General Chemistry (First Quarter)

This course covers the topics shown below. Students navigate learning paths based on their level of readiness. Institutional users may customize the scope and sequence to meet curricular needs.

Curriculum (252 topics)

- Math and Physics (57 topics)
  - Mathematics (16 topics)
    - Integer multiplication and division
    - Simplifying a fraction
    - Equivalent fractions
    - Signed fraction addition or subtraction: Basic
    - Signed fraction multiplication: Basic
    - Signed fraction division
    - Exponents and fractions
    - Introduction to inequalities
    - Writing expressions using exponents
    - Introduction to exponents
    - Introduction to order of operations
    - Ordering numbers with positive exponents
    - Evaluating expressions with exponents of zero
    - Evaluating an expression with a negative exponent: Whole number base
    - Evaluating an expression with a negative exponent: Positive fraction base
    - Complex fraction without variables: Problem type 1
  - Algebra Expressions (16 topics)
    - Evaluating a quadratic expression: Integers
    - Combining like terms: Integer coefficients
    - Combining like terms in a quadratic expression
    - Distributive property: Integer coefficients
    - Using distribution and combining like terms to simplify: Univariate
    - Introduction to the product rule of exponents
    - Product rule with positive exponents: Univariate
    - Introduction to the product rule with negative exponents
    - Introduction to the quotient rule of exponents
    - Simplifying a ratio of univariate monomials
    - Quotient rule with negative exponents: Problem type 1
    - Introduction to the power of a product rule of exponents
    - Power and quotient rules with positive exponents
    - Rewriting an algebraic expression without a negative exponent
    - Multiplying rational expressions involving multivariate monomials
    - Complex fraction involving univariate monomials
  - Linear Equations (10 topics)
    - Identifying solutions to a linear equation in one variable: Two-step equations
    - Identifying solutions to a linear equation in two variables
    - Additive property of equality with integers
Additive property of equality with a negative coefficient
Multiplicative property of equality with signed fractions
Solving a multi-step equation given in fractional form
Solving a linear equation with several occurrences of the variable: Fractional forms with monomial numerators
Solving for a variable in terms of other variables using addition or subtraction with division
Solving for a variable in terms of other variables in a linear equation with fractions
Additive property of inequality with integers

Graphing Equations (4 topics)
Classifying slopes given graphs of lines
Graphing a line through a given point with a given slope
Finding slope given the graph of a line on a grid
Finding slope given two points on the line

Graphing Data (6 topics)
Constructing a scatter plot
Sketching the line of best fit
Scatter plots and correlation
Choosing a graph to fit a narrative: Basic
Choosing a graph to fit a narrative: Advanced
Constructing a histogram for numerical data

Electrostatics (5 topics)
Understanding that opposite charges attract and like charges repel
Understanding how electrostatic force scales with charge and separation
Understanding how electrostatic forces cancel
Understanding how electrostatic energy scales with charge and separation
Sketching polarization induced by a nearby charge

Measurement (28 topics)
Scientific Notation (5 topics)
Multiplication of a decimal by a power of ten
Division of a decimal by a power of ten
Converting between decimal numbers and numbers written in scientific notation
Multiplying and dividing numbers written in scientific notation
Calculating positive powers of scientific notation
SI Units (7 topics)
Knowing the dimension of common simple SI units
Understanding the purpose of SI prefixes
Knowing the value of an SI prefix as a power of 10
Interconversion of prefixed and base SI units
Interconversion of prefixed SI units
Interconverting compound SI units
Interconverting temperatures in Celsius and Kelvins
Measurement Math (3 topics)
Addition and subtraction of measurements
Simplifying unit expressions
Multiplication and division of measurements
Measurement Uncertainty (5 topics)
Counting significant digits
Rounding to a given significant digit
Counting significant digits when measurements are added or subtracted
Counting significant digits when measurements are multiplied or divided
Adding or subtracting and multiplying or dividing measurements
Quantitative Problem Solving (8 topics)
Setting up a one-step unit conversion
◊ Setting up a unit reprefix conversion
◊ Predicting the units of the solution to a basic quantitative problem
◊ Setting up the solution to a basic quantitative problem
◊ Identifying errors in the solution to a basic quantitative problem
◊ Setting up the math for a one–step quantitative problem
◊ Setting up the math for a one–step problem with unit conversion
◊ Setting up the math for a two–step quantitative problem

• Matter (14 topics)
  ◆ Mass, Volume and Density (4 topics)
    ◊ Estimating the volume in liters of a square prism object
    ◊ Finding the side length of a cube from its volume in liters
    ◊ Calculating mass density
    ◊ Using mass density to find mass or volume
  ◆ Atomic Theory (4 topics)
    ◊ Distinguishing elements and compounds
    ◊ Distinguishing compounds and mixtures
    ◊ Distinguishing chemical and physical change
    ◊ Distinguishing solid, liquid and gas phases of a pure substance
  ◆ Chemical Elements (6 topics)
    ◊ Names and symbols of important elements
    ◊ Reading a Periodic Table entry
    ◊ Understanding periods and groups of the Periodic Table
    ◊ Organization of the Periodic Table
    ◊ Standard chemical and physical states of the elements
    ◊ Using the Periodic Table to identify similar elements

• Atoms, Ions and Molecules (27 topics)
  ◆ Atomic Structure (11 topics)
    ◊ Identifying the parts of an atom
    ◊ Counting protons and electrons in atoms and atomic ions
    ◊ Finding isoelectronic atoms
    ◊ Predicting the ions formed by common main–group elements
    ◊ Isotopes
    ◊ Finding atomic mass from isotope mass and natural abundance
    ◊ Finding isotope mass or natural abundance from atomic mass
    ◊ Counting valence electrons in a neutral atom
    ◊ Counting valence electrons in an atomic ion
    ◊ Drawing the Lewis dot diagram of a main group atom or common atomic ion
    ◊ Counting the electron shells in a neutral atom
  ◆ Chemical Compounds (5 topics)
    ◊ Counting the number of atoms in a formula unit
    ◊ Writing a chemical formula given a molecular model
    ◊ Writing a chemical formula given a chemical structure
    ◊ Understanding the prefixes used in naming binary compounds
    ◊ Naming binary covalent compounds
  ◆ Ionic Compounds (11 topics)
    ◊ Predicting whether a compound is ionic or molecular
    ◊ Predicting the formula of binary ionic compounds
    ◊ Naming binary ionic compounds
    ◊ Deducing the ions in a binary ionic compound from its empirical formula
    ◊ Predicting and naming ionic compounds formed by two elements
    ◊ Identifying common polyatomic ions
    ◊ Predicting the formula of ionic compounds with common polyatomic ions
    ◊ Naming ionic compounds with common polyatomic ions

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◊ Deducing the ions in a polyatomic ionic compound from its empirical formula
◊ Identifying oxoanions
◊ Naming ionic compounds with common oxoanions

• Stoichiometry (30 topics)
  ◆ Moles and Molar Mass (10 topics)
    ◊ Using the Avogadro Number
    ◊ Calculating and using the molar mass of elements
    ◊ Calculating and using the molar mass of diatomic elements
    ◊ Finding chemical formulae from a mole ratio
    ◊ Finding molar mass from chemical formulae
    ◊ Interconverting number of atoms and mass of compound
    ◊ Finding mass percent from chemical formulae
    ◊ Elemental analysis
    ◊ Finding a molecular formula from molar mass and elemental analysis
  ◆ Chemical Equations (6 topics)
    ◊ Stoichiometric coefficients
    ◊ Balancing chemical equations with noninterfering coefficients
    ◊ Balancing chemical equations with interfering coefficients
    ◊ Identifying combination, decomposition, single and double displacement reactions
    ◊ Writing a chemical equation from a description of the reaction
    ◊ Writing the net equation for a sequence of reactions
  ◆ Reaction Stoichiometry (7 topics)
    ◊ Using a chemical equation to find moles of product from moles of reactant
    ◊ Solving for a reactant using a chemical equation
    ◊ Identifying the limiting reactant in a drawing of a mixture
    ◊ Limiting reactants
    ◊ Theoretical yield of chemical reactions
    ◊ Percent yield of chemical reactions
    ◊ Reaction sequence stoichiometry
  ◆ Solution Stoichiometry (7 topics)
    ◊ Calculating molarity using solute moles
    ◊ Using molarity to find solute moles and solution volume
    ◊ Calculating molarity using solute mass
    ◊ Using molarity to find solute mass and solution volume
    ◊ Dilution
    ◊ Solving for a reactant in solution
    ◊ Solving limiting reactant problems in solution

• Simple Reactions (15 topics)
  ◆ Precipitation (3 topics)
    ◊ Predicting the products of dissolution
    ◊ Writing net ionic equations
    ◊ Predicting precipitation
  ◆ Acid–Base Reactions (6 topics)
    ◊ Identifying precipitation, combustion and acid–base reactions
    ◊ Identifying acids and bases by their chemical formula
    ◊ Predicting the products of a neutralization reaction
    ◊ Naming inorganic acids
    ◊ Deducing the formulae of inorganic acids from their names
    ◊ Naming acid salts
  ◆ Oxidation–Reduction Reactions (6 topics)
    ◊ Assigning oxidation numbers
    ◊ Recognizing reduction and oxidation
Identifying oxidizing and reducing agents
Identifying oxidized and reduced reactants in a metal–nonmetal reaction
Identifying oxidized and reduced reactants in a single–displacement reaction
Predicting whether simple electrochemical reactions happen

• Thermochemistry (17 topics)
  ♦ Energy (5 topics)
    ◊ Understanding how kinetic energy scales with mass and speed
    ◊ Using conservation of energy to predict the qualitative exchange of kinetic and potential energy
    ◊ Calculating pressure–volume work
    ◊ Understanding the definitions of heat and work
    ◊ Understanding the definition of enthalpy
  ♦ Calorimetry (6 topics)
    ◊ Interconverting calories and joules
    ◊ Calculating specific heat capacity
    ◊ Using specific heat capacity to find heat
    ◊ Using specific heat capacity to find temperature change
    ◊ Calculating molar heat capacity
    ◊ Solving a basic calorimetry problem
  ♦ Reaction Enthalpy (6 topics)
    ◊ Using the general properties of reaction enthalpy
    ◊ Calculating the heat of reaction from molar reaction enthalpy and the mass of a reactant
    ◊ Using Hess’s Law to calculate net reaction enthalpy
    ◊ Writing a standard formation reaction
    ◊ Calculating a molar heat of reaction from formation enthalpies
    ◊ Calculating the heat of reaction from bond energies and Lewis structures

• Electronic Structure (34 topics)
  ♦ Quantum Mechanics (4 topics)
    ◊ Understanding the meaning of a de Broglie wavelength
    ◊ Finding the minimum uncertainty in a position or velocity measurement
    ◊ Interpreting the angular probability distribution of an orbital
    ◊ Recognizing s and p orbitals
  ♦ Electron Configuration (14 topics)
    ◊ Deducing n and l from a subshell label
    ◊ Deciding the relative energy of electron subshells
    ◊ Drawing a box diagram of the electron configuration of an atom
    ◊ Deducing the allowed quantum numbers of an atomic electron
    ◊ Calculating the capacity of electron subshells
    ◊ Knowing the subshells of an electron shell
    ◊ Writing the electron configuration of a neutral atom with a filled d subshell
    ◊ Interpreting the electron configuration of an atom or atomic ion
    ◊ Interpreting the electron configuration of an atom or atomic ion in noble–gas notation
    ◊ Writing the electron configuration of an atom or atomic ion with s and p electrons only
    ◊ Writing the electron configuration of an atom using the Periodic Table
    ◊ Identifying quantum mechanics errors in electron configurations
    ◊ Identifying the electron added or removed to form an ion from an s or p block atom
    ◊ Identifying the electron added or removed to form an ion
  ♦ Electronic Properties of The Elements (10 topics)
    ◊ Identifying s, p, d and f block elements
    ◊ Identifying elements with a similar valence electron configuration
    ◊ Understanding the definitions of ionization energy and electron affinity
    ◊ Predicting the relative ionization energy of elements
    ◊ Deducing valence electron configuration from trends in successive ionization energies
    ◊ Ranking the screening efficacy of atomic orbitals
Understanding periodic trends in effective nuclear charge
Deducing the block of an element from an electron configuration
Understanding periodic trends in atomic size
Understanding periodic trends in atomic ionizability

Atomic Spectroscopy (6 topics)
Understanding the organization of the electromagnetic spectrum
Interconverting the wavelength and frequency of electromagnetic radiation
Interconverting wavelength, frequency and photon energy
Calculating the wavelength of a spectral line from an energy diagram
Predicting the qualitative features of a line spectrum
Calculating the wavelength of a line in the spectrum of hydrogen

Chemical Bonding (30 topics)
Lewis Structures (13 topics)
Counting bonding and nonbonding electron pairs in a Lewis structure
Counting electron pairs in a Lewis structure with double or triple bonds
Counting valence electrons in a molecule or polyatomic ion
Deciding whether a Lewis structure satisfies the octet rule
Writing Lewis structures for diatomic molecules
Predicting the single-bonded molecular compounds formed by two elements
Predicting the compound formed by two main group elements
Calculating formal charge
Writing Lewis structures for a molecule with one central atom and no octet-rule exceptions
Recognizing exceptions to the octet rule
Writing Lewis structures for an expanded valence shell central atom
Writing the Lewis structures for a molecule with resonance
Drawing Lewis structures for simple organic compounds

Molecules (11 topics)
Predicting the relative electronegativities of atoms
Predicting bond polarity
Predicting the arrangement of electron groups around the central atom of a molecule
Naming the shape of molecules with one central atom and no octet-rule exceptions
Predicting bond angles in molecules with one central atom and no octet-rule exceptions
Predicting and naming the shape of molecules with a central atom
Predicting deviations from ideal bond angles
Predicting the relative length and energy of chemical bonds
Predicting whether molecules are polar or nonpolar
Naming common chemical groups
Identifying common chemical groups in a Lewis structure

VB and MO Theory (6 topics)
Identifying hybridization in a small molecule
Counting sigma and pi bonds in a small molecule
Identifying carbon hybridization in simple organic molecules
Recognizing typical LCAO molecular orbitals
Drawing the MO energy diagram for a Period 2 homodiatom
Using the MO model to predict bond order and paramagnetism