

Chemistry Standard	Concepts	Workbook
1a Students know how to relate the position of an element in the periodic table to its atomic number and atomic mass.	Atomic terminology Families (groups)	
1b Students know how to use the periodic table to identify metals, semimetals, nonmetals, and halogens.	Families (groups) Periods (rows)	
1c Students know how to use the periodic table to identify alkali metals, alkaline earth metals and transition metals, trends in ionization energy, electronegativity, and the relative sizes of ions and atoms.	Families Transition Elements Atomic Size Ionization Energy Electron Affinity	
1d Students know how to use the periodic table to determine the number of electrons available for bonding.	Electron configurations Orbital configurations Position on Periodic Table relative to Electron configuration	
1e Students know the nucleus of the atom is much smaller than the atom yet contains most of its mass.		
1f Students know how to use the periodic table to identify the lanthanide, actinide, and transactinide elements and know that the transuranium elements were synthesized and identified in laboratory experiments through the use of nuclear accelerators.	Lanthanide and Actinide Series Applications of nuclear energy	
1g Students know how to relate the position of an element in the periodic table to its quantum electron configuration and to its reactivity with other elements in the table.	Writing Electron Configurations Chemicals in families have similar properties	
1h Students know the experimental basis for Thomson's discovery of the electron, Rutherford's nuclear atom, Millikan's oil drop experiment, and Einstein's explanation of the photoelectric effect.	The dual nature of light	
1i Students know the experimental basis for the development of the quantum theory of atomic structure and the historical importance of the Bohr model of the atom.	The Bohr Model	
1j Students know that spectral lines are the result of transitions of electrons between energy levels and that these lines correspond to photons with a frequency related to the energy spacing between levels by using Planck's relationship ( $E = h\nu$ ).	The Electron Spin	
2a Students know atoms combine to form molecules by sharing electrons to form covalent or metallic bonds or by exchanging electrons to form ionic bonds.	Ionic Bonding Covalent Bond Types of Bonds	
2b Students know chemical bonds between atoms in molecules such as H <sub>2</sub> , CH <sub>4</sub> , NH <sub>3</sub> , H <sub>2</sub> CCH <sub>2</sub> , N <sub>2</sub> , Cl <sub>2</sub> , and many large biological molecules are covalent.	Atoms that Form Covalent Bonds Naming Covalent Compounds	

Chemistry Standard	Concepts	Workbook
2c Students know salt crystals, such as NaCl, are repeating patterns of positive and negative ions held together by electrostatic attraction.	Formation of Ions Properties of Ionic compounds	
2d Students know the atoms and molecules in liquids move in a random pattern relative to one another because the intermolecular forces are too weak to hold the atoms or molecules in a solid form.	Forces of Attraction	
2e Students know how to draw Lewis dot structures.	Lewis Electron Dot Diagrams	
2f Students know how to predict the shape of simple molecules and their polarity from Lewis dot structures.	Electronic and Molecular Geometry Molecular Polarity	
2g Students know how electronegativity and ionization energy relate to bond formation.	Ionization Energy Electron Affinity Ionic Bonding	
2h Students know how to identify solids and liquids held together by Van der Waals forces or hydrogen bonding and relate these forces to volatility and boiling/melting point temperatures.	Forces of Attraction	
3a Students know how to describe chemical reactions by writing balanced equations.	Chemical Equations Balancing Equations	
3b Students know the quantity one mole is set by defining one mole of carbon 12 atoms to have a mass of exactly 12 grams.	The Mole	
3c Students know one mole equals $6.02 \times 10^{23}$ particles (atoms or molecules).	The Mole Concept	
3d Students know how to determine molar mass of a molecule from its chemical formula and a table of atomic masses and how to convert the mass of a molecular substance to moles, number of particles, or volume of gas at standard temperature and pressure.	Molar Mass Percent Composition	
3e Students know how to calculate the masses of reactants and products in a chemical reaction from the mass of one of the reactants or products and the relevant atomic masses.	Mass-mass calculations	
3f Students know how to calculate percent yield in a chemical reaction.	Percent Yield	
3g Students know how to identify reactions that involve oxidation and reduction and how to balance oxidation-reduction reactions.	Redox reactions	
4a Students know the random motion of molecules and their collisions with a surface create the observable pressure on that surface.	Gases Pressure	
4b Students know the random motion of molecules explains the diffusion of gases.	Molar volume	
4c Students know how to apply the gas laws to relations between the pressure, temperature, and volume of any amount of an ideal gas or any mixture of ideal gases.	Gas Laws Universal Gas Law	

Chemistry Standard	Concepts	Workbook
4d Students know the values and meanings of standard temperature and pressure (STP).	STP	
4e Students know how to convert between the Celsius and Kelvin temperature scales.	Gas Laws	
4f Students know there is no temperature lower than 0 Kelvin.	Gas Laws	
4g Students know the kinetic theory of gases relates the absolute temperature of a gas to the average kinetic energy of its molecules or atoms.	Gases KMT	
4h Students know how to solve problems by using the ideal gas law in the form $PV = nRT$ .	Universal Gas Law	
4i Students know how to apply Dalton's law of partial pressures to describe the composition of gases and Graham's law to predict diffusion of gases.	Dalton's Law	
5a Students know the observable properties of acids, bases, and salt solutions.	Arrhenius Salts	
5b Students know acids are hydrogen-ion-donating and bases are hydrogen-ion-accepting substances.	Arrhenius Acids Arrhenius Bases	
5c Students know strong acids and bases fully dissociate and weak acids and bases partially dissociate.	Strong and Weak Acids	
5d Students know how to use the pH scale to characterize acid and base solutions.	pH Indicators Titration	
5e Students know the Arrhenius, Brønsted-Lowry, and Lewis acid-base definitions.	Brønsted-Lowry Lewis Acids and Bases	
5f Students know how to calculate pH from the hydrogen-ion concentration.	pH	
5g Students know buffers stabilize pH in acid-base reactions.	Buffers	
6a Students know the definitions of solute and solvent.	Solution Terminology	
6b Students know how to describe the dissolving process at the molecular level by using the concept of random molecular motion.	Why Solutions Occur	
6c Students know temperature, pressure, and surface area affect the dissolving process.	Solubility Graphs Factors Affecting Solubility	
6d Students know how to calculate the concentration of a solute in terms of grams per liter, molarity, parts per million, and percent composition.	Measuring concentration	
6e Students know the relationship between the molality of solute in a solution and the solution's depressed freezing point or elevated boiling point.	Colligative properties	
6f Students know how molecules in a solution are separated or purified by the methods of chromatography and distillation.	Separating mixtures	
7a Students know how to describe temperature and heat flow in terms of the motion of molecules (or atoms).	Thermodynamics	

Chemistry Standard	Concepts	Workbook
7b Students know chemical processes can either release (exothermic) or absorb (endothermic) thermal energy.	Energy Calculations Potential Energy Diagrams Spontaneous Processes	
7c Students know energy is released when a material condenses or freezes and is absorbed when a material evaporates or melts.	Vapor Pressure Boiling Point Heat of Vaporization	
7d Students know how to solve problems involving heat flow and temperature changes, using known values of specific heat and latent heat of phase change.	Heat of Vaporization Melting	
7e Students know how to apply Hess's law to calculate enthalpy change in a reaction.	Enthalpy	
7f Students know how to use the Gibbs free energy equation to determine whether a reaction would be spontaneous.	Gibb's Free Energy	
8a Students know the rate of reaction is the decrease in concentration of reactants or the increase in concentration of products with time.	Rate of Reactions	
8b Students know how reaction rates depend on such factors as concentration, temperature, and pressure.	Collision Theory	
8c Students know the role a catalyst plays in increasing the reaction rate.	Factors that affect Reaction Rates	
8d Students know the definition and role of activation energy in a chemical reaction.	Collision Theory	
9a Students know how to use Le Châtelier's principle to predict the effect of changes in concentration, temperature, and pressure.	The Effects of Stress to a Reaction	
9b Students know equilibrium is established when forward and reverse reaction rates are equal.	Introduction to Equilibrium	
9c Students know how to write and calculate an equilibrium constant expression for a reaction.	Equilibrium Constant	
10a Students know large molecules (polymers), such as proteins, nucleic acids, and starch, are formed by repetitive combinations of simple subunits.	Biomolecules	
10b Students know the bonding characteristics of carbon that result in the formation of a large variety of structures ranging from simple hydrocarbons to complex polymers and biological molecules.	Carbon properties	
10c Students know amino acids are the building blocks of proteins.	Proteins	
10d Students know the system for naming the ten simplest linear hydrocarbons and isomers that contain single bonds, simple hydrocarbons with double and triple bonds, and simple molecules that contain a benzene ring.	Hydrocarbons Aromatics	

Chemistry Standard	Concepts	Workbook
10e Students know how to identify the functional groups that form the basis of alcohols, ketones, ethers, amines, esters, aldehydes, and organic acids.	Functional Groups	
10f Students know the R-group structure of amino acids and know how they combine to form the polypeptide backbone structure of proteins.	Biomolecules	
11a Students know protons and neutrons in the nucleus are held together by nuclear forces that overcome the electromagnetic repulsion between the protons.	Nuclear Forces	
11b Students know the energy release per gram of material is much larger in nuclear fusion or fission reactions than in chemical reactions. The change in mass (calculated by $E = mc^2$ ) is small but significant in nuclear reactions.	Nuclear Equations	
11c Students know some naturally occurring isotopes of elements are radioactive, as are isotopes formed in nuclear reactions.	Nuclear Notation Radiation around us	
11d Students know the three most common forms of radioactive decay (alpha, beta, and gamma) and know how the nucleus changes in each type of decay.	Nuclear decay	
11e Students know alpha, beta, and gamma radiation produce different amounts and kinds of damage in matter and have different penetrations.	Nuclear disintegration	
11f Students know how to calculate the amount of a radioactive substance remaining after an integral number of half lives have passed.	Half-life	
11g Students know protons and neutrons have substructures and consist of particles called quarks.	Nuclear Force	