

Archdiocese of Philadelphia Secondary School System Chemistry Standards

The Catholic school community strives to make its faith commitment a complement to academic excellence by developing a curriculum that leads all students to Christ as it prepares them for a successful life in the twenty-first century. It is a curriculum that recognizes the sanctity of each human life while affirming the dignity of each person as a unique creation of God. It is a curriculum that is intended to offer all students the opportunity to study the world at many levels of complexity, through a variety of courses.

Schools of the Archdiocese of Philadelphia shall teach, challenge, and support every student to realize his/her maximum potential and to acquire the knowledge and skill to achieve the general standards in chemistry.

General Standards

- ◆ Matter and Energy
- ◆ Elements and Atomic Structure
- ◆ Nuclear Chemistry
- ◆ Periodic Table
- ◆ Bonding
- ◆ Chemical Reactions and Equations
- ◆ Molar Relationships
- ◆ Environmental Issues

Standards Terminology Glossary

- ◆ General - Goals
- ◆ Content - What a student should be able to do
- ◆ Competency - What a student should be able to perform
- ◆ Assessment - How well a student should be able to perform
- ◆ Rubric - Scoring tool to evaluate the level of student performance

1. Matter and Energy

Content Standard

1.1.Properties of Matter

Competency Standard

- 1.1.1. Compare mass and volume.
- 1.1.2. Describe matter by its chemical and physical properties.
- 1.1.3. Apply the kinetic molecular theory to distinguish between solids, liquids and gases.
- 1.1.4. List extensive and intensive properties of matter.
- 1.1.5. Explain the Law of Conservation of Matter.

Content Standard

1.2.Forms of Energy

Competency Standard

- 1.2.1. Distinguish between potential energy and kinetic energy.
- 1.2.2. Relate examples of energy transformation.
- 1.2.3. Explain the Law of Conservation of Energy.

Content Standard

1.3.Classification of Matter

Competency Standard

- 1.3.1. Define element, compound and mixture.
- 1.3.2. Distinguish between homogeneous and heterogeneous mixtures.
- 1.3.3. Explain methods of separating a mixture.
- 1.3.4. Use the density formula to identify unknown substances.
- 1.3.5. Differentiate between organic and inorganic compounds.

Content Standard

1.4.SI Units

Competency Standard

- 1.4.1. Identify the standard units for length, mass, time and temperature.
- 1.4.2. Explain derived units.
- 1.4.3. Distinguish between accuracy and precision.
- 1.4.4. Demonstrate the ability to use significant digits correctly.

2. Elements and Atomic Structure

Content Standard

2.1.Elements

Competency Standard

2.1.1. Use chemical symbols to represent the elements.

2.1.2. Write names of elements from symbols.

Content Standard

2.2.Atomic models

Competency Standard

2.2.1. Infer the existence of atoms from the laws of definite composition, conservation of mass and multiple proportions.

2.2.2. List the basic principles of Dalton's atomic theory.

2.2.3. Describe the models of the atom as they evolved.

2.2.4. Compare and contrast the properties of electrons, protons and neutrons.

2.2.5. Describe the quantum model of the atom.

Content Standard

2.3.Structure of the Atom

Competency Standard

2.3.1. Decipher an element's atomic number and mass number.

2.3.2. Use the four quantum numbers to describe atoms.

2.3.3. Apply information from the periodic table to write the electron configurations and orbital diagrams for atoms.

3. Nuclear Chemistry

Content Standard

3.1. Radioactivity

Competency Standard

- 3.1.1. Differentiate between ionizing and nonionizing radiation.
- 3.1.2. Use equations to represent the different types of radioactive decay.
- 3.1.3. Predict the fraction of radioactive nuclei that remain after a certain amount of time given the half-life.
- 3.1.4. Estimate the age of materials that contain isotopes by using the predictability of nuclear decay.
- 3.1.5. List some of the effects of ionizing radiation on life forms and the environment.

Content Standard

3.2. Uses of Nuclear Reactions

Competency Standard

- 3.2.1. Compare and contrast nuclear fission and nuclear fusion.
- 3.2.2. Analyze the risks associated with nuclear waste and evaluate disposal methods.

4. Periodic Table

Content Standard

4.1. Organization

Competency Standard

- 4.1.1. State the Periodic Law
- 4.1.2. Describe how the model periodic table is organized.
- 4.1.3. Explain why elements in the same family of the periodic table have similar properties.
- 4.1.4. Describe properties of the individual families on the periodic table.
- 4.1.5. Relate the properties of elements to their electron configuration.
- 4.1.6. Distinguish among metals, nonmetals and metalloids.

Content Standard

4.2. Periodic Trends

Competency Standard

- 4.2.1. Describe the trends seen in the periodic table with respect to atomic radius, ionization energy, electron affinity and electronegativity.
- 4.2.2. Relate trends of the periodic table to the atomic structure of the elements.

Content Standard

4.3. Symbols and Names of Compounds

Competency Standard

- 4.3.1. Use chemical symbols to represent formulas for compounds.
- 4.3.2. Identify the names of binary molecular compounds from their formulas.
- 4.3.3. Identify the names of ionic compounds from their formulas.
- 4.3.4. Predict the formulas of ionic compounds from their ionic charge.
- 4.3.5. Recognize the charge of an ion from a chemical formula.

Content Standard

4.4. Reaction Rate

Competency Standard

- 4.4.1. Explain what is meant by reaction rate.
- 4.4.2. Apply the kinetic molecular theory to reaction rate.
- 4.4.3. Identify the factors that affect reaction rate.
- 4.4.4. Apply the Collision Theory to explain why reaction rates change.
- 4.4.5. Compare the rate of a reaction with and without a catalyst.

5. Bonding

Content Standard

5.1. Chemical Bonding

Competency Standard

- 5.1.1. Describe the nature of a chemical bond.
- 5.1.2. Compare and contrast ionic and covalent bonds.
- 5.1.3. Predict whether bonds are ionic, polar covalent, or nonpolar covalent using electronegativity values.

Content Standard

5.2. Octet Rule

Competency Standard

- 5.2.1. Apply the octet rule to write electron dot structures of simple molecules and polyatomic ions.

Content Standard

5.3. Shapes and Properties of Molecules

Competency Standard

- 5.3.1. Predict the shapes of molecules.
- 5.3.2. Determine if a molecule is polar or nonpolar.
- 5.3.3. Discuss the unique bonding of carbon in the formation of hydrocarbons and hydrocarbon derivatives.

Content Standard

5.4. Intermolecular Bonding

Competency Standard

- 5.4.1. Use the Kinetic Molecular Theory to explain how the three types of intermolecular forces arise.
- 5.4.2. Compare and contrast the physical properties of gases, liquids and solids by Comparing the strength of their intermolecular forces.
- 5.4.3. Discuss the effects of hydrogen bonding on the properties of water.
- 5.4.4. Explain the molecular basis for surface tension.
- 5.4.5. Explain the molecular basis for chromatography as a method of separating a mixture.
- 5.4.6. Relate vapor pressure to the boiling point of a liquid.

6. Chemical Reactions and Equations

Content Standard

6.1. Evidence for Chemical Reactions

Competency Standard

- 6.1.1. Recognize the occurrence of chemical reactions by external signs.
- 6.1.2. Identify reactants and products in a chemical reaction.
- 6.1.3. Write balanced chemical equations.
- 6.1.4. Explain the difference between exothermic and endothermic reactions.

Content Standard

6.2. Types of Chemical Reactions

Competency Standard

- 6.2.1. Classify reactions as belonging to one of five general types of chemical reactions.
- 6.2.2. Predict the products of a reaction.
- 6.2.3. Determine, by using an activity series, whether a single replacement reaction will occur.
- 6.2.4. Evaluate energy changes in chemical reactions.
- 6.2.5. Interpret energy changes in chemical reactions using potential energy diagrams.

Content Standard

6.3. Ionic equations and Precipitation Reactions

Competency Standard

- 6.3.1. Identify ionic substances that precipitate from aqueous solution.
- 6.3.2. Write ionic equations and net ionic equations for precipitation reactions in aqueous solutions.

7. Molar Relationships

Content Standard

7.1.Moles

Competency Standard

- 7.1.1. Define the term mole and describe how it is used in chemistry.
- 7.1.2. Calculate molar mass.
- 7.1.3. Convert grams to moles, moles to molecules, grams to molecules and variations of each.

Content Standard

7.2.Formula Calculations

Competency Standard

- 7.2.1. Calculate Percent composition of compounds by mass.
- 7.2.2. Determine empirical and molecular formulas for compounds.

Content Standard

7.3.Stoichiometry

Competency Standard

- 7.3.1. Display mastery of mole-mass calculations and mass-mass calculations.
- 7.3.2. Determine the limiting reactant in a chemical reaction to predict the amount of product that can be formed.

Content Standard

7.4.Molarity

Competency Standard

- 7.4.1. Explain how to prepare molar solutions.

8. Acids and Bases

Content Standard

8.1. Properties of acids and bases

Competency Standard

- 8.1.1. Describe the characteristic properties of aqueous acids and bases.
- 8.1.2. Distinguish between the Arrhenius and Bronsted definitions of acids and bases.
- 8.1.3. Explain the difference between a strong acid and a weak acid and between a strong base and a weak base.
- 8.1.4. Identify conjugate acid-base pairs.

Content Standard

8.2. Environmental Issues

Competency Standard

- 8.2.1. Discuss the causes of acid rain and its effects on the environment.

Content Standard

8.3. pH

Competency Standard

- 8.3.1. Apply the pH scale to calculate the concentration of hydronium ions and hydroxide ions given the pH of a solution.

Content Standard

8.4. Titration

Competency Standard

- 8.4.1. Write an equation for a neutral reaction.
- 8.4.2. Describe how an acid-base titration is performed.
- 8.4.3. Determine the molarity of an acid or base solution using titration data.