

Introduction to Chemistry



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Alta Introduction to Chemistry aims to develop the basic chemical principles, such as atomic structure, chemical classifications, bonding, chemical reactions, gas laws, and thermodynamics. The course was developed to meet the scope and sequence of a typical one-semester introductory chemistry course. To develop the course, Knewton used three main sources of content: Openstax Chemistry, videos created by a Chemistry professor with a graduate degree from Cal State Northridge who has taught in various undergraduate settings but specializes in organic chemistry, and a team of Subject Matter Experts (SMEs). The SMEs come from diverse backgrounds and are all accomplished academics in the chemistry field.

Alta Introduction to Chemistry has at least two instructional sequences for every learning objective, giving students multiple opportunities to learn new concepts. Between our instructional texts, videos, and SMEs, we were able to solicit ideas from chemistry instructors and students. Alta Introduction to Chemistry covers the typical breadth of chemistry topics, and also provides the necessary depth to ensure the course is manageable and engaging for instructors and students alike.

Introduction to Chemistry | Table of Contents

Chapter 1: An Introduction to Chemistry

1.1 Chemistry in the World

- Understand the scope, importance, and aim of chemistry
- Identify examples of chemistry encountered in daily life

1.2 The Scientific Method

- Understand the scientific method

Chapter 2: Measurement and Problem Solving

2.1 Scientific Notation

- Express numbers in standard notation using prefixes and in scientific notation

2.2 Accuracy, Precision, and Significant Figures

- Distinguish between accuracy and precision in measurements
- Determine the number of significant figures in measurements
- Use significant figures when performing calculations

2.3 The Basic Units of Measurement

- Understand how to use the SI system for units names and abbreviations
- Identify and use SI units for length, volume, and mass
- Identify and use the SI units for time and temperature

2.4 Problem Solving, Unit Conversion, and Dimensional Analysis

- Solve unit conversion problems using dimensional analysis: single step
- Solve unit conversion problems using dimensional analysis: multiple steps
- Use Celsius, Fahrenheit, and Kelvin temperature scales and convert between them

2.5 Converting Units Raised to a Power

- Solve conversion problems involving units raised to a power

2.6 Density

- Perform specific gravity and density calculations

Chapter 3: Matter and Energy

3.1 Matter, Mass, and Weight

- Compare and contrast the three states of matter
- Distinguish between weight and mass

3.2 Atoms, Molecules, Compounds, Mixtures

- Identify and describe molecules and atoms
- Classify matter as elements or compounds
- Distinguish between homogeneous and heterogeneous mixtures

3.3 Physical and Chemical Properties and Changes

- Understand physical properties and physical changes
- Understand chemical properties and chemical changes

3.4 Conservation of Mass

- Understand and demonstrate the law of conservation of matter
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3.5 Energy

- Define the types of energy
- Define thermal energy and heat and distinguish between exothermic and endothermic processes
- Calculate heat capacity given heat and temperature change

Chapter 4: Atoms and Elements

4.1 The Evolution of the Atomic Theory

- Understand Dalton's Atomic Theory
- Describe modern atomic theory and recognize the scientists involved

4.2 Atomic Structure

- Identify and describe the subatomic particles that make up an atom

4.3 Identifying Elements

- Determine the number of protons, electrons, and neutrons in the atom by using the atomic and mass numbers
- Read and identify chemical symbols

4.4 The Periodic Table

- Read and interpret element blocks on the periodic table
- Identify the group on the periodic table an element belongs to
- Understand how elements are arranged in the periodic table

4.5 Identifying Ions and Isotopes

- Define ions and distinguish between monatomic and polyatomic ions
- Determine the number of protons, electrons, and neutrons in the isotope from the atomic symbol and write the atomic symbol for the specific isotope

4.6 Calculating Atomic Mass

- Calculate the average atomic mass of an element given isotopic mass and fractional abundance isotopes

Chapter 5: Molecules and Compounds

5.1 An Introduction to Molecules: Constant Composition

- Understand the law of definite and the law of multiple proportions

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- Read and write molecular formulas for given atomic composition
- Read and interpret structural formulas

5.3 Ionic and Molecular Compounds

- Describe the properties of ionic compounds
- Understand the type of bonding between atoms in a molecular compound

5.4 Naming Ionic Compounds

- Write the name and formula of an ionic compound with a simple ion
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- Write the name and formula of a metal ion with a variable charge

5.5 Naming Molecular Compounds and Acids

- Write the name and formula of a molecular compound
 - Write the name and formula of a binary acid
 - Write the name and formula of an oxyacid
-

5.6 Calculating Formula Mass

- Determine the formula mass for covalent substances
- Determine the formula mass for ionic compounds

Chapter 6: Chemical Composition

6.1 The Mole

- Understand the mole as a unit in measurements
- Convert moles to grams and grams to moles for elements and compounds

6.2 Counting Atoms

- Derive the number of atoms from an element's mass
- Derive the number of molecules and atoms from the mass of a compound

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- Calculate percent composition from molecular formula

6.4 Calculating Empirical Formulas

- Determine an empirical formula from the masses of a compound's elements
- Determine an empirical formula from the percent composition of a compound

6.5 Calculating Molecular Formulas

- Derive a molecular formula for a compound from percent composition and molecular mass

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7.1 Identifying Chemical Reactions

- Identify and describe chemical reactions

7.2 Writing and Balancing Chemical Equations

- Understand how to represent chemical reactions using an equations
- Write and balance chemical reactions

7.3 Precipitation Reactions and Solubility Rules

- Understand solubility rules and precipitation reactions

7.4 Chemical Equations For Ionic Reaction in Solution

- Write and balance equations for ionic reactions

7.5 Acid—Base and Gas Evolution Reactions

- Write balanced chemical equations for acid-base reactions
- Write the chemical equation for a gas evolution reaction

7.6 Oxidation—Reduction Reactions

- Understand oxidation and reduction

7.7 Classifying Chemical Reactions

- Classify chemical reactions

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- Calculate the molar ratios from balanced equations

8.2 Mole-Mole and Mass-Mass conversions

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- Calculate the number of product moles generated by a reaction
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- Define and calculate enthalpy

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9.1 The Electromagnetic Spectrum

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9.2 The Bohr Model

- Understand the Bohr atomic model
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9.3 Orbitals and Electron Configuration

- Define and describe quantum numbers
- Describe electron configurations of atoms
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9.4 Electron Configurations and the Periodic Table

- Distinguish between valence and core electrons
- Determine the electron configuration of an element
- Write the electron configuration of an ion

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- Understand the units of pressure and convert between them

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- Perform calculations using Avogadro's law

11.5 The Ideal Gas Law: Pressure, Volume, Temperature, and Moles

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- Perform calculations with Dalton's Law
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- Determine the amount of product from a chemical reaction of gases

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12.1 Properties of Liquids and Solids

- Compare and contrast intermolecular and intramolecular forces
- Compare and contrast properties of liquids and solids

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- Define, identify, and describe viscosity
- Identify cohesive forces and adhesive forces in nature
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- Define and describe condensation and vaporization
- Define boiling point and describe its changes at various pressures
- Calculate heat required to vaporize a liquid
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12.4 Melting, Freezing, and Sublimation

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 - Compare and contrast the properties of deposition and sublimation
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12.5 Types of Intermolecular Forces

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12.6 Types of Crystalline Solids: Molecular, Ionic, and Atomic

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- Describe the formation and properties of solutions
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14.4 The pH and pOH Scales

- Calculate concentrations of hydronium and hydroxide ions
 - Classify solutions as an acidic, basic, or neutral based on pH or hydronium/hydroxide concentrations
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- Identify hydronium and hydroxide concentrations on the pH and pOH scales
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- Interpret and understand titration curves
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15.1 Rate of a Chemical Reaction and the Collision Theory

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- Define collision theory

15.2 Factors Affecting Reaction Rates

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- Explain how concentration and temperature of reactant affects the rate of reaction

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- Describe the features of chemical equilibria
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- Compare heterogeneous and homogeneous equilibria

15.5 Calculating and Using Equilibrium Constants

- Calculate equilibrium constants
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- Calculate changes in concentration in equilibrium reactions

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- Understand the effect that changes in concentration have on equilibrium
- Understand the effect that changes in pressure have on equilibrium
- Understand the effect that changes in temperature have on equilibrium

15.7 The Solubility-Product Constant

- Write equations for solubility products
- Calculate K_{sp} values
- Perform calculations using K_{sp} values
- Calculate the solubility of a molecule using K_{sp} values

15.8 Activation Energy and Catalysts

- Calculate activation energy using the Arrhenius equation
 - Define and identify catalysts
-

Chapter 16: Oxidation and Reduction

16.1 Oxidation and Reduction

- Explain the fundamentals of electrochemistry
- Determine the oxidation state of each atom in a molecule

16.2 Balancing Redox Equations

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- Determine if a redox reaction will occur spontaneously

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- Explain galvanic cells
- Explain the features of primary batteries and how they work
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- Describe electrolysis and electrolytic cells
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- Describe corrosion and identify examples

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- Explain stability of nuclei

17.2 Nuclear Equations

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- Write and balance equations for alpha, beta, positron, and gamma decay

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- Calculate half-lives of radioactive substances
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- Explain the synthesis of nuclides and transmutation
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18.1 Distinguishing between Organic and Inorganic

- Compare and contrast properties of organic and inorganic compounds

18.2 Hydrocarbons

- Distinguish between the various types of hydrocarbons and describe their basic properties
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18.3 Alkanes: Saturated Hydrocarbons

- Recognize chemical and physical properties of alkanes
- Identify and draw isomers of alkanes
- Understand how to name alkanes and write their formulas

18.4 Alkenes and Alkynes

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- Name and write formulas for aromatic compounds and recognize their physical and chemical properties

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- Identify the characteristics of ketones and aldehydes

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19.2 Carbohydrates: Sugar, Starch, and Fiber

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19.3 Lipids

- Understand lipid diversity and distinguish between the lipids as a group and the polymers
- Identify the carboxyl group and the hydrocarbon chain in a fatty acid and distinguish between saturated and unsaturated fatty acids

19.4 Proteins and Amino Acids

- Identify the structural components of an amino acid and understand the chemical diversity of amino acids

19.5 Protein Structure

- Distinguish between the different levels of protein structure, including primary, secondary, tertiary, and quaternary
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19.6 Nucleic Acids

- Identify the three components of nucleotides and distinguish between purines and pyrimidines

19.7 DNA Structure

- Understand the complementarity of the DNA double helix
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