

Scientific Investigation Skills

Overall Expectations

By the end of this course, students will:

- demonstrate an understanding of safety practices consistent with Workplace Hazardous Materials Information System (WHMIS) legislation by selecting and applying appropriate techniques for handling, storing, and disposing of laboratory materials (e.g., identify the appropriate procedures for storing and disposing of flammable solvents, and for handling acids, bases, and non-aqueous solutions of toxic substances);
- select appropriate instruments and use them effectively and accurately in collecting observations and data (e.g., frequency meter, oscilloscope, dialysis tubing, data loggers);
- demonstrate the skills required to plan and carry out investigations, using laboratory equipment safely, effectively, and accurately (e.g., conduct an experiment to investigate the physical and chemical properties of common synthetic polymers);
- select and use appropriate numeric, symbolic, graphical, and linguistic modes of representation to communicate scientific ideas, plans, and experimental results (e.g., express as an equation the relationship among variables for a vibrating string pendulum);
- locate, select, analyse, and integrate information on topics under study, working independently and as part of a team, and using appropriate library and electronic research tools, including Internet sites (e.g., compile a table of energy sources and their uses; prepare a report on waste disposal in alternative life-sustaining environments);
- compile, organize, and interpret data, using appropriate formats and treatments, including tables, flow charts, graphs, and diagrams;
- communicate the procedures and results of laboratory investigations and research for specific purposes using data tables and laboratory reports (e.g., prepare a laboratory report on the dialysis of nutrients);
- select and use appropriate SI units;
- identify and collect information on science- and technology-based careers related to the subject area under study (e.g., horticulturalist, medical technician, forester).

Specific Expectations

By the end of this course, students will:



Hazards in the Workplace

Overall Expectations

By the end of this course, students will:

- assess common workplace environments for hazards, and propose appropriate control methods.
- investigate, through experimentation and research, the nature of workplace hazards, legislation, and safe procedures;
- demonstrate an understanding of common biological, chemical, and physical workplace hazards

Specific Expectations

By the end of this course, students will:

Relating Science to Technology, Society, and the Environment

- ▶ design a checklist for assessing workplace hazards, using appropriate criteria (e.g., proper ventilation of organic products, proper grounding for electrical devices, separate storage of incompatible chemicals, proper signage for emergency exits), and use the checklist in a simulated or real workplace situation; [IP, PR, C]
- ▶ propose, based on information gathered from print and electronic sources, an environmentally-friendly course of action for controlling exposure to hazards, using elimination and/or substitution (e.g., substituting window cleaners containing organic solvents with a solution of vinegar and water). [IR, C]

- ▶ plan and conduct an experiment to determine how factors affect the rates of chemical reactions (e.g., how the concentration of an acid affects its rate of reaction with metals); [IP, PR]

- ▶ investigate methods of noise reduction (e.g., earplugs, sound insulation) in the workplace (e.g., using a decibel meter to measure sound intensity before and after enclosure; measuring the effectiveness of earplugs on sound levels); [II, C]

- ▶ investigate and report on the effects of exposure to heat or cold on the human body; [IR, C]

- ▶ communicate safety procedures for the safe handling of biohazardous/infectious materials in the workplace (e.g., create a poster outlining the steps for proper hand-washing, create a webpage illustrating the universal precautions for biological hazards); [C]

Developing Skills of Inquiry and Communication

- ▶ select and use appropriate safety terminology and acronyms, including: Occupational Exposure Limits (OEL), Designated Substance Regulation (DSR); [C]

- ▶ communicate strategies for addressing safety issues in the workplace (e.g., reporting an unsafe condition to a supervisor, expressing the right to refuse unsafe work); [C]

- ▶ summarize aspects of workplace safety legislation related to a career of personal interest (e.g., reading and writing a summary paragraph on a section of the Mines and Mining Regulation from the Occupational Health and Safety Act). [IR, C]

Understanding Basic Concepts

- ▶ describe routes by which hazardous materials enter the body (e.g., ingestion, inhalation, absorption and injection), associated symptoms, and appropriate personal protective equipment (PPE) (e.g., goggles, aprons, self-contained breathing apparatus);
- ▶ identify common physical hazards (e.g., noise, electrical shock, falls, heat and cold stress), and describe potentially harmful situations in the workplace (e.g., wet floors can lead to personal injuries; unsecured ladders and scaffolds can tip);
- ▶ identify common biological hazards (e.g., bacteria, viruses, fungi), and describe potentially harmful situations in the workplace (e.g., improper disposal of syringes can lead to spread of communicable diseases; wet ceiling tiles can lead to mould growth);
- ▶ identify common chemical hazards (e.g., oxidizers), and describe potentially harmful situations in the workplace (e.g., a pile of rags soaked in solvent can lead to a fire; fine particle dust can lead to an explosion);
- ▶ explain qualitatively how factors, such as temperature, concentration, and surface area impact storage and disposal of chemicals in the workplace.

Chemistry at Home and Work

Overall Expectations

By the end of this course, students will:

- analyse the importance of emulsions on individuals, society, and the environment.
- investigate the preparation and properties of emulsions, using appropriate laboratory procedures and equipment safely and accurately;
- describe the properties and uses of emulsions found in the home and workplace;

Specific Expectations

By the end of this course, students will:

Relating Science to Technology, Society, and the Environment

- ▶ research and assess how emulsions are used in an industry (e.g., food industry uses emulsions in milk; pharmaceutical industry uses emulsions in liquid antacids; paving industry uses emulsions to repair road damage); [IR, C]
- ▶ research a product made using the emulsification process, and prepare a safety sheet (e.g., report on the safe use, purpose, effectiveness and environmentally-safe disposal of sunscreen, soap, detergent, or paint). [C, IR]
- ▶ prepare and present a report on the social, environmental, or economic consequences of using organic materials and their consequences (e.g., natural and synthetic textiles)

Developing Skills of Inquiry and Communication

- ▶ select and use appropriate vocabulary, including correct chemical terminology such as miscible, micelle, emulsion, polar, non-polar, to communicate scientific ideas, procedures, and results; [C]
- ▶ determine, through experimentation, the miscibility of a variety of organic liquids with each other and with water; [PR, AI]

- ▶ conduct safe laboratory investigations on emulsions (e.g., determine the effects of emulsion-forming and emulsion-breaking agents such as soap, salt, or eggs on the stability of emulsions); [PR, AI]
- ▶ carry out experiments to compare the relative quantities of soap and detergent required to form emulsions in hard and soft water; [PR, C]
- ▶ safely prepare a common emulsion (e.g., cold cream, mayonnaise, ice cream, sunscreen, lip balm, salad dressing). [PR]

Understanding Basic Concepts

- ▶ explain, in qualitative terms, why some substances mix, while others do not (e.g., ethanol and vinegar are both polar and therefore miscible);
- ▶ describe the behaviour of emulsifying agents (e.g., soap forms a micelle; eggs disperse oil);
- ▶ explain the importance of emulsions (e.g., paints; cosmetics) in the home and workplace (e.g., for cooking and cleaning);
- ▶ contrast and compare the properties of hard and soft water.

Electricity at Home and Work

Overall Expectations

By the end of this course, students will:

- assess the impact of electrical circuits and devices on individuals, society or the environment;
- investigate properties of electric circuits and common electrical devices relating to their everyday use;
- demonstrate an understanding of the components and functions of electrical circuits and devices commonly found at home and in the workplace;

Specific Expectations

By the end of this course, students will:

Relating Science to Technology, Society, and the Environment

- ▶ assess electrical hazards at home, and in the workplace, and propose practical courses of action to address the problems (e.g., overloading circuits, replacement of fuses, improper grounding); [IR, C]
- ▶ identify and propose solutions to problems related to the environmental impact of the consumption of electrical energy and the disposal of used electrical appliances in Canada (e.g., alternatives to the wholesale discarding of old electrical devices; advantages and disadvantages of the recycling of outdated computer equipment or used batteries). [IR, C]

Developing Skills of Inquiry and Communication

- ▶ communicate concepts and units related to electricity, in qualitative terms, including energy, power, kilowatt-hour, potential difference, current, and resistance (e.g., how current depends on resistance);
- ▶ draw energy flow diagrams and/or energy transformation equations that apply to household devices (e.g., energy conversions occurring in a digital music player: electrical energy → kinetic energy + sound energy + light); [C]

- ▶ build a simple electrical device or circuit (e.g., loudspeaker, electric motor, D-cell, simple household circuit containing a 40W lightbulb and dimmer switch), following a clear set of instructions and diagrams, and using appropriate tools safely; [IP, PR]
- ▶ calculate , using the voltage and power rating given on the label of an electrical device, the current flowing through the device; [PR, C]
- ▶ calculate and compare the cost of energy electrical energy consumption of two similar appliances (e.g., old fridge and new fridge) using power ratings of electrical devices ($E = P \times t$). [PR, C]
- ▶ compare graphically the estimate to actual consumption on an electricity bill (e.g., calculate household usage using data for monthly estimate). [PR, C]

Understanding Basic Concepts

- ▶ describe basic electric circuit components, including those that regulate the flow of electricity or are used as safety mechanisms (e.g., switches, bimetallic strips, resistors, ground fault interrupters (GFIs), surge protectors), and their layout in an electric circuit;

- ▶ describe forms of energy (e.g., electrical, mechanical, sound, light, thermal) and the energy transformations that occur in common electrical devices;
- ▶ compare direct current (DC) and alternating current (AC) by identifying situations in which each is used (e.g., compare the use of DC in a portable appliance such as a flashlight to the use of AC in a household appliance such as a kettle);
- ▶ explain the difference in voltage requirements and identify some household appliances that require 110 V AC (e.g., microwave oven, blender) and some that require 220 V AC to operate (e.g., conventional oven, clothes dryer) ;
- ▶ describe the safety procedures that are to be followed during the use of electric systems at home or at work and explain dangerous situations that can occur (e.g., use of electric tools in the rain);
- ▶ describe factors affecting the resistance of an electrical wire (e.g., diameter, length, type of material, temperature) and explain how these factors impact the design of household wiring (e.g., different gauges of wire, the dangers of using high-current appliances with extension cords); [IR, C]

Forestry

Overall Expectations

By the end of this course, students will:

- assess the importance of forest products and forest-management to society, technology, or the environment.
- investigate the structure, growth and propagation of trees;
- demonstrate an understanding of the structure of trees and the processes of forest regeneration;

Specific Expectations

By the end of this course, students will:

Relating Science to Technology, Society, and the Environment

- ▶ compare and contrast viewpoints of different groups or stakeholders for the use of land in a forest ecosystem (e.g., logging and recreation; Aboriginal land claims and urbanization; camping and wildlife); [AI, C]
- ▶ assess the environmental and/or economic effects of a specific type of forestry practice or technology (e.g., clear-cut forestry, sustainable forestry using selective cutting, controlled burning, high resolution satellite imagery to map forest growth, forest resource inventory (FRI) map). [IR, AI]
- ▶ compare and contrast the reproductive structures of various tree species (e.g., flowers in deciduous trees; cones in coniferous trees); [AI]
- ▶ design a reforestation plan using appropriate planting practices (e.g., choice of tree species, spacing, type of soil) for a designated area (e.g., reclaimed meadow or land, clear-cut forest, empty lot); [AI]
- ▶ conduct a forest inventory of a school yard, local park, or woodlot (e.g., identify number and age of different tree species, abiotic and biotic factors, use of land and wildlife habitat, areas of concern) and design a model or map of the area studied (e.g., using global positioning system (GPS) technology to map the area). [PR, C]

Developing Skills of Inquiry and Communication

- ▶ identify and classify common tree species (e.g., using botanical keys or tree identification guides); [C, AI]
- ▶ investigate the age and growth history of trees by examining real or simulated cross-sections or increment bore samples; [PR, AI]

Understanding Basic Concepts

- ▶ describe the parts of a coniferous and deciduous tree (crown, trunk and root) and the main stem tissues (bark, sap, heartwood, springwood, and summerwood);

- ▶ explain the role of succession in the natural regeneration of a forest ecosystem (e.g., secondary succession after a forest fire);
- ▶ describe tree propagation methods, including seed collection, cone collection, stratification, field and container culture, and transplanting;
- ▶ explain the uses of forests and forest-products in Canada (e.g., parkland, recreation, lumber, food, fuel, value added product);
- ▶ describe common forest-management practices (e.g., clear-cutting, selective cutting, pruning, releasing);
- ▶ illustrate and explain the forest management planning cycle (consultation, planning, harvesting, reforestation).

Minerals and Mining

Overall Expectations

By the end of this course, students will:

- analyze issues related to the mining industry in Canada.
- investigate properties of minerals and mining techniques through experiments and research;
- demonstrate an understanding of minerals and the mining industry;

Specific Expectations

By the end of this course, students will:

Relating Science to Technology, Society, and the Environment

- ▶ assess environmental issues, or health and safety concerns related to the mining industry in Canada (e.g., effect of mine tailings on local water sources; land reclamation after strip mining; pollution from smelting; death or personal injury due to mining accidents); [IR, C]
- ▶ evaluate how a technology has advanced the Canadian mining industry (e.g., the use of heavy duty rigid frame trucks to haul rock from open pit mines; pneumatic drills to break up rock; core samplers to locate minerals; hoist systems to move people, equipment, and materials) [AI, C].

Developing Skills of Inquiry and Communication

- ▶ test various minerals to determine their physical and chemical properties (e.g., colour differences, streak, hardness, lustre, magnetism, reaction with weak acid, heat conduction); [PR, C]
- ▶ identify and classify selected unknown minerals on the basis of their physical properties (e.g., sort the groups by hardness, colour, lustre); [PR, AI]
- ▶ investigate, through a simulation, a method to remove minerals from a sample (e.g., use a magnet to separate a mixture of iron filings and pencil shavings; use detergent to remove metal glitter from water; use a sieve series to separate sand from gravel); [II, PR]

- ▶ investigate and evaluate a mining survey method, through a simulation (e.g., simulate a magnetic survey by using a metal detector to find iron objects buried in various positions in a box of sand; simulate an electromagnetic survey by comparing signal reception by walking towards a filing cabinet or metal shelving with a functioning portable radio); [II, PR]
- ▶ conduct research using a variety of print and electronic media, and present the properties and uses of an important Canadian mineral [IR, C].

Understanding Basic Concepts

- ▶ describe different minerals by their physical and chemical properties (e.g., colour, hardness, lustre, magnetism, reaction with weak acids);
- ▶ list uses for a number of important minerals mined in Canada (e.g., molybdenum for steel, cadmium for batteries, gold for jewellery, gypsum for drywall);
- ▶ explain how a mineral (e.g., diamond, nickel, copper, coal) is found, extracted, and processed (e.g., for diamonds: miners could use a geological survey to locate potential diamond sites, drill to remove the rough diamonds, and then process by sorting and cutting the finished gems);

- ▶ describe environmental effects that can be caused by various mining processes (e.g., loss of habitat and vegetation due to strip mining; noise and vibration caused by blasting);

- ▶ identify and describe important mining safety standards (e.g., review mining section in Occupational Health and Safety Act);

- ▶ explain how the local and/or Canadian economy is affected either directly or indirectly by the mining industry (e.g., impact on a local economy when a mine closes; the relationship between automotive manufacturing plants and mining products);