

Curriculum Organizer: Introduction to Chemistry

- list the safety and protective equipment available in the laboratory
- describe how and when to use each piece of equipment
- indicate on a school map the location of the nearest fire alarm and appropriate fire exits
- list sources of first-aid assistance other than the classroom teacher
- describe common chemistry laboratory hazards
- describe the appropriate procedure or technique for dealing with particular hazards
- produce a list of general rules of safe laboratory conduct
- display a conscious safety attitude in the laboratory
- use SI units and their accepted alternatives in chemistry
- demonstrate skills in measuring mass, volume (liquid), and temperature
- describe the imprecise nature of all measurements
- determine the number of significant figures in a measured quantity and relate to the uncertainty
- round off calculated results to the appropriate number of significant figures
- correctly determine the unit of a derived quantity
- state the acceptability of the numerical results of a lab experiment with regard to the uncertainty of the results
- communicate results and data in clear and understandable forms
- define matter
- describe chemistry as the science concerned with the properties, composition, and behaviour of matter
- describe and give examples of a variety of forms and properties that matter can exhibit
- distinguish between observation and interpretation
- describe the types of changes that may be observed when matter is heated, combined, or separated
- differentiate between physical and chemical changes
- classify a substance as solid, liquid, or gas, and describe its different properties
- define boiling point, freezing point, and melting point
- describe the simple molecular motions and arrangements for solids, liquids, and gases
- relate the heat that occur during phase changes to changes in molecular motions and arrangements

Curriculum Organizer: Atoms, Molecules, and Ions

- describe a substance as having a set of unique and identifiable properties
- classify a given material as an element, compound, or mixture, using the properties of the material
- describe several ways that substances may be separated from one another
- relate the observable properties and characteristics of elements, compounds, and mixtures to the concept of atoms and molecules
- define atom, molecule, and ion
- write chemical symbols for elements and formulae for ions from appropriate charts

- name the ionic compound from a formula, and write the formula given a name
- name the covalent compound from a formula using the prefix naming system, and write the formula given a name
- predict the formulae of covalent compounds given the formula of another compound containing elements in the same family (families)
- write the names and formulae for some common acids

Curriculum Organizer: Mole Concept

- explain the relative nature of atomic mass
- identify the unit for counting atoms, molecules, or ions as the mole
- define the mole
- determine the molar mass of an element or compound
- perform calculations relating the number of particles, moles, and mass
- state Avogadro's hypothesis
- determine experimentally the molar volume of a gas at room temperature and pressure
- state the molar volume of a gas at STP
- calculate the moles or mass of a gas from a given volume at STP or vice versa
- compare and contrast molecular and empirical formulae
- determine the percent composition by mass from the formula of a compound
- determine the empirical formula for the compound from the percent composition by mass
- determine the molecular formula from the molecular mass and empirical formula
- describe molarity (mol/L or M) as a measure of molar concentration
- prepare a standard solution
- perform calculations relating mass (or moles) of solute, volume of solution, and molarity
- calculate the resulting concentration when a given volume of a standard solution is diluted with water to a given volume

Curriculum Organizer: Chemical Reactions

- define reactants and products
- observe and record changes that occur during a chemical reaction
- describe chemical reactions in terms of the rearrangement of the atoms as bonds are broken and new bonds are formed
- gather experimental data that lead to the law of conservation of mass
- apply the law of conservation of mass to a formula equation of a reaction to demonstrate that atoms are conserved in the reaction
- balance formula equations of several chemical reactions
- use subscripts to represent solids, liquids, gases, and aqueous solutions

- classify, predict products, and write balanced equations for the following types of chemical reactions:
  - synthesis
  - decomposition
  - single replacement
  - double replacement
  - combustion
  - acid-base neutralization
- define exothermic and endothermic reactions
- classify reactions as exothermic or endothermic based on experimental observations
- relate energy changes to bond breaking and formation
- write equations for chemical reactions including the energy term
- relate the coefficients in a balanced equation to the relative number of molecules or moles (the mole ratio) of reactants and products in the chemical reaction
- perform calculations involving reactions using any of the following:
  - number of molecules
  - moles
  - mass
  - gas volume at STP
  - solution concentration and volume
- perform calculations involving limiting reagent

#### Curriculum Organizer: Atomic Theory

- describe early models of the atom
- describe the relative position, mass, and charge for a proton, neutron, and electron
- identify the atomic number for an element, using a table
- calculate the number of protons and electrons in a atom or ion
- define isotope and explain it in terms of atomic structure
- calculate the number of neutrons, protons, and electrons for a atom or ion of an isotope given the mass number of the isotope and the charge of the ion
- calculate the average atomic mass from isotopic data
- describe a simple electron arrangement for the first 20 elements
- classify elements as metal, non-metal, or metalloid and locate them on the periodic table
- describe the similarities and trends among elements using such properties as: melting point, ionization energy, atomic radius, chemical reactivity, ion charge, conductivity
- distinguish the ordering of elements in early periodic tables (based on atomic mass) from the ordering of elements in the modern periodic table (based on atomic number)
- identify the following families of elements: alkali metals, alkaline earth metals, halogens, noble gases
- describe some properties of the alkali metals, alkaline earth metals, halogens, and noble gases
- relate noble gas stability to electron arrangement within the atom
- predict the probable electron gain or loss for elements in columns 1, 2, 13, 15, 16, and 17 to attain stability
- relate the observed charge of monatomic ions of metals and non-metals to numbers of electrons lost or gained
- predict the characteristics of elements knowing the characteristics of another element in that family
- predict the metallic character of an element based upon its position in the table

- define covalent and ionic bonding
- define valence electrons
- demonstrate a knowledge that bonding involves valence electrons
- draw an electron dot diagram for an atom
- identify from a chemical formula the probable type of bond (ionic or covalent)
- draw electron dot diagrams and structural formulae for simple molecules and ions and deduce molecular formulae

#### Curriculum Organizer: Solution Chemistry

- define solution as a homogeneous mixture
- classify a solution as a system distinct from a pure solid, liquid, or gas
- identify the solute and the solvent as the components of a solution
- describe the causes of molecular polarity
- categorize various common solvents as polar and non-polar
- on the basis of observations, make deductions concerning the solubility of polar and non-polar solutes in polar and non-polar solvents
- use lab observations to describe the relative conductivity of several solutes in aqueous solution
- summarize the results of a conductivity experiment as to the types of solute that conduct electricity when dissolved in water
- propose a mechanism that explains the conductivity of soluble salts in water
- write dissociation or ionization equations for several substances that dissolve to give conducting solutions
- calculate the molarity of each ion in a salt solution given the molarity of the solution
- calculate the concentration of ions resulting when two solutions of known concentration and volume are mixed (assuming no reaction)

#### Curriculum Organizer: Organic Chemistry

- identify the multiple bonding character of carbon atoms
- identify carbon as the "backbone" of organic chemistry
- relate organic chemistry to products such as plastics, fuels, pharmaceutical drugs, pesticides, insecticides, solvents, synthetics
- identify major sources of organic compounds
- describe a specific industrial application of organic chemistry
- define hydrocarbon, alkane, alkene, alkyne, cyclic, and aromatic as they relate to organic compounds
- classify a hydrocarbon as either saturated or unsaturated
- compare the geometry of single, double, and triple bonds between two carbon atoms
- compare the rotational ability in single, double, and triple bonds
- name and draw structures of alkanes, alkenes, and alkynes up to C<sub>10</sub>
- recognize and name the substituent groups methyl, ethyl, fluoro, chloro, bromo, and iodo
- name and draw structures of simple substituted alkanes to C<sub>10</sub>
- identify cis- or trans-isomers of alkenes