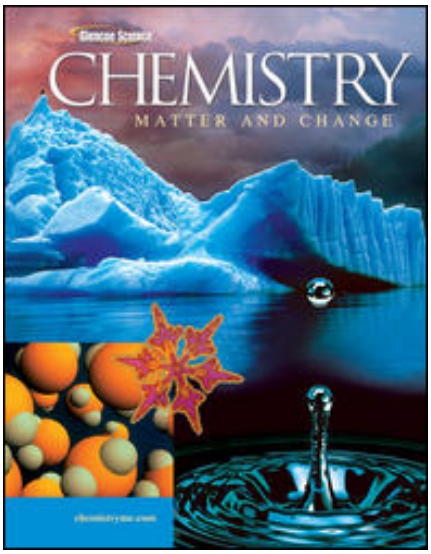
Chemistry High School Standards

Massachusetts



CHEMISTRY

MATTER AND CHANGE

	STANDARDS	PAGE REFERENCES
	I. Content Standards	
	1. Properties of Matter	
	Broad Concept: Physical and chemical properties reflect the nature of the interactions between molecules or atoms and can be used to classify and describe matter.	
1.1	Identify and explain physical properties (such as density, melting point, boiling point, conductivity, and malleability) and chemical properties (such as the ability to form new substances). Distinguish between chemical and physical changes.	**Student Edition:** 56-58, 61-63 *Chapter Assessment* 82 #37 & #39 *ChemLab* 78-79 *Discovery Lab* 55 *Section Assessment* 65 #14 **Teacher Wraparound Edition:** A 65; CJ 56; QD 57, 64
1.2	Explain the difference between pure substances (elements and compounds) and mixtures. Differentiate between heterogeneous and homogeneous mixtures.	**Student Edition:** 55-56, 66-67, 476-479 *Chapter Assessment* 83 #48-#50 *ChemLab* 78 #5 *Section Assessment* 69 #15 & #17 **Teacher Wraparound Edition:** A 66, 77, 479; CU 76

Codes used for Teacher Wraparound Edition pages are the initial caps of headings on that page.

STANDARDS		PAGE REFERENCES
1.3	Describe the three normal states of matter (solid, liquid, gas) in terms of energy, particle motion, and phase transitions.	**Student Edition:** 58-62, 385-392, 396-408 *ChemLab* 410-411 *Section Assessment* 409 #27 **Teacher Wraparound Edition:** A 406; BM 396; IM 405; QD 61; R 59
	2. Atomic Structure and Nuclear Chemistry	
	Broad Concept: Atomic models are used to explain atoms and help us understand the interaction of elements and compounds observed on a macroscopic scale. Nuclear chemistry deals with radioactivity, nuclear processes, and nuclear properties. Nuclear reactions produce tremendous amounts of energy and the formation of the elements.	
2.1	Recognize discoveries from Dalton (atomic theory), Thomson (the electron), Rutherford (the nucleus), and Bohr (planetary model of atom) and understand how these discoveries lead to the modern theory.	**Student Edition:** 89-97, 127-134 *ChemLab* 109 #6 *Problem-Solving Lab* 130 **Teacher Wraparound Edition:** A 128; CJ 94; D 92-93; DI 94; E 97; R 97
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.	**Student Edition:** 94-96 *Chapter Assessment* 112 #42 *Chemistry Online* 96 **Teacher Wraparound Edition:** DI 95
2.3	Interpret and apply the laws of conservation of mass, constant composition (definite proportions), and multiple proportions.	**Student Edition:** 63-65, 75-77, 354-356 *Chapter Assessment* 83 #61-#69 **Teacher Wraparound Edition:** CJ 76, 355; QD 64, 75
2.4	Write the electron configurations for the first twenty elements of the periodic table.	**Student Edition:** 135-139 *Chapter Assessment* 147 #78 *Section Assessment* 141 #25 **Teacher Wraparound Edition:** A 139
2.5	Identify the three main types of radioactive decay (alpha, beta, and gamma) and compare their properties (composition, mass, charge, and penetrating power).	**Student Edition:** 106-107, 806-809 *Section Assessment* 107 #24 **Teacher Wraparound Edition:** E 809

STANDARDS		PAGE REFERENCES
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.	**Student Edition:** 106-107, 810-814, 817-820 *Chapter Assessment* 837 #69-#72 *MiniLab* 819 **Teacher Wraparound Edition:** AC 818; CU 107, 819; D 810-811; E 814
2.7	Compare and contrast nuclear fission and nuclear fusion.	**Student Edition:** 822-823, 826 *Chapter Study Guide* 835 *Section Assessment* 826 #25 **Teacher Wraparound Edition:** E 826; QD 822
	3. Periodicity	
	Broad Concept: Repeating (periodic) patterns of physical and chemical properties occur among elements that define families with similar properties. The periodic table displays this repeating pattern, which is related to an atom's outermost electrons.	
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.	**Student Edition:** 70, 98-99, 154 *Section Assessment* 158 #2 **Teacher Wraparound Edition:** A 156; CU 161
3.2	Use the periodic table to identify the three classes of elements: metals, nonmetals, and metalloids.	**Student Edition:** 154-158 *Chapter Assessment* 174 #31 *ChemLab* 170-171 *Section Assessment* 158 #2 **Teacher Wraparound Edition:** A 158
3.3	Relate the position of an element on the periodic table to its electron configuration and compare its reactivity with other elements in the table.	**Student Edition:** 159-162 *Chapter Assessment* 174 #49 *ChemLab* 300-301 *Problem-Solving Lab* 288 **Teacher Wraparound Edition:** A 161, 162; CD 159; CJ 161; D 166-167

STANDARDS		PAGE REFERENCES
3.4	Identify trends on the periodic table (ionization energy, electronegativity, and relative size of atoms and ions).	**Student Edition:** 163-169 *Chapter Assessment* 176 #82 *ChemLab* 170-171 *MiniLab* 164 *Section Assessment* 169 #19 **Teacher Wraparound Edition:** A 164; CU 169; D 166-167; MC 167; R 169
	4. Chemical Bonding	
	Broad Concept: Atoms bond with each other by transferring or sharing valence electrons to form compounds.	
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.	**Student Edition:** 215-217, 221-225, 241-246 *ChemLab* 232-233 **Teacher Wraparound Edition:** A 225, 227; CJ 217, 243; D 248-249; P 215
4.2	Draw Lewis dot structures for simple molecules and ionic compounds.	**Student Edition:** 243-245, 252-258 *Chapter Assessment* 273 #99 & #100 *Section Assessment* 247 #12 **Teacher Wraparound Edition:** A 245; CD 254; CJ 254; CU 257; DI 255; R 257
4.3	Use electronegativity to explain the difference between polar and nonpolar covalent bonds.	**Student Edition:** 263-266 *Chapter Assessment* 273 #108-#113 *Section Assessment* 267 #65 **Teacher Wraparound Edition:** A 265; CJ 263; IM 264
4.4	Use valence-shell electron-pair repulsion theory (VSEPR) to predict the electron geometry (linear, trigonal planar, and tetrahedral) of simple molecules.	**Student Edition:** 259-262 *Chapter Assessment* 273 #105 & #106; 274 #121 *MiniLab* 261 *Section Assessment* 262 #58 & #59 **Teacher Wraparound Edition:** A 261, 262; CJ 261; MC 260

STANDARDS		PAGE REFERENCES
4.5	Identify how hydrogen bonding in water affects a variety of physical, chemical, and biological phenomena (such as, surface tension, capillary action, density, and boiling point).	**Student Edition:** 395, 398-399, 404, 408 *Chapter Assessment* 415 #52; 416 #85 **Teacher Wraparound Edition:** A 395; AC 394
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.	**Student Edition:** 221-227, 248-251 *Chapter Assessment* 237 #74-#79; 273 #94-#98 **Teacher Wraparound Edition:** A 227, 250, 251; CJ 250; P 226; R 227
	5. Chemical Reactions and Stoichiometry	
	Broad Concept: In a chemical reaction, one or more reactants are transformed into one or more new products. Chemical equations represent the reaction and must be balanced. The conservation of atoms in a chemical reaction leads to the ability to calculate the amount of products formed and reactants used (stoichiometry).	
5.1	Balance chemical equations by applying the laws of conservation of mass and constant composition (definite proportions).	**Student Edition:** 280-283, 354-356 *Chapter Assessment* 305 #75-#78 *ChemLab* 375 #2 *Discovery Lab* 489 *Section Assessment* 357 #7 **Teacher Wraparound Edition:** A 282; CJ 355; CU 355; E 283
5.2	Classify chemical reactions as synthesis (combination), decomposition, single displacement, double displacement, and combustion.	**Student Edition:** 284-291 *Chapter Assessment* 305 #80-#84 *ChemLab* 300-301 **Teacher Wraparound Edition:** A 291; CJ 287; P 290; RS 303
5.3	Use the mole concept to determine the number of particles and the molar mass of elements and compounds.	**Student Edition:** 309-327 *Chapter Assessment* 346-348 #89-#106 & #111-#135 *Problem-Solving Lab* 314 **Teacher Wraparound Edition:** A 312, 317, 323; CJ 316, 326; E 319; MC 315

STANDARDS		PAGE REFERENCES
5.4	Determine percent compositions, empirical formulas, and molecular formulas.	**Student Edition:** 328-337 *Chapter Assessment* 348-349 #136-#150 *MiniLab* 329 **Teacher Wraparound Edition:** A 329, 335, 337; D 332-333; QD 330
5.5	Calculate the mass-to-mass stoichiometry for a chemical reaction.	**Student Edition:** 361-363 *Chapter Assessment* 380 #69-#75 *ChemLab* 374-375 *MiniLab* 362 **Teacher Wraparound Edition:** A 363; CJ 362; CU 363; R 363
5.6	Calculate percent yield in a chemical reaction.	**Student Edition:** 370-373 *Chapter Assessment* 381 #84-#90 *ChemLab* 374-375 *Problem-Solving Lab* 372 *Section Assessment* 373 #32 **Teacher Wraparound Edition:** A 373; CU 373; DI 371; QD 371; R 373
	6. States of Matter, Kinetic Molecular Theory, and Thermochemistry	
	Broad Concept: Gas particles move independently of each other and are far apart. Their behavior can be modeled by the kinetic molecular theory. In liquids and solids, unlike gases, the particles are close to each other. The driving forces of chemical reactions are energy and entropy. The reorganization of atoms in chemical reactions results in the release or absorption of heat energy.	
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.	**Student Edition:** 419-433 *Chapter Assessment* 448-449 #88-#96 *MiniLab* 439 **Teacher Wraparound Edition:** A 430; BM 426; D 420-421; IM 426; QD 425; R 432
6.2	Perform calculations using the ideal gas law. Understand the molar volume at 273K and 1 atmosphere (STP).	**Student Edition:** 431, 434-438, 440-443 *Chapter Assessment* 449 #97-#100 *ChemLab* 444-445 **Teacher Wraparound Edition:** A 435, 438, 439; CU 439, 442

STANDARDS		PAGE REFERENCES
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.	**Student Edition:** 385-387, 396-408, 419-420 *ChemLab* 410-411 *Section Assessment* 409 #27 **Teacher Wraparound Edition:** A 391, 406; CJ 397; IM 405; R 403
6.4	Describe the law of conservation of energy. Explain the difference between an endothermic process and an exothermic process.	**Student Edition:** 219, 247, 490, 498-500 *Chapter Assessment* 524 #54 *Discovery Lab* 453 **Teacher Wraparound Edition:** CJ 64; P 499, 538
6.5	Recognize that there is a natural tendency for systems to move in a direction of disorder or randomness (entropy).	**Student Edition:** 514-516 *Chapter Assessment* 524 #65, #70, & #71 *Section Assessment* 519 #42 **Teacher Wraparound Edition:** E 514, 516, 519; QD 515; R 518
	7. Solutions, Rates of Reaction, and Equilibrium	
	Broad Concept: Solids, liquids, and gases dissolve to form solutions. Rates of reaction and chemical equilibrium are dynamic processes that are significant in many systems (biological, ecological, and geological).	
7.1	Describe the process by which solutes dissolve in solvents.	**Student Edition:** 453-457 *Discovery Lab* 453 **Teacher Wraparound Edition:** DI 455; VL 455
7.2	Calculate concentration in terms of molarity. Use molarity to perform solution dilution and solution stoichiometry.	**Student Edition:** 464-468 *Chapter Assessment* 485 #76-#82 *Section Assessment* 470 #30 **Teacher Wraparound Edition:** A 467; MC 465; R 470
7.3	Identify and explain the factors that affect the rate of dissolving, such as, temperature, concentration, surface area, pressure, and mixing.	**Student Edition:** 456 *Chapter Assessment* 484 #52

STANDARDS		PAGE REFERENCES
7.4	Compare and contrast qualitatively the properties of solutions and pure solvents (colligative properties such as boiling point and freezing point).	**Student Edition:** 471-475 *Chapter Assessment* 484 #56-#58 *MiniLab* 473 *Section Assessment* 475 #39 **Teacher Wraparound Edition:** A 474; CU 474; IM 472
7.5	Identify the factors that affect the rate of a chemical reaction (temperature, mixing, concentration, particle size, surface area, and catalyst).	**Student Edition:** 536-541 *ChemLab* 550-551 *Discovery Lab* 529 *How It Works* 552 *MiniLab* 539 **Teacher Wraparound Edition:** A 541, 542; CJ 538; D 536-537
7.6	Predict the shift in equilibrium when the system is subjected to a stress (LeChatelier's principle) and identify the factors that can cause a shift in equilibrium (concentration, pressure, volume, temperature).	**Student Edition:** 569-574 *Chapter Assessment* 591 #59-#64 *Chemistry and Technology* 588 *ChemLab* 586-587 *MiniLab* 573 *Problem-Solving Lab* 624 *Section Assessment* 574 #10-#13 **Teacher Wraparound Edition:** A 571, 574; R 574
	8. Acids and Bases and Oxidation-Reduction Reactions	
	Broad Concept: Acids and bases are important in numerous chemical processes that occur around us, from industrial procedures to biological ones, from the laboratory to the environment. Oxidation-reduction reactions occur when one substance transfers electrons to another substance and constitutes a major class of chemical 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 donor and acceptor.	**Student Edition:** 597-599 *Chapter Assessment* 630 #51; 632 #102 *Section Assessment* 601 #8 **Teacher Wraparound Edition:** A 599; DI 599; R 600

STANDARDS		PAGE REFERENCES
8.2	Relate hydrogen ion concentrations to the pH scale, and to acidic, basic, and neutral solutions. Compare and contrast the strength of various common acids and bases such as vinegar, baking soda, soap, and citrus juice.	**Student Edition:** 602-616 *Chapter Assessment* 632 #107 *MiniLab* 604 *Section Assessment* 616 #24 **Teacher Wraparound Edition:** CJ 605, 611; CU 615; P 614
8.3	Explain how a buffer works.	**Student Edition:** 622-625 *Chapter Assessment* 632 #106 *Problem-Solving Lab* 624 **Teacher Wraparound Edition:** A 624, 625; D 622-623
8.4	Describe oxidation and reduction reactions and give some every day examples, such as, fuel burning, corrosion. Assign oxidation numbers in a reaction.	**Student Edition:** 635-643 *ChemLab* 654-655 *How It Works* 656 *MiniLab* 638 *Problem-Solving Lab* 647 **Teacher Wraparound Edition:** A 639, 655; CU 642; QD 637; R 643
	II. Scientific Inquiry Skills Standards	
	Scientific literacy can be achieved by supporting students to inquire about chemical phenomena. Engaging students in scientific inquiry allows them to develop conceptual understandings and scientific skills that are necessary to be informed decision-makers. The science curriculum should include substantial hands-on laboratory and field experiences, as appropriate, for students to develop and use these skills in a Chemistry course.	
SIS1. Make observations, raise questions, and formulate hypotheses. *Students will be able to:* Observe the world around them from a scientific perspective. Pose questions and form hypotheses based on personal observations, scientific articles, experiments, and knowledge. Read, interpret, and examine the credibility and validity of scientific claims in different sources of information, such as scientific articles, advertisements, or media stories.		**Student Edition:** *ChemLab* 108-109, 550-551 *Discovery Lab* 385 *MiniLab* 15, 230, 439 **Teacher Wraparound Edition:** A 109, 533; E 13; P 456

STANDARDS	PAGE REFERENCES
SIS2. Design and conduct scientific investigations. *Students will be able to:* Articulate and explain the major concepts being investigated and the purpose of an investigation. Select required materials, equipment, and conditions for conducting an experiment. Identify independent and dependent variables. Write procedures that are clear and replicable. Employ appropriate methods for accurately and consistently O making observations; O making and recording measurements at an appropriate level of precision; and O collecting data or evidence in an organized way. Properly use instruments, equipment, and materials (such as scales, probeware, meter sticks, microscopes, computers, etc.) including: set-up, calibration (if required), technique, maintenance, and storage. Follow safety guidelines.	**Student Edition:** *ChemLab* 18-19, 300-301, 550-551 *Problem-Solving Lab* 372, 478 **Teacher Wraparound Edition:** A 392, 405, 411, 542; DI 396
SIS3. Analyze and interpret results of scientific investigations. *Students will be able to:* Present relationships between variables in appropriate forms. O Represent data and relationships between variables in charts and graphs. O Use appropriate technology (such as graphing software, etc.) and other tools. Use mathematical operations to analyze and interpret data results. Identify reasons for inconsistent results, such as sources of error or uncontrolled conditions, and assess the reliability of data. Use results of an experiment to develop a conclusion to an investigation that addresses the initial questions and supports or refutes the stated hypothesis. State questions raised by an experiment that may require further investigation.	**Student Edition:** *ChemLab* 410-411, 550-551 *Problem-Solving Lab* 267, 288, 860 **Teacher Wraparound Edition:** A 833; CJ 430; E 468; MC 192, 218

STANDARDS	PAGE REFERENCES
SIS4. Communicate and apply the results of scientific investigations. *Students will be able to:* Develop descriptions and explanations of scientific concepts that an investigation focused on. Review information, explain statistical analysis, and summarize data collected and analyzed from an investigation. Explain diagrams and charts that represent relationships of variables. Construct a reasoned argument and respond appropriately to critical comments and questions. Use language and vocabulary appropriately, speak clearly and logically, and use appropriate technology (such as presentation software, etc.) and other tools to present findings. Use and refine scientific models that simulate physical processes or phenomena.	**Student Edition:** *Chapter Assessment* 632 #107 *Chemistry and Society* 482 #1 *ChemLab* 766-767 *MiniLab* 164 *Section Assessment* 169 #24 **Teacher Wraparound Edition:** A 618, 627, 829; BM 426; MC 167