Preparation for Organic Chemistry

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 (179 topics)

- General Chemistry Review (46 topics)
  - Electrostatics (6 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 that electrostatic forces add as vectors
    - Understanding how electrostatic energy scales with charge and separation
    - Sketching polarization induced by a nearby charge
  - Elements and Compounds (10 topics)
    - Distinguishing elements and compounds
    - Distinguishing compounds and mixtures
    - Names and symbols of important elements
    - Reading a Periodic Table entry
    - Understanding periods and groups of the Periodic Table
    - Using the Periodic Table to identify similar elements
    - Counting the number of atoms in a formula unit
    - Predicting whether a compound is ionic or molecular
    - Predicting the compound formed by two main group elements
    - Identifying organic compounds
  - Electronic Structure and Properties (11 topics)
    - Identifying the parts of an atom
    - Counting the number of protons and electrons in a neutral atom
    - Predicting the ions formed by common main-group elements
    - 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
    - Interpreting the angular probability distribution of an orbital
    - Recognizing s and p orbitals
    - Interpreting the electron configuration of an atom or atomic ion in noble-gas notation
    - Writing the electron configuration of an atom using the Periodic Table
    - Understanding periodic trends in atomic size
  - Chemical Bonding (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
    - 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
    - Predicting the relative electronegativities of atoms
    - Predicting bond polarity
• Predicting the relative length and energy of chemical bonds

■ Introduction to Kinetics and Equilibrium (6 topics)
  • Using a rate law
  • Understanding the qualitative predictions of the Arrhenius equation
  • Understanding that no reaction goes to 100% completion
  • Predicting relative forward and reverse rates of reaction in a dynamic equilibrium
  • Using Le Chatelier’s Principle to predict the result of changing concentration or volume
  • Writing a concentration equilibrium constant expression

• Representations of Organic Molecules (52 topics)

  ■ Lewis Structures (10 topics)
    • Assigning formal charges in simple Lewis structures
    • Correcting formal charges in complex Lewis structures
    • Placing lone pairs on simple Lewis structures
    • Correcting lone pair placement in complex Lewis structures
    • Drawing a Lewis structure for a simple organic molecule from a description
    • Completing the Lewis structure for an organic molecule with non-zero formal charges
    • Interpreting condensed chemical structures
    • Identifying isomers
    • Drawing constitutional isomers
    • Evaluating octet compliance at carbon

  ■ Condensed Formulas (7 topics)
    • Naming common chemical groups
    • Identifying common chemical groups in a Lewis structure
    • Identifying organic functional groups in simple structures
    • Drawing a Lewis structure from the condensed formula of an unsaturated molecule
    • Drawing a Lewis structure from a condensed formula with parentheses
    • Drawing a Lewis structure from a condensed formula with N and O
    • Drawing a Lewis structure from a condensed formula with a carbonyl-containing functional group

  ■ Skeletal Structures (6 topics)
    • Identifying carbon atoms in a skeletal structure
    • Identifying hydrogen atoms in a skeletal structure
    • Expanding a chemical group and drawing in lone pairs on a skeletal structure
    • Identifying functional groups in organic molecules written in skeletal format
    • Converting a skeletal structure to a Lewis structure
    • Drawing a skeletal structure from a Lewis structure

  ■ Introduction to Curved Arrows (5 topics)
    • Determining the product of a curved arrow drawn on a Lewis structure
    • Drawing simple curved arrows on a Lewis structure to show how electrons move
    • Drawing cascading curved arrows on a Lewis structure to show how electrons move
    • Drawing curved arrows on a skeletal structure to show how electrons move
    • Determining the product of curved arrows drawn on a skeletal structure

  ■ Resonance Structures (5 topics)
    • Identifying isomers and resonance structures
    • Drawing resonance structures with complete octets
    • Ranking resonance structures
    • Drawing the second best resonance structure
    • Identifying skeletal resonance structures

  ■ Bonding Models and 3D Shape (9 topics)
    • 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
    • Matching Lewis structures to a 3D model
    • Predicting deviations from ideal bond angles
Identifying hybridization in a small molecule with s and p orbitals
Counting sigma and pi bonds in a small molecule
Identifying carbon hybridization in simple organic molecules
Determining the electron group geometry and hybridization state of atoms in a skeletal structure
Identifying bonds with restricted rotation

**MO Theory (6 topics)**
- Recognizing orbital representations
- Understanding how to make sp hybrid orbitals
- Understanding how AOs combine to make MOs
- 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

**Wedge and Dash Models (4 topics)**
- Understanding dash-wedge structures
- Interpreting a flipped or rotated dash-wedge skeletal structure
- Identifying bond rotations in dash-wedge skeletal structures
- Understanding the 3D shape of molecules with pi bonds

**Structure and Property Relationships (41 topics)**

**Properties of Bonds and Molecules (15 topics)**
- Predicting the products of dissolution
- Assigning oxidation numbers
- Ranking relative oxidation or reduction for a set organic molecules
- Understanding partial charge notation and comparing relative bond polarities
- Using hybridization to predict relative length and strength of chemical bonds
- Identifying degree of carbon substitution
- Ranking the stability of carbocation intermediates
- Predicting whether molecules are polar or nonpolar
- Identifying a molecule from its electrostatic potential map
- Predicting the strength of intermolecular forces from an electrostatic potential map
- Identifying hydrogen-bonding interactions between molecules
- Identifying the important intermolecular forces in pure compounds
- Predicting the relative strength of the dispersion force between molecules
- Predicting the relative boiling points of pure substances
- Applying like dissolves like

**Concepts of Acidity (11 topics)**
- Identifying acids and bases by their reaction with water
- Identifying acids and bases by their chemical formula
- Predicting the products of a neutralization reaction
- Identifying Bronsted-Lowry acids and bases
- Identifying strong or weak acids and bases from a sketch
- Finding the conjugate of an acid or base
- Predicting the products of the reaction of a strong acid with water
- Predicting the reactants of a neutralization reaction
- Writing the dissociation reactions of a polyprotic acid
- Drawing organic conjugate acids and bases
- Understanding organic acids and bases

**Organic Acid-Base Reactions (3 topics)**
- Drawing the products of an organic acid-base reaction shown in condensed Lewis format
- Drawing the products of an organic acid-base reaction shown in skeletal format
- Drawing the structure of a missing acid or base in an equilibrium reaction

**Understanding pKa (5 topics)**
- Interconverting Ka and pKa
- Using a pKa table to rank acids and bases
Using pKa to evaluate acid-base equilibria
Using a pKa table to estimate site acidities in complex molecules
Understanding the solvent leveling effect

**Acidity and Chemical Structure (7 topics)**
- Predicting the relative acidity of binary acids
- Using periodic trends to identify an organic molecule's most acidic or basic site
- Understanding the relative acidity or basicity of organic molecules with multiple acidic or basic sites
- Understanding how induction affects organic acid and base strength
- Understanding how resonance affects organic acid and base strength
- Understanding how hybridization affects organic acid and base strength
- Identifying Lewis acids and bases from their structures

**Alkanes (8 topics)**

**Nomenclature (8 topics)**
- Classifying hydrocarbons
- Identifying the main chain of branched alkanes
- Numbering the main chain of branched alkanes
- Naming normal alkanes
- Naming the parent hydrocarbon of branched alkanes
- Naming alkyl side chains
- Naming branched alkanes
- Using multiplying affixes in the names of branched alkanes

**Introduction to Organic Reactions (32 topics)**

**Analyzing Organic Reactions (8 topics)**
- Recognizing reduction and oxidation
- Identifying the molecularity of an elementary reaction
- Identifying bond changes in Lewis structures for an organic reaction
- Identifying bond changes in skeletal structures for an organic reaction
- Recognizing substitution, addition, elimination, reduction, and oxidation in organic reactions
- Interpreting the components of organic reaction equations
- Identifying nucleophiles and electrophiles in a reaction mechanism
- Using a model reaction to predict the product for a similar reaction

**Curved Arrow Reaction Mechanisms (7 topics)**
- Determining the product of a reaction mechanism that shows a sigma bond change at an explicit atom
- Drawing the mechanism for a reaction that shows a sigma bonding change with partially condensed Lewis structures
- Drawing the mechanism for a reaction that shows multiple bonding changes with partially condensed Lewis structures
- Determining the product of a reaction mechanism drawn with skeletal structures
- Drawing a mechanism on skeletal structures for a reaction with no implicit bond changes
- Drawing the mechanism for an acid base reaction involving an implicit hydrogen atom
- Drawing the mechanism for a carbocation rearrangement in a skeletal structure

**Kinetics and Thermodynamics (12 topics)**
- Using the general properties of reaction enthalpy
- Calculating the heat of reaction from bond energies and Lewis structures
- Interpreting a reaction energy diagram
- Relating activation energy to reaction rate
- Drawing the reaction energy diagram of a catalyzed reaction
- Using the Hammond Postulate to predict the starting material or products of a reaction
- Writing the rate law of an elementary reaction
- Writing the rate law implied by a simple mechanism with an initial slow step
- Qualitatively predicting reaction entropy
- Using the general properties of Gibbs free energy
- Interconverting standard Gibbs free energy and K
- Recognizing consistency between statements about standard Gibbs free energy
Multistep Mechanisms (5 topics)
- Writing the net equation for a sequence of reactions
- Identifying intermediates in a reaction mechanism
- Writing a plausible missing step for a simple reaction mechanism
- Deducing information about reaction mechanisms from a reaction energy diagram
- Identifying possible mechanisms for a reaction using a reaction coordinate diagram