Reading Public Schools

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Science Curriculum Guide **High School Chemistry**

Course Description

Chemistry offers students a comprehensive year-long exploration of core chemistry concepts. Topics studied include: matter and change, periodicity, atomic theory, bonding theories, chemical quantities, reactivity, stoichiometry, solubility, gas laws and equilibrium. Engagement in laboratory activities, online investigations and projects reinforce core concepts and present opportunities for students to further develop scientific skills and practices.

Content Standards

HS-PS1-1. Use the periodic table to predict the properties of main group elements. Use the patterns of valence electron configurations to explain and predict general trends in ionization energies, sizes of atoms, and reactivity of pure elements.

HS-PS1-2. Predict and design simple reactions that result in two main classes of binary compounds, ionic and molecular. Develop an explanation based on given observational data and the electronegativity model about the relative strengths of ionic or covalent bonds.

HS-PS1-3. Relate physical properties of substances at the bulk scale to, movement, and strength of electrostatic forces among ions, small molecules, or regions of large molecules in the substances. Make arguments to account for how structural differences in molecules result in different types of intermolecular or intramolecular interactions.

HS-PS1-4. Illustrate the energy transferred during an exothermic or endothermic chemical reaction based on the bond energy difference between bonds broken and bonds formed.

HS-PS1-5. Construct an explanation based on kinetic molecular theory for why varying conditions influence the rate of a chemical reaction or a dissolving process. Design and test ways to slow down or accelerate rates of processes by altering various conditions.

HS-PS1-6. Design ways to control the extent of a reaction at equilibrium by altering various conditions using Le Chatelier's principle. Make arguments based on kinetic molecular theory to account for how altering conditions would affect the forward and reverse rates of the reaction until a new equilibrium is established.

HS-PS1-7. Use mathematical representations and experimental evidence to support that atoms and mass are conserved during a chemical reaction. Use the mole concept and proportional relationships to evaluate the quantities of specific reactants needed in order to obtain a specific amount of product.

HS-PS1-9. Relate the strength of an aqueous acidic or basic solution to the extent of an acid or base reacting with water as measured by the hydronium ion concentration (pH) of the solution.

HS-PS1-10. Use an oxidation-reduction reaction model to predict products of reactions given the reactants, and to communicate the reaction models using a representation that shows electron transfer. Use oxidation numbers to account for how electrons are redistributed in redox processes used in devices that generate electricity or systems that prevent corrosion.

HS-PS1-11. Design strategies to identify and separate the components of a mixture based on relevant chemical and physical properties.

HS-PS2-6. Communicate scientific and technical information about the molecular-level structures of polymers, ionic compounds, acids and bases, and metals to justify why these are useful in the functioning of designed materials.

HS-PS2-7. Construct a model to explain how ions dissolve in polar solvents (particularly water). Analyze and compare solubility and conductivity data to determine the extent to which different ionic species dissolve.

HS-PS2-8. Use kinetic molecular theory to compare the strengths of electrostatic forces and interactions that occur between molecules in solids, liquids, and gases. Use the combined gas law to determine changes in pressure, volume, and temperature of gases.

HS-PS3-4b. Provide evidence from informational text or available data to illustrate that the transfer of energy during a chemical reaction in a closed system involves changes in energy dispersal (enthalpy change) and heat content (entropy change) while assuming the overall energy in the system is conserved.

Skills

The high school chemistry standards place particular emphasis on science and engineering practices related to design and evaluation as well as investigation and modeling. Students are expected to:

- apply chemistry knowledge to design ways to control the extent of chemical reactions for practical purposes
- analyze unknown samples to determine identities and concentrations of possible pollutants, and evaluate the consequences of using different materials for household items.
- apply mathematical reasoning when considering conservation of matter in chemical reactions and in comparing strength of acid-base solutions.

Subject High School Chemistry

Units	Essential Questions	Key Activities MAY include…
Unit 1: Matter	• What is the universe made of? • How do we classify matter?	• Density Lab • Physical and Chemical Change Lab
Unit 2: Measurement	• How do we objectively quantify the natural world?	• Measuring Devices Lab
Unit 3: Atomic Structure and Periodic Table	• What determines the structure and properties of atoms?	• Black Box Experiment
Unit 4: Electronic Structure	• Why do substances react the way they do?	• Flame Test Lab • Emission Spectra Lab
Unit 5: Bonding	• How is the structure of a compound related to its properties?	• Molecular Modeling
Unit 6: Mole Concept and Chemical Reactions	• How do we describe what happens during a chemical change?	• Magnesium Oxide Synthesis Lab
Unit 7: Stoichiometry	• How can we quantify the behavior of a chemical reaction?	• Stoichiometry Lab
Unit 8: Gases	• How does the kinetic molecular theory inform our understanding of the behavior of gases?	• Boyle's Law Lab • Molar Mass of Butane Lab
Unit 9: Solutions	• How can we model the process of solution formation? • How can we manipulate the rate of a chemical reaction?	• Supersaturated Solution Demo • Colligative Properties Lab
Unit 10: Equilibrium	• How does a reaction reach a steady state? • How can we manipulate the direction of a chemical reaction? • What conditions influence the extent of a chemical reaction?	• Le Chatelier's Principle Lab
Unit 11: Acids and Bases	• How does the presence of an acid or a base influence an aqueous system?	• Titration Lab

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Science Curriculum Guide Overview

Curriculum Guide	Curriculum guides are public documents aligned with the Massachusetts Department of Education Curriculum Frameworks. They focus on the set of standards that students will learn within certain disciplines at appropriate grade levels. Each area of the curriculum is divided into general strands (broad categories) under which the standards fall. When we discuss "standards-based education" we mean that students are measured against their proficiency and growth towards meeting these standards. Curriculum Guides are intended for teachers, parents, and the wider school community as an overview document of the course of study for the year.
Content Standards	The Chemistry curriculum at Reading Memorial High School is aligned with the 2016 Massachusetts Science and Technology/Engineering Curriculum Frameworks for High School Chemistry . Detailed information for the STE Framework can be found at: http://www.doe.mass.edu/frameworks/scitech/2016-04.pdf. The content standards describe what students should know and be able to do. They build from middle school physical science standards. In High School Chemistry, students consider how structure and composition at sub-atomic scales explain structure-property relationships in chemistry and influence energy transformations and dissipation of energy during chemical and physical changes.
Science and Engineering Practices	The integration of science and engineering practices in high school science courses gives students dynamic and relevant opportunities to refine and communicate science understandings to be well prepared for civic life, postsecondary education, and career success.
Essential Questions	Essential questions are questions that are not answerable with an easy answer or a simple instruction. The purpose of essential questions is to provide opportunities for inquiry into the learning and act as an umbrella to anchor the unit/lesson.
Key Activities	Key Activities identified in Curriculum Guides are not intended to be exhaustive, nor are they intended to be prescriptive. The activities identified may function as a menu of curriculum resources from which educators identify the most appropriate tools to utilize in their classrooms.