

Chemistry 30S Curriculum Outcomes

Topic 1: Physical Properties of Matter

105 Total outcomes

- C11-1-01 Describe the properties of gases, liquids, solids, and plasma.
***Include:** density, compressibility, diffusion*
- C11-1-02 Use the Kinetic Molecular Theory to explain properties of gases.
***Include:** random motion, intermolecular forces, elastic collisions, average kinetic energy, temperature*
- C11-1-03 Explain the properties of liquids and solids using the Kinetic Molecular Theory.
- C11-1-04 Explain the process of melting, solidification, sublimation, and deposition in terms of the Kinetic Molecular Theory.
***Include:** freezing point, exothermic, endothermic*
- C11-1-05 Use the Kinetic Molecular Theory to explain the processes of evaporation and condensation.
***Include:** intermolecular forces, random motion, volatility, dynamic equilibrium*
- C11-1-06 Operationally define vapour pressure in terms of observable and measurable properties.
- C11-1-07 Operationally define normal boiling point temperature in terms of vapour pressure.
- C11-1-08 Interpolate and extrapolate the vapour pressure and boiling temperature of various substances from pressure versus temperature graphs.

8 Outcomes

Topic 2: Gases and the Atmosphere

- C11-2-01 Identify the abundances of the naturally occurring gases in the atmosphere and examine how these abundances have changed over geologic time.
Include: *oxygenation of Earth's atmosphere, the role of biota in oxygenation, changes in carbon dioxide content over time*
- C11-2-02 Research Canadian and global initiatives to improve air quality.
- C11-2-03 Examine the historical development of the measurement of pressure.
Examples: *the contributions of Galileo Galilei, Evangelista Torricelli, Otto von Guericke, Blaise Pascal, Christiaan Huygens, John Dalton, Joseph Louis Gay-Lussac, Amadeo Avogadro...*
- C11-2-04 Describe the various units used to measure pressure.
Include: *atmospheres (atm), kilopascals (kPa), millimetres of mercury (mmHg), millibars (mb)*
- C11-2-05 Experiment to develop the relationship between the pressure and volume of a gas using visual, numeric, and graphical representations.
Include: *historical contributions of Robert Boyle*
- C11-2-06 Experiment to develop the relationship between the volume and temperature of a gas using visual, numeric, and graphical representations.
Include: *historical contributions of Jacques Charles, the determination of absolute zero, the Kelvin temperature scale*
- C11-2-07 Experiment to develop the relationship between the pressure and temperature of a gas using visual, numeric, and graphical representations.
Include: *historical contributions of Joseph Louis Gay-Lussac*
- C11-2-08 Solve quantitative problems involving the relationships among the pressure, temperature, and volume of a gas using dimensional analysis.
Include: *symbolic relationships*
- C11-2-09 Identify various industrial, environmental, and recreational applications of gases.
Examples: *self-contained underwater breathing apparatus (scuba), anaesthetics, air bags, acetylene welding, propane appliances, hyperbaric chambers...*

9 Outcomes

Topic 3: Chemical Reactions

- C11-3-01 Determine average atomic mass using isotopes and their relative abundance.
Include: *atomic mass unit (amu)*
- C11-3-02 Research the importance and applications of isotopes.
Examples: *nuclear medicine, stable isotopes in climatology, dating techniques...*
- C11-3-03 Write formulas and names for polyatomic compounds using International Union of Pure and Applied Chemistry (IUPAC) nomenclature.
- C11-3-04 Calculate the mass of compounds in atomic mass units.
- C11-3-05 Write and classify balanced chemical equations from written descriptions of reactions.
Include: *polyatomic ions*
- C11-3-06 Predict the products of chemical reactions, given the reactants and type of reaction.
Include: *polyatomic ions*
- C11-3-07 Describe the concept of the mole and its importance to measurement in chemistry.
- C11-3-08 Calculate the molar mass of various substances.
- C11-3-09 Calculate the volume of a given mass of a gaseous substance from its density at a given temperature and pressure.
Include: *molar volume calculation*
- C11-3-10 Solve problems requiring interconversions between moles, mass, volume, and number of particles.
- C11-3-11 Determine empirical and molecular formulas from percent composition or mass data.
- C11-3-12 Interpret a balanced equation in terms of moles, mass, and volumes of gases.
- C11-3-13 Solve stoichiometric problems involving moles, mass, and volume, given the reactants and products in a balanced chemical reaction.
Include: *heat of reaction problems*
- C11-3-14 Identify the limiting reactant and calculate the mass of a product, given the reaction equation and reactant data.
- C11-3-15 Perform a lab involving mass-mass or mass-volume relations, identifying the limiting reactant and calculating the mole ratio.
Include: *theoretical yield, experimental yield*
- C11-3-16 Discuss the importance of stoichiometry in industry and describe specific applications.
Examples: *analytical chemistry, chemical engineering, industrial chemistry...*

16 Outcomes

Topic 4: Solutions

- C11-4-01 Describe and give examples of various types of solutions.
Include: *all nine possible types*
- C11-4-02 Describe the structure of water in terms of electronegativity and the polarity of its chemical bonds.
- C11-4-03 Explain the solution process of simple ionic and covalent compounds, using visual, particulate representations and chemical equations.
Include: *crystal structure, dissociation, hydration*
- C11-4-04 Explain heat of solution with reference to specific applications.
Examples: *cold packs, hot packs...*
- C11-4-05 Perform a lab to illustrate the formation of solutions in terms of the polar and nonpolar nature of substances.
Include: *soluble, insoluble, miscible, immiscible*
- C11-4-06 Construct, from experimental data, a solubility curve of a pure substance in water.
- C11-4-07 Differentiate among saturated, unsaturated, and supersaturated solutions.
- C11-4-08 Use a graph of solubility data to solve problems.
- C11-4-09 Explain how a change in temperature affects the solubility of gases.
- C11-4-10 Explain how a change in pressure affects the solubility of gases.
- C11-4-11 Perform a lab to demonstrate freezing-point depression and boiling-point elevation.
- C11-4-12 Explain freezing-point depression and boiling-point elevation at the molecular level.
Examples: *antifreeze, road salt...*
- C11-4-13 Differentiate among, and give examples of, the use of various representations of concentration.
Include: *grams per litre (g/L), % weight-weight (% w/w), % weight-volume (% w/v), % volume/volume (% v/v), parts per million (ppm), parts per billion (ppb), moles per litre (mol/L) (molarity)*
- C11-4-14 Solve problems involving calculation for concentration, moles, mass, and volume.
- C11-4-15 Prepare a solution, given the amount of solute (in grams) and the volume of solution (in millilitres), and determine the concentration in moles/litre.
- C11-4-16 Solve problems involving the dilution of solutions.
Include: *dilution of stock solutions, mixing common solutions with different volumes and concentrations*
- C11-4-17 Perform a dilution from a solution of known concentration.
- C11-4-18 Describe examples of situations where solutions of known concentration are important.
Examples: *pharmaceutical preparations, administration of drugs, aquaria, swimming-pool disinfectants, gas mixes for scuba, radiator antifreeze...*
- C11-4-19 Describe the process of treating a water supply, identifying the allowable concentrations of metallic and organic species in water suitable for consumption.

19 Outcomes

Topic 5: Organic Chemistry

- C11-5-01 Compare and contrast inorganic and organic chemistry.
Include: *the contributions of Friedrich Wöhler to the overturn of vitalism*
- C11-5-02 Identify the origins and major sources of hydrocarbons and other organic compounds.
Include: *natural and synthetic sources*
- C11-5-03 Describe the structural characteristics of carbon.
Include: *bonding characteristics of the carbon atom in hydrocarbons (single, double, triple bonds)*
- C11-5-04 Compare and contrast the molecular structures of alkanes, alkenes, and alkynes.
Include: *trends in melting points and boiling points of alkanes only*
- C11-5-05 Name, draw, and construct structural models of the first 10 alkanes.
Include: *IUPAC nomenclature, structural formulas, condensed structural formulas, molecular formulas, general formula $C_nH_{(2n+2)}$*
- C11-5-06 Name, draw, and construct structural models of branched alkanes.
Include: *six-carbon parent chain, methyl and ethyl substituent groups, IUPAC nomenclature*
- C11-5-07 Name, draw, and construct structural models of isomers for alkanes up to six-carbon atoms.
Include: *condensed structural formulas*
- C11-5-08 Outline the transformation of alkanes to alkenes and vice versa.
Include: *dehydrogenation/hydrogenation, molecular models*
- C11-5-09 Name, draw, and construct molecular models of alkenes and branched alkenes.
Include: *six-carbon parent chain, methyl and ethyl substituent groups, IUPAC nomenclature, structural formulas, condensed structural formulas, molecular formulas, general formula C_nH_{2n}*
- C11-5-10 Differentiate between saturated and unsaturated hydrocarbons.
- C11-5-11 Outline the transformation of alkenes to alkynes and vice versa.
Include: *dehydrogenation/hydrogenation, molecular models*
- C11-5-12 Name, draw, and construct structural models of alkynes and branched alkynes.
Include: *six-carbon parent chain, methyl and ethyl substituent groups, IUPAC nomenclature, structural formulas, condensed structural formulas, molecular formulas, general formula C_nH_{2n-2}*
- C11-5-13 Compare and contrast the structure of aromatic and aliphatic hydrocarbons.
Include: *molecular models, condensed structural formulas*
- C11-5-14 Describe uses of aromatic hydrocarbons.
Examples: *polychlorinated biphenyls, caffeine, steroids, organic solvents (toluene, xylene)...*
- C11-5-15 Write condensed structural formulas for and name common alcohols.
Include: *maximum of six-carbon parent chain, IUPAC nomenclature*
- C11-5-16 Describe uses of methyl, ethyl, and isopropyl alcohols.
- C11-5-17 Write condensed structural formulas for and name organic acids.
Include: *maximum of six-carbon parent chain, IUPAC nomenclature*
- C11-5-18 Describe uses or functions of common organic acids.
Examples: *acetic, ascorbic, citric, formic, acetylsalicylic (ASA), lactic...*
- C11-5-19 Perform a lab involving the formation of esters, and examine the process of esterification.
- C11-5-20 Write condensed structural formulas for and name esters.
Include: *up to 6-C alcohols and 6-C organic acids, IUPAC nomenclature*

- C11-5-21 Describe uses of common esters.
Examples: *pheromones, artificial flavourings...*
- C11-5-22 Describe the process of polymerization and identify important natural and synthetic polymers.
Examples: *polyethylene, polypropylene, polystyrene, polytetrafluoroethylene (Teflon®)...*
- C11-5-23 Describe how the products of organic chemistry have influenced quality of life.
Examples: *synthetic rubber, nylon, medicines, polytetrafluoroethylene (Teflon®)...*
- C11-5-24 Use the decision-making process to investigate an issue related to organic chemistry.
Examples: *gasohol production, alternative energy sources, recycling of plastics...*

24 Outcomes

Cluster 0: Skills and Attitudes Outcomes

Demonstrating Understanding

- C11-0-U1 Use appropriate strategies and skills to develop an understanding of chemical concepts.
Examples: analogies, concept frames, concept maps, manipulatives, particulate representations, role-plays, simulations, sort-and-predict frames, word cycles...
- C11-0-U2 Demonstrate an understanding of chemical concepts.
Examples: use accurate scientific vocabulary, explain concepts to others, compare and contrast concepts, apply knowledge to new situations and/or contexts, create analogies, use manipulatives...

Scientific Inquiry

- C11-0-S1 Demonstrate work habits that ensure personal safety and the safety of others, as well as consideration for the environment.
Include: knowledge and use of relevant safety precautions, Workplace Hazardous Materials Information System (WHMIS), emergency equipment
- C11-0-S2 State a testable hypothesis or prediction based on background data or on observed events.
- C11-0-S3 Design and implement an investigation to answer a specific scientific question.
Include: materials, independent and dependent variables, controls, methods, safety considerations
- C11-0-S4 Select and use scientific equipment appropriately and safely.
Examples: volumetric glassware, balance, thermometer...
- C11-0-S5 Collect, record, organize, and display data using an appropriate format.
Examples: labelled diagrams, graphs, multimedia applications, software integration, probeware...
- C11-0-S6 Estimate and measure accurately using Système International (SI) and other standard units.
Include: SI conversions, significant figures
- C11-0-S7 Interpret patterns and trends in data, and infer and explain relationships.
- C11-0-S8 Evaluate data and data-collection methods for accuracy and precision.
Include: discrepancies in data, sources of error, percent error
- C11-0-S9 Draw a conclusion based on the analysis and interpretation of data.
Include: cause-and-effect relationships, alternative explanations, supporting or rejecting a hypothesis or prediction

Research

- C11-0-R1 Synthesize information obtained from a variety of sources.
Include: print and electronic sources, specialists, other resource people
- C11-0-R2 Evaluate information obtained to determine its usefulness for information needs.
Examples: scientific accuracy, reliability, currency, relevance, balance of perspectives, bias...
- C11-0-R3 Quote from or refer to sources as required and reference information sources according to an accepted practice.
- C11-0-R4 Compare diverse perspectives and interpretations in the media and other information sources.
- C11-0-R5 Communicate information in a variety of forms appropriate to the audience, purpose, and context.

Communication and Teamwork

- C11-0-C1 Collaborate with others to achieve group goals and responsibilities.
- C11-0-C2 Elicit, clarify, and respond to questions, ideas, and diverse points of view in discussions.
- C11-0-C3 Evaluate individual and group processes.

Decision Making

C11-0-D1 Identify and explore a current STSE issue.

Examples: *clarify what the issue is, identify different viewpoints and/or stakeholders, research existing data/information...*

C11-0-D2 Evaluate implications of possible alternatives or positions related to an STSE issue.

Examples: *positive and negative consequences of a decision, strengths and weaknesses of a position...*

C11-0-D3 Recognize that decisions reflect values and consider their own values and those of others when making a decision.

Examples: *being in balance with nature, generating wealth, respecting personal freedom...*

C11-0-D4 Recommend an alternative or identify a position and provide justification.

C11-0-D5 Propose a course of action related to an STSE issue.

C11-0-D6 Reflect on the process used by self or others to arrive at an STSE decision.

Attitudes

C11-0-A1 Demonstrate confidence in their ability to carry out investigations in chemistry and to address STSE-related issues.

C11-0-A2 Value skepticism, honesty, accuracy, precision, perseverance, and openmindedness as scientific and technological habits of mind.

C11-0-A3 Demonstrate a continuing, increasingly informed interest in chemistry and chemistry-related careers and issues.

C11-0-A4 Be sensitive and responsible in maintaining a balance between the needs of humans and a sustainable environment.

29 Outcomes