

Subareas/Courses	CHEM1145	CHEM1146	CHEM2031	CHEM2242	CHEM3341	CHEM3342	CHEM3441	CHEM3140
<b>ATOMIC STRUCTURE AND THE PROPERTIES OF MATTER</b>								
Understand the various models of atomic structure, the principles of quantum theory, and the properties and interactions of subatomic particles.								
• identifying major features of models of atomic structure (e.g., Bohr, Rutherford, Heisenberg, Schrödinger) and the supporting evidence for these models (e.g., gold foil experiment, emission spectra)	x				x			x
• identifying the characteristics of protons, neutrons, and electrons and the contribution each makes to atomic number, mass number, and the formation of ions	x			x	x	x	x	x
• analyzing the relationship between atomic mass and the relative abundance of different isotopes of a particular element	x			x	x	x	x	x
• analyzing an atom's electron configuration	x				x		x	x
• demonstrating knowledge of how atomic spectra relate to the quantum properties of atoms, including how spectra are used for identifying elements and determining their electron configuration	x			x	x	x	x	x
Understand the organization of the Periodic Table.								
• analyzing the organization of the Periodic Table in terms of atomic numbers and properties of the elements	x							
• predicting periodic trends within periods and groups of the Periodic Table	x							
• inferring physical and chemical properties of the elements based on their position in the Periodic Table	x							
• demonstrating knowledge of how the chemical properties of elements are related to their electron configurations	x			x	x		x	x
Understand the physical and chemical properties and changes of matter.								
• distinguishing between physical and chemical properties and changes of matter	x							
• identifying methods for determining physical and chemical properties of substances	x			x	x	x		
• identifying unknown substances based on physical and chemical properties	x	x		x	x	x		
• selecting appropriate techniques to achieve a desired separation of a mixture	x			x	x	x	x	x
Understand the factors that affect the solubility of a substance and the properties of solutions.								
• demonstrating knowledge of the dissolution process at the atomic and molecular levels	x	x		x				
• analyzing factors that affect the solubility of a substance (e.g., temperature, pressure) and the rate of the dissolving process		x		x				
• interpreting solubility curves	x			x				
• solving problems involving solution concentrations (e.g., molarity, molality, percent by mass, mole fraction)	x	x	x	x	x	x	x	x
• demonstrating knowledge of how to prepare solutions of desired concentration and properties	x	x		x	x	x	x	x
• analyzing the colligative properties of solutions (e.g., freezing point, boiling point, osmotic pressure, vapor pressure)	x			x				
• distinguishing among colloids, solutions, and suspensions	x							
Understand chemical formulas and the nomenclature of ionic and covalent compounds.								
• predicting the formulas of stable ionic compounds based on the charges of the ions that compose them	x	x	x	x			x	x
• applying knowledge of IUPAC and common nomenclature in the analysis of the names and formulas of ionic and covalent compounds	x	x	x	x			x	x
• analyzing the basic composition and chemical structure of organic compounds (e.g., alkanes, alkenes, alkynes)					x	x	x	x
• distinguishing among the common functional groups of organic compounds (e.g., alcohols, ketones, aldehydes, esters, ethers, carboxylic acids, amines, alkylhalides)					x	x	x	x
Understand the processes of nuclear transformations.								
• differentiating between nuclear and chemical reactions	x							
• comparing the characteristics (e.g., mass, charge, penetrating power) of different types of emanations from the decay of radioactive elements								
• analyzing the processes of natural radioactivity and artificial transmutation								
• solving problems involving half-life of radioactive particles								
• calculating the energies associated with various nuclear reactions								
• demonstrating knowledge of nuclear fission and its applications								
• recognizing the role of nuclear fusion in the production of elements more massive than hydrogen								
<b>CHEMICAL BONDING AND ENERGY</b>								
Understand the different types of chemical bonds, the formation of these bonds, and the effect bond type has on the properties of substances.								
• comparing the characteristics of the different types of bonds between particles (e.g., bond strength, polarity, hybridization)	x				x		x	x
• predicting the properties of a substance (e.g., ductility, electrical and thermal conductivity) based on the type of bonds	x				x		x	x
• predicting molecular geometry based on Lewis structures	x				x		x	x
Understand the different types of intermolecular forces and the effects they have on the properties of substances.								
• identifying and comparing the characteristics of the different types of intermolecular forces	x				x	x	x	x
• determining the type of intermolecular force present between the particles of a given substance	x				x	x	x	x
• demonstrating knowledge of the relationship between the physical properties of substances (e.g., boiling point, solubility, vapor pressure) and their intermolecular forces	x			x	x	x	x	x
• interpreting phase diagrams	x						x	
Understand the kinetic molecular theory and the gas laws.								
• comparing the arrangement and movement of particles in the solid, liquid, gas, and plasma phases of matter	x			x			x	
• demonstrating knowledge of basic principles of kinetic molecular theory	x						x	
• analyzing the effects of intermolecular forces on real gases	x						x	
• solving problems involving relationships among temperature, pressure, volume, and moles of a gas (e.g., ideal and combined gas laws)	x			x			x	
Understand the laws of thermodynamics and the flow of heat in physical and chemical processes.								
• distinguishing between heat and temperature		x					x	
• analyzing heating and cooling curves both qualitatively and quantitatively		x					x	
• solving problems involving calorimetry		x					x	
• interpreting the laws of thermodynamics and their applications to chemical systems		x					x	
• predicting the spontaneity of chemical reactions based on enthalpy changes, entropy		x					x	





