BIG IDEAS

Dynamic Equilibrium	Solubility Equilibrium	Acids and Bases	Oxidation-Reduction
• Some chemical reactions are reversible and proceed to equilibrium. • Dynamic equilibrium can be altered by changing the surrounding conditions.	• Saturated solutions are systems in equilibrium.	• The strength of an acid or base depends on the degree of dissociation of its ions. • Weak acids, weak bases, and buffers are systems in equilibrium.	• Reduction and oxidation are complementary processes that involve the gain or loss of electrons. • Redox reactions have implications for resource development and for the environment.

Module You May Choose to Include

Reaction Kinetics

- Reactants must collide to react.
- Conditions surrounding a reaction determine its rate.

Learning Standards

Curricular Competencies	Content
Students are expected to be able to do the following: **Questioning and predicting** • Demonstrate a sustained intellectual curiosity about a scientific topic or problem of personal, local, or global interest • **Make observations aimed at identifying their own questions**, including increasingly abstract ones, about the natural world • Formulate multiple hypotheses and predict multiple outcomes **Planning and conducting** • Collaboratively and individually **plan, select, and use appropriate investigation methods**, including field work and lab experiments, to collect reliable data (qualitative and quantitative) • Assess risks and address ethical, cultural, and/or environmental issues associated with their proposed methods • Apply the concepts of accuracy and precision to experimental procedures and data: – significant figures – uncertainty – scientific notation **Processing and analyzing data and information** • Experience and interpret the local environment • Apply **First Peoples perspectives** and knowledge, other ways of knowing, and local knowledge as sources of information • Seek and analyze patterns, trends, and connections in data, including **describing relationships between variables**, **performing calculations**, and identifying inconsistencies • **Construct, analyze, and interpret graphs**, **models, and/or diagrams** • Use knowledge of scientific concepts to draw conclusions that are consistent with evidence • Analyze cause-and-effect relationships	**This course comprises four modules and one module (Reaction Kinetics), which teachers may choose to include.** *Students are expected to know the following:* **Dynamic Equilibrium** • **dynamic nature of chemical equilibrium** • equilibrium shifts: – effect of enthalpy and entropy on equilibrium – **application of Le Châtelier's principle** – effect of a catalyst • **equilibrium constant, K_{eq}** • **quantitative problem solving:** – to evaluate the changes in the value of K_{eq} and in concentrations of substances – to determine if a system is at equilibrium and resultant shifts **Solubility Equilibrium** • saturated solutions as equilibrium systems • equilibrium constant expression, Ksp, for a saturated solution • **quantitative problem solving** involving solubility equilibrium concepts

Learning Standards (continued)

Curricular Competencies	Content
Evaluating • Evaluate their methods and experimental conditions, including identifying sources of error or uncertainty, confounding variables, and possible alternative explanations and conclusions • Describe specific ways to improve their investigation methods and the quality of the data • Evaluate the validity and limitations of a model or analogy in relation to the phenomenon modelled • Demonstrate an awareness of assumptions, question information given, and identify bias in their own work and in primary and secondary sources • Consider the changes in knowledge over time as tools and technologies have developed • Connect scientific explorations to careers in science • Exercise a healthy, informed skepticism and use scientific knowledge and findings to form their own investigations to evaluate claims in primary and secondary sources • Consider social, ethical, and environmental implications of the findings from their own and others' investigations • Critically analyze the validity of information in primary and secondary sources and evaluate the approaches used to solve problems • Assess risks in the context of personal safety and social responsibility **Applying and innovating** • Contribute to care for self, others, community, and world through individual or collaborative approaches • Co-operatively design projects with local and/or global connections and applications • Contribute to finding solutions to problems at a local and/or global level through inquiry • Implement multiple strategies to solve problems in real-life, applied, and conceptual situations • Consider the role of scientists in innovation	**Acids and Bases** • different types of acids and bases: – Arrhenius acids and bases – Brönsted-Lowry acids and bases • **relative strength of acids and bases in solution** • equilibrium in weak acid or weak base systems • amphiprotic species • equilibrium that exists in water and Kw • calculate $[H_3O^+]$ or [OH-] given the other, using Kw • calculate $[H_3O^+]$ or [OH-] from pH and pOH • **quantitative problem solving** involving the acid-base equilibrium constants (Ka and Kb) • **titration** • write formulae, complete ionic equations, and net ionic equations for strong and weak acids and bases • quantitative calculations involving titration, including concentration, volume, and pH • **indicators** • quantitative calculations involving the pH in a solution and Ka for an indicator • applications of acid/base reactions • **hydrolysis of ions in salt solutions** • calculation of the pH of a salt solution from relevant data, assuming that the predominant hydrolysis reaction is the only reaction determining the pH • **buffers as equilibrium systems** • oxides in water • general environmental problems associated with non-metal oxides reacting with water

Learning Standards (continued)

Curricular Competencies	Content
Communicating • Formulate physical or mental theoretical models to describe a phenomenon • Communicate scientific ideas, information, and perhaps a suggested course of action, for a specific purpose and audience, constructing evidence-based arguments and using appropriate scientific language, conventions, and representations • Express and reflect on a variety of experiences, perspectives, and worldviews through place	**Oxidation-Reduction** • **the oxidation-reduction process** • **relative strength of oxidizing and reducing agents** • balancing redox reactions • redox titration • quantitative problem solving involving the concentration of a species in a redox titration from data (e.g., grams, moles, molarity) • electrochemical cells: – half-reactions – cell voltage (E^0) – **practical applications** • electrolytic cells: – half-reactions – minimum voltage to operate – **practical applications** **Module you may choose to include:** **Reaction Kinetics** • **reaction rate** • factors that affect reaction rates • **collision theory:** – collision geometry – kinetic energy • relate PE, KE, and enthalpy (ΔH) during a reaction • chemical equations describing energy effects • **reaction mechanism** • effect of a catalyst on a PE diagram • **applications of catalysts**