Massachusetts Science Grades 9-12
Learning Standards Mapping

CHEMISTRY	Boardworks High School Chemistry Presentation
1. Properties of Matter	
1.1 Identify and explain physical properties (e.g. density, melting point, boiling point, conductivity, malleability) and chemical properties (e.g. the ability to form new substances). Distinguish between chemical and physical changes.	–
1.2 Explain the difference between pure substances (elements and compounds) and mixtures. Differentiate between heterogeneous and homogeneous mixtures.	Compounds Introducing Atoms
1.3 Describe the three normal states of matter (solid, liquid, gas) in terms of energy, particle motion, and phase transitions.	Changing State Particles in Action
2. Atomic Structure and Nuclear Chemistry	
2.1 Recognize discoveries from Dalton (atomic theory), Thomson (the electron), Rutherford (the nucleus), and Bohr (planetary model of atom), and understand how each discovery leads to modern theory.	Introducing Atoms
2.2 Describe Rutherford's "gold foil" experiment that led to the discovery of the nuclear atom. Identify the major components (protons, neutrons, and electrons) of the nuclear atom and explain how they interact.	Atomic Structure Introducing Atoms
2.3 Interpret and apply the laws of conservation of mass, constant composition (definite proportions), and multiple proportions.	Conservation of Mass
2.4 Write the electron configurations for the first twenty elements of the periodic table.	Electron Configuration Electron Structure and the Periodic Table Energy Sublevels Orbitals The Periodic Table
2.5 Identify the three main types of radioactive decay (alpha, beta, and gamma) and compare their properties (composition, mass, charge, and penetrating power).	Gamma Rays Radioactivity Types of Radiation Uses of Radiation
2.6 Describe the process of radioactive decay by using nuclear equations, and explain the concept of half-life for an isotope (for example, C-14 is a powerful tool in determining the age of objects)	Half-life Isotopes Radioactive Dating
2.7 Compare and contrast nuclear fission and nuclear fusion.	Nuclear Fission Nuclear Fusion
3. Periodicity	

3.1 Explain the relationship of an element's position on the periodic table to its atomic number. Identify families (groups) and periods on the periodic table.	Electron Structure and the Periodic Table Patterns of Behavior The Periodic Table
3.2 Use the periodic table to identify the three classes of elements: metals, nonmetals, and metalloids.	Electron Structure and the Periodic Table The Periodic Table
3.3 Relate the position of an element on the periodic table to its electron configuration and compare its reactivity to the reactivity of other elements in the table.	Electron Structure and the Periodic Table Orbitals Patterns of Behavior
3.4 Identify trends on the periodic table (ionization energy, electronegativity, and relative sizes of atoms and ions).	Electron Structure and the Periodic Table Electronegativity Ionization Energy The Periodic Table
4. Chemical Bonding	
4.1 Explain how atoms combine to form compounds through both ionic and covalent bonding. Predict chemical formulas based on the number of valence electrons.	Covalent Bonding Comparing Bonding Electron Structure and the Periodic Table Ionic Bonding Types of Formulae Why do Atoms Form Bonds?
4.2 Draw Lewis dot structures for simple molecules and ionic compounds.	–
4.3 Use electronegativity to explain the difference between polar and nonpolar covalent bonds.	Electronegativity
4.4 Use valence-shell electron-pair repulsion theory (VSEPR) to predict the molecular geometry (linear, trigonal planar, and tetrahedral) of simple molecules.	–
4.5 Identify how hydrogen bonding in water affects a variety of physical, chemical, and biological phenomena (e.g. surface tension, capillary action, density, boiling point).	Intermolecular Forces Water
4.6 Name and write the chemical formulas for simple ionic and molecular compounds, including those that contain the polyatomic ions: ammonium, carbonate, hydroxide, nitrate, phosphate, and sulfate.	Naming Compounds Types of Formulae
5. Chemical Reactions and Stoichiometry	
5.1 Balance chemical equations by applying the laws of conservation of mass and constant composition (definite proportions).	Conservation of Mass Reacting Masses
5.2 Classify chemical reactions as synthesis (combination), decomposition, single displacement (replacement), double displacement, and combustion.	Combustion Neutralization Thermal Decomposistion
5.3 Use the mole concept to determine number of particles and molar mass for elements and compounds.	Gases and Moles Molar Mass What are Moles?

5.4 Determine percent compositions, empirical formulas, and molecular formulas.	Percentage Composition by Mass Types of Formulae
5.5 Calculate the mass-to-mass stoichiometry for a chemical reaction.	–
5.6 Calculate percent yield in a chemical reaction.	Yield and Atom Economy
6. States of Matter, Kinetic Molecular Theory, and Thermochemistry	
6.1 Using the kinetic molecular theory, explain the behavior of gases and the relationship between pressure and volume (Boyle's law), volume and temperature (Charles's law), pressure and temperature (Gay-Lussac's law), and the number of particles in a gas sample (Avogadro's hypothesis). Use the combined gas law to determine changes in pressure, volume, and temperature.	Gases and Moles Ideal Gas Laws
6.2 Perform calculations using the ideal gas law. Understand the molar volume at 273 K and 1 atmosphere (STP).	Ideal Gas Laws
6.3 Using the kinetic molecular theory, describe and contrast the properties of gases, liquids, and solids. Explain, at the molecular level, the behavior of matter as it undergoes phase transitions.	Changing State Particles in Action
6.4 Describe the law of conservation of energy. Explain the difference between an endothermic process and an exothermic process.	Endothermic Reactions Exothermic Reactions
6.5 Recognize that there is a natural tendency for systems to move in a direction of disorder or randomness (entropy).	–
7. Solutions, Rates of Reaction, and Equilibrium	
7.1 Describe the process by which solutes dissolve in solvents.	Solubility Solutions
7.2 Calculate concentration in terms of molarity. Use molarity to perform solution dilution and solution stoichiometry.	–
7.3 Identify and explain the factors that affect the rate of dissolving (e.g. temperature, concentration, surface area, pressure, mixing).	Solubility Solutions
7.4 Compare and contrast qualitatively the properties of solutions and pure solvents (colligative properties such as boiling point and freezing point).	Solutions
7.5 Identify the factors that affect the rate of a chemical reaction (temperature, mixing, concentration, particle size, surface area, catalyst).	Concentration, Pressure and Reaction Rates Rates of Reactions Surface Area, Catalysts and Reaction Rates Temperature and Reaction Rates
7.6 Predict the shift in equilibrium when a system is subjected to a stress (Le Chatelier's principle) and identify the factors that can cause a shift in equilibrium (concentration, pressure, volume, temperature).	Dynamic Equilibruim Equilibrium - Changing Conditions Le Chatelier's Principle
8. Acids and Bases and Oxidation-Reduction Reactions	

8.1 Define the Arrhenius theory of acids and bases in terms of the presence of hydronium and hydroxide ions in water and the Bronsted-Lowry theory of acids and bases in terms of proton donors and acceptors.	Properties of Acids and Alkalis
8.2 Relate hydrogen ion concentrations to the pH scale and to acidic, basic, and neutral solutions. Compare and contrast the strengths of various common acids and bases (e.g., vinegar, baking soda, soap, citrus juice).	Neutralization pH and Indicators Properties of Acids and Alkalis
8.3 Explain how a buffer works	–
8.4 Describe oxidation and reduction reactions and give some everyday examples, such as fuel burning and corrosion. Assign oxidation numbers in a reaction.	Oxidation Numbers Redox Reaction