

Chemistry 40S Curriculum Outcomes

Unit 1: Aqueous Solutions

93 Total outcomes

- C12-1-01 Explain observed examples of solubility and precipitation at the molecular and symbolic levels.
- C12-1-02 Perform a lab to develop a set of solubility rules.
- C12-1-03 Use a table of solubility rules to predict the formation of a precipitate.
- C12-1-04 Write balanced neutralization reactions involving strong acids and bases.
- C12-1-05 Perform a lab to demonstrate the stoichiometry of a neutralization reaction between a strong base and a strong acid.
- C12-1-06 Calculate the concentration or volume of an acid or base from the concentration and volume of an acid or a base required for neutralization.
- C12-1-07 Design and test a procedure to determine the identity of a number of unknown solutions.
- C12-1-08 Define oxidation and reduction.
Include: *gain and loss of electrons, oxidizing agent, reducing agent.*
- C12-1-09 Determine the oxidation numbers for atoms in compounds and ions.
- C12-1-10 Identify and describe reactions as redox or non-redox.
Include: *oxidizing agent, reducing agent, oxidized substance, and reduced substance.*
- C12-1-11 Balance oxidation-reduction reactions using redox methods.
Include: *acidic and basic solutions*
Examples: *rocket fuels, fireworks, household bleach, photography, metal recovery from ores, steel making, aluminum recycling, fuel cells, batteries, tarnish removal, fruit clocks, forensic blood detection using luminol, chemiluminescence/bioluminescence, electrolytic cleaning, electrodeposition, photochemical etching, antioxidants/preservatives*

11 Outcomes

Unit 2: Atomic Structure

- C12-2-01 Qualitatively describe the electromagnetic spectrum in terms of frequency, wavelength and energy.
- C12-2-02 Recognize, through direct observation, that elements have unique line spectra.
Include: *flame tests or gas discharge tubes, spectrosopes or diffraction gratings.*
- C12-2-03 Describe applications and / or natural occurrences of line spectra.
Examples: *astronomy, aurora borealis, fireworks, neon lights.*
- C12-2-04 Outline the historical development of the Quantum Mechanical Model of the atom.
- C12-2-05 Write electron configurations for elements of the periodic table.
Include: *selected elements up to atomic number 36 (krypton)*
- C12-2-06 Relate the electron configuration of an element to its valence electron(s) and its position on the periodic table.
- C12-2-07 Identify periodic trends among the properties of elements and relate to electron configuration.
Include: *atomic radii, ionic radii, ionization energy, electronegativity.*

7 Outcomes

Unit 3: Kinetics

- C12-3-01 Formulate an operational definition of reaction rate.
Include: *examples of chemical reactions that occur at different rate.*
- C12-3-02 Identify variables used to monitor reaction rates (i.e. change per unit time, $\Delta x/\Delta t$).
Examples: *pressure, temperature, pH, conductivity, colour.*
- C12-3-03 Perform a lab to measure the average and instantaneous rate of a chemical reaction.
Include: *initial rate.*
- C12-3-04 Relate the rate of formation of a product to the rate of disappearance of a reactant given experimental rate data and reaction stoichiometry.
Include: *Descriptive treatment at the particulate level.*
- C12-3-05 Perform a lab to identify factors that affect the rate of a chemical reaction.
Include: *nature of reactants, surface area, concentration, pressure, volume, temperature, and presence of a catalyst.*
- C12-3-06 Use the Collision Theory to explain the factors which affect the rate of chemical reactions
Include: *Activation energy, orientation of molecules.*
- C12-3-07 Draw potential energy diagrams for endothermic and exothermic reactions.
Include: *relative rates, effects of catalyst, heat of reaction (enthalpy change).*
- C12-3-08 Explain the concept of a reaction mechanism.
Include: *rate determining step.*
- C12-3-09 Explain the concept of a reaction mechanism.
Include: *rate determining step.*
- C12-3-10 Determine the rate law and order of a chemical reaction from experimental data.
Include: *reactions that are zero, first or second order, rate versus concentration graphs.*

10 Outcomes

Unit 4: Chemical Equilibrium

- C12-4-01 Relate the concept of equilibrium to physical and chemical systems.
Include: *conditions necessary to achieve equilibrium.*
- C12-4-02 Write equilibrium law expressions from balanced chemical equations for heterogeneous and homogeneous systems.
- C12-4-03 Use the value of the equilibrium constant to identify how far a system at equilibrium has gone towards completion.
- C12-4-04 Solve problems involving equilibrium constants.
- C12-4-05 Perform a lab to determine the equilibrium constant of an equilibrium system.
- C12-4-06 Use Le Chatelier's Principle to predict shifts in equilibrium.
Include: *temperature changes, pressure / volume changes, changes in reactant/product concentration, the addition of a catalyst, the addition of an inert gas, and the effects of the various stresses on the equilibrium constant.*
- C12-4-07 Perform a lab to demonstrate Le Chatelier's Principle.
- C12-4-08 Interpret concentration versus time graphs.
Include: *temperature changes, concentration changes, addition of a catalyst*
- C12-4-09 Discuss practical applications of Le Chatelier's principle.
Examples: *Haber Process, haemoglobin production at high altitude, carbonated beverages, eyes adjusting to light, blood pH, recharging of batteries, turbocharged/supercharged engines, ester synthesis, weather indicators, carbonated beverages in a hen's diet.*
- C12-4-10 Write solubility product (K_{sp}) expressions from balanced chemical equations for salts with low solubility.
- C12-4-11 Solve problems involving K_{sp} .
Include: *common ion problems*
- C12-4-12 Describe practical applications of salts with low solubilities.
Examples: *kidney stones, limestone caverns, osteoporosis, tooth decay*
- C12-4-13 Perform a lab to determine the K_{sp} of a salt with low solubility.

13 Outcomes

Unit 5: Acids and Bases

- C12-5-01 Outline the historical development of acid base theories.
Include: Arrhenius, Bronsted-Lowry, Lewis
- C12-5-02 Write balanced acid/base chemical equations.
Include: conjugate acid/base pairs, amphoteric behavior
- C12-5-03 Describe the relationship between the hydronium and hydroxide ion concentrations in water.
Include: the ion product constant for water, K_w .
- C12-5-04 Perform an activity to formulate an operational definition of pH.
- C12-5-05 Describe how an acid-base indicator works in terms of colour shifts and Le Chatelier's Principle.
- C12-5-06 Solve problems involving pH.
- C12-5-07 Distinguish between weak and strong aqueous solutions of acids and bases.
Include: electrolytes and non-electrolytes
- C12-5-08 Write the equilibrium expression (K_a or K_b) from a balanced chemical equation.
- C12-5-09 Use K_a or K_b to solve problems for pH, percent dissociation and concentration.
- C12-5-10 Using a standardized acid or base, experimentally determine the concentration of an unknown base or acid.
- C12-5-11 Predict whether an aqueous solution of a given ionic compound will be acidic, basic or neutral given the formula.

11 Outcomes

Unit 6: Electrochemistry

- C12-6-01 Develop an activity series experimentally.
- C12-6-02 Predict the spontaneity of reactions using an activity series.
- C12-6-03 Outline the historical development of voltaic (galvanic) cells.
Include: contributions by Alessandro Volta, Luigi Galvani
- C12-6-04 Explain the operation of a voltaic (galvanic) cell using at the visual, molecular and symbolic levels.
Include: writing half-cell reactions, overall reaction and shorthand (line) notation.
- C12-6-05 Construct a functioning voltaic (galvanic) cell and measure its potential.
- C12-6-06 Define standard electrode potential.
Include: hydrogen electrode as a reference.
- C12-6-07 Calculate standard cell potentials.
- C12-6-08 Predict the spontaneity of reactions using standard electrode potentials.
- C12-6-09 Compare and contrast voltaic (galvanic) and electrolytic cells.
- C12-6-10 Explain the operation of an electrolytic cell at the visual, particulate, and symbolic levels.
Include: a molten ionic compound; an aqueous ionic compound
- C12-6-11 Describe practical uses of electrolytic cells.
Examples: electrolysis of water, electrolysis of brine, electroplating, production and purification of metals.
- C12-6-12 Using Faraday's law, solve problems related to electrolytic cells.

12 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