIT I: Introduction to the Physical Sciences

Goal 1. The student will demonstrate the ability to explore and apply the processes of science.

Objectives - The student will be able to:

- a. Describe and apply the steps of the scientific method.
- b. Defend the benefit of a consistent system of units.
- c. Identify the SI units for length, mass, and time.
- d. Identify and use common metric prefixes including kilo, centi, and milli.
- e. Describe the importance of significant figures.
- f. Use significant figures in calculations.
- g. Read and write numbers with scientific notation.
- h. Explain accuracy and precision.
- i. Use proper analytical techniques in laboratories and calculations.

UNIT II: Matter

Goal 1. The student will demonstrate the ability to classify different kinds of matter.

Objectives - The student will be able to:

- a. Identify materials as pure substances or mixtures.
- b. Distinguish between elements and compounds.
- c. Identify and use the chemical formulas of common substances.
- d. Describe the characteristics of solids, liquids, and gases.
- e. Describe the energy transitions involved in a change of state.
- f. Distinguish between the physical and the chemical properties of matter.
- g. Explain that the arrangement of atoms or molecules causes physical properties.
- h. Explain that outer electrons cause chemical properties of elements.
- i. Distinguish between physical and chemical changes in matter.
- j. Use $D = m/V$ to calculate an object's density or find its mass or volume.

Goal 2. The student will demonstrate the ability to summarize and apply the law of conservation of matter and the law of conservation of energy.

Objectives - The student will be able to:

- a. Identify and apply the law of conservation of mass.
- b. Identify and apply the law of conservation of energy.

UNIT III: Atomic Structure

Goal 1. The student will demonstrate the ability to determine the composition of atoms, ions, and isotopes and the significance of subatomic particles.

Objectives - The student will be able to:

- a. Describe the particulate form of matter.
- b. Identify the parts of atoms and their relative sizes.
- c. List the three basic particles that comprise the atom.
- d. Identify the charge, location, and mass of protons, neutrons, and electrons.
- e. Explain the significance of atomic number.
- f. Explain how isotopes differ from one another.
- g. Describe why atoms have no charge and ions have a charge.
- h. Calculate the number of protons, neutrons, and electrons of an atom, ion, or isotope, given its symbol, mass number, atomic number, and/or charge.
- i. Describe how the abundance of isotopes affects an element's average atomic mass.

Goal 2. The student will demonstrate the ability to illustrate the development of modern atomic theory.

Objectives - The student will be able to:

- a. Compare the Bohr model of the atom with more current models.
- b. Explain how science is a developing field where theories are challenged and improved.

UNIT IV: The Periodic Table

Goal 1. The student will demonstrate the ability to describe the organization of the periodic table.

Objectives - The student will be able to:

- a. Identify the location of metals, nonmetals, and semimetals in the periodic table.
- b. Define families, or groups, of elements and explain why these elements are grouped together.
- c. Identify the alkali metals, alkaline-earth metals, transition metals, halogens, and noble gases in the periodic table.

Goal 2. The student will demonstrate the ability to describe periodicity.

Objectives - The student will be able to:

- a. Explain what periodicity is in terms of the periodic table.
- b. Explain the source of the chemical periodicity of the periodic table.
- c. Define valence electrons.
- d. Explain why some atoms gain or lose electrons to form ions.
- e. Predict the charge of an ion, given the element's location on the periodic table.

UNIT V: Bonding

Goal 1. The student will demonstrate the ability to distinguish among ionic, covalent, and metallic bonds and explain how the different kinds of bonds affect the properties of the substance.

Objectives - The student will be able to:

- a. Distinguish between mixtures and compounds.
- b. Relate the chemical formula of a compound to its number of atoms or ions.
- c. Explain how bonds are formed.
- d. Explain why atoms sometimes join to form bonds.
- e. Compare ionic, covalent, and metallic bonds.
- f. Compare the properties of substances with different bond types.
- g. Describe how bond type affects the properties of substances.

UNIT VI: Chemical Reactions

Goal 1. The student will demonstrate the ability to classify chemical reactions.

Objectives - The student will be able to:

- a. Explain that chemical reactions occur both around us and inside us.
- b. Identify the evidences of a chemical reaction.
- c. Distinguish among the five general types of chemical reactions.
- d. Describe the differences between exothermic and endothermic reactions.
- e. Describe the factors that affect reaction rates.
- f. Describe the behavior of catalysts.

Goal 2. The student will demonstrate the ability to balance simple equations.

Objectives - The student will be able to:

- a. Distinguish between reactants and products in a chemical reaction.
- b. Explain that a balanced chemical equation supports the law of conservation of mass.
- c. Balance simple chemical equations.

UNIT VII: Solutions

Goal 1. The student will demonstrate the ability to describe characteristics of solutions.

Objectives - The student will be able to:

- a. Compare homogeneous vs. heterogeneous mixtures.
- b. Explain how dissolving is different than melting.
- c. Compare the properties of solutions, colloids, and suspensions.
- d. Compare the properties of saturated, unsaturated, and supersaturated solutions.
- e. Identify the factors that affect the rate of dissolving.

UNIT VIII: Acids and Bases

Goal 1. The student will demonstrate the ability to describe the characteristics of acids and bases.

Objectives - The student will be able to:

- a. Compare the definitions and properties of acids and bases.
- b. Relate concentration and strength to the pH of an acid or base.
- c. Describe what a neutralization reaction is and list its products.
- d. Recognize several acidic and basic substances commonly found in homes.

UNIT IX: One-Dimensional Motion

Goal 1. The student will demonstrate the ability to select the kinematics and algebraic concepts necessary to describe one-dimensional motion.

Objectives – The student will be able to:

- a. Use kinematic concepts to describe an object's motion, including frames of reference, position, direction, distance and displacement, speed and velocity, and acceleration.
- b. Use $d = vt$, $a = \Delta v / \Delta t$, and $d = at^2$ to calculate for the three variables.
- c. Use simple motion graphs to describe an object's motion.

UNIT X: Newton's Laws and Gravity

Goal 1. The student will analyze the changes in an object's motion as described by Newton's laws.

Objectives – The student will be able to:

- a. Explain how balanced and unbalanced forces affect motion.
- b. Explain the concept of inertia and its relation to motion.
- c. Explain how acceleration, force, and mass are related.
- d. Explain how action and reaction forces affect motion.

Goal 2. The student will analyze the behavior of masses under the influence of gravitational forces.

Objectives – The student will be able to:

- a. Recognize the factors that affect the strength of the gravitational force between two masses.
- b. Describe how the gravitational force between the earth and masses near the surface of the earth acts on those masses.

UNIT XI: Two-Dimensional Motion

Goal 1. The student will apply algebraic and geometric concepts to describe the two-dimensional motion of an object.

Objectives – The student will be able to:

- a. Symbolically represent vector quantities
- b. Use algebraic and geometric concepts to describe motions, including uniform circular motion and projectile motion.

UNIT XII: Energy and Momentum

Goal 1. The student will demonstrate the ability to interpret the behavior of objects using energy concepts.

Objectives – The student will be able to:

- a. Define energy and work.
- b. Identify the relationship of work to energy.
- c. Use $W=Fd$ to calculate for any of the three variables.
- d. Analyze systems with regard to the law of conservation of energy.
- e. Show the connections that exist within the various fields of science and among science and other disciplines with regards to energy.

Goal 2. The student will demonstrate the ability to explain the behavior of objects using momentum concepts.

Objectives – The student will be able to:

- a. Define momentum as the product of mass and velocity.
- b. Analyze systems in terms of the law of conservation of momentum.

UNIT XIII: Electricity

Goal 1. The student will demonstrate the ability to explain the principles that describe electricity.

Objectives – The student will be able to:

- a. Describe different types of electric charges and the forces that exist between them, including magnitude, sign, and Coulomb's law.
- b. Describe the sources and effects of electric fields, including static charge, moving charge, and simple circuits.
- c. Describe the effect of electric fields on different kinds of materials, including conductors, insulators, and semiconductors.
- d. Illustrate applications of the laws of electricity in nature and technology.

UNIT XIV: Magnetism

Goal 1. The student will demonstrate the ability to explain the principles that describe magnetism.

Objectives – The student will be able to:

- a. Describe the sources and effects of magnetic fields, including moving charges and permanent magnets.
- b. Describe how different kinds of materials respond to magnetic fields, including magnetic materials.
- c. Explain the principle of electromagnetic induction and its applications to motors and generators.
- d. Illustrate applications of the laws of magnetism in nature and technology.