

CHEMISTRY POWER STANDARDS

2013-2014

Atomic Structure and the Periodic Table

Description: Knowledge of the fundamental structure of the atom is a key component to understanding how matter interacts. The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure. As a basis for understanding this concept students can:

- a. Identify the historical experimental basis for the development of atomic structure and the quantum theory.
- b. Given the atomic number and atomic mass number of an isotope, draw and label a model of the isotope's atomic structure (number of protons, neutrons, and electrons).
- c. Use the relative mass and abundance of isotopes to calculate the atomic mass of an element.
- d. Describe the relationship between frequency, wavelength, and the speed of light to perform calculations, and classify the major regions of the electromagnetic spectrum.
- e. Explain that spectral lines are the result of transitions of electrons between energy levels.
- f. Relate the position of an element on the periodic table to its electron configuration.
- g. Use the periodic table to find elements based on their properties, explain their positions and show trends that explain how and why elements will form bonds.
- h. Apply technologies, mathematical concepts, and reasoning to solve problems and report findings.
- i. Analyze and apply scientific information to issues confronting society, from a personal to a global level.

Standard 2 – Nuclear Processes

Description: Nuclear processes are those in which an atomic nucleus changes, including radioactive decay of naturally occurring and human-made isotopes, nuclear fission, and nuclear fusion. As a basis for understanding this concept students can:

- a. Distinguish between fission and fusion and describe potential applications of nuclear processes.
- b. Identify the differences between the three forms of radioactive decay (alpha, beta, gamma) and bombardment reactions and describe how the nucleus changes in each type of decay and/or bombardment.
- c. Describe how alpha, beta, and gamma radiation produce different kinds of damage in living tissue and have different penetrating ability.
- d. Predict the amount of a radioactive substance remaining after an integral number of half-lives have passed.
- e. Apply technologies, mathematical concepts, and reasoning to solve problems and report findings.
- f. Analyze and apply scientific information to issues confronting society, from a personal to a global level.

Standard 3 – Chemical Bonds

Description: Biological, chemical, and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules. As a basis for understanding this concept students can:

- Identify the properties of, can write formulas for, and can name ionic compounds.
- Identify the properties of, can write formulas for, and can name covalent compounds.
- Defend the explanation of the relationship between electro negativity in a Lewis dot diagram and the general shape of a molecule.
- Defend the explanation of the relationship between geometric shape and the polarity of a molecule.
- Apply technologies, mathematical concepts, and reasoning to solve problems and report findings.
- Analyze and apply scientific information to issues confronting society, from a personal to a global level.

Standard 4 – Conservation of Matter and Stoichiometry

Description: The balancing of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants. As a basis for understanding this concept students can:

- Balance chemical equations.
- Classify chemical equations.
- Calculate and explain the relationship between mass, moles and particles.
- Calculate percent composition, empirical formulas and molecular formulas using data provided.
- Calculate the mass/molar relationships of the components in a balanced chemical equation.
- Determine the limiting reactant in an equation and calculate the percent yield.
- Apply technologies, mathematical concepts, and reasoning to solve problems and report findings.
- Analyze and apply scientific information to issues confronting society, from a personal to a global level.

Standard 5 – Chemical Thermodynamics

Description: Energy is exchanged or transformed in all chemical reactions and physical changes of matter. As a basis for understanding this concept students can:

- Describe chemical and physical processes as either releasing (exothermic) or absorbing (endothermic) energy.
- Solve problems involving calorimetry.
- Apply technologies, mathematical concepts, and reasoning to solve problems and report findings.

- d. Analyze and apply scientific information to issues confronting society, from a personal to a global level.

Standard 6 – Gases and Their Properties

Description: The kinetic molecular theory describes the motion of atoms and molecules and explains the properties of gases. As a basis for understanding this concept students can:

- a. Describe the Kinetic-Molecular Theory and explain how it accounts for observed gas behavior.
- a. Solve problems by using the gas laws.
- b. Apply Dalton's law of partial pressures to describe the composition of gases.
- c. Apply technologies, mathematical concepts, and reasoning to solve problems and report findings.
- d. Analyze and apply scientific information to issues confronting society, from a personal to a global level.

Standard 7 – Solutions, Mixtures, Acids, and Bases

Description: Solutions are homogeneous mixtures of two or more substances. Acids, bases, and salts are three classes of compounds that form ions in water solutions. As a basis for understanding this concept students can:

- a. Use the terms solute and solvent to differentiate between homogeneous and heterogeneous mixtures.
- b. Describe the dissolving process and identify factors that impact the rate of dissolving.
- c. Calculate the concentration of a solute in various ways.
- d. Describe the properties and various definitions of acids and bases.
- e. Use the pH scale to characterize acid and base solutions.
- f. Perform and calculate acid/base titrations.
- g. Apply technologies, mathematical concepts, and reasoning to solve problems and report findings.
- h. Analyze and apply scientific information to issues confronting society, from a personal to a global level.

Standard 8 – Laboratory Experimentation

Description: Science involves two processes: first, the process of investigation to explore concepts and ideas in the world; and second, the process of analysis and explanation to draw conclusions from experimentation. As a basis for understanding this concept students can:

- a. Use various methods to perform experiments; gather data; and analyze results using the metric system, dimensional analysis and significant digits where applicable.
- b. Draw logical conclusions based on evidence that is consistent with current scientific knowledge.

- c. Write detailed laboratory reports to communicate the results of investigations.
- d. Apply technologies, mathematical concepts, and reasoning to solve problems and report findings.
- e. Analyze and apply scientific information to issues confronting society, from a personal to a global level.