GRADE 10

Processes of Science

It is expected that students will:

A1 demonstrate safe procedures
A2 perform experiments using the scientific method
A3 represent and interpret information in graphic form
A4 demonstrate scientific literacy
A5 demonstrate ethical, responsible, cooperative behaviour
A6 describe the relationship between scientific principles and technology
A7 demonstrate competence in the use of technologies specific to investigative procedures and research

Life Science: Sustainability of Ecosystems

It is expected that students will:

B1 explain the interaction of abiotic and biotic factors within an ecosystem
B2 assess the potential impacts of bioaccumulation
B3 explain various ways in which natural populations are altered or kept in equilibrium

Physical Science: Chemical Reactions and Radioactivity

It is expected that students will:

C1 differentiate between atoms, ions, and molecules using knowledge of their structure and components
C2 classify substances as acids, bases, or salts, based on their characteristics, name, and formula
C3 distinguish between organic and inorganic compounds
C4 analyse chemical reactions, including reference to conservation of mass and rate of reaction
C5 explain radioactivity using modern atomic theory

Physical Science: Motion

C6 explain the relationship of displacement and time interval to velocity for objects in uniform motion
C7 demonstrate the relationship between velocity, time interval, and acceleration

Earth and Space Science: Energy Transfer in Natural Systems

It is expected that students will:

D1 explain the characteristics and sources of thermal energy
D2 explain the effects of thermal energy within the atmosphere
D3 evaluate possible causes of climate change and its impact on natural systems

Earth and Space Science: Plate Tectonics

D4 analyse the processes and features associated with plate tectonics
D5 demonstrate knowledge of evidence that supports plate tectonic theory

GRADE 10

KEY ELEMENTS: PROCESSES OF SCIENCE

The Prescribed Learning Outcomes related to Processes of Science support the development of attitudes, skills, and knowledge essential for an understanding of science. These Prescribed Learning Outcomes should not be taught in isolation, but should be integrated with activities related to the other three curriculum organizers.

Vocabulary

accuracy, conclusion, control, controlled experiment, dependent variables, hypothesis, independent variables, observation, precision, prediction, procedure, principle, scientific literacy, uncertainty, validity, variable

Knowledge

- metric system (SI units)
- elements of a valid experiment
- dependent and independent variables
- appropriate scale
- application of scientific principles in the development of technologies

Skills and Attitudes

- recognize dangers
- demonstrate emergency response procedures
- use personal protective equipment
- use proper techniques for handling and disposing of lab materials
- use the Bunsen burner and hotplate
- make accurate measurements using a variety of instruments (e.g., rulers, balances, graduated cylinders)
- use the Internet as a research tool
- communicate results
- use appropriate types of graphic models and/or formulae to represent a given type of data, including the Bohr model
- use bar graphs, line graphs, pie charts, tables, and diagrams to extract and convey information
- deduce relationships between variables given a graph or by constructing graphs
- use models to demonstrate how systems operate
- apply given criteria for evaluating evidence and sources of information
- identify main points, supporting or refuting information, and bias in a science-related article or illustration
- demonstrate ethical, responsible, cooperative behaviour
- acquire and apply scientific and technological knowledge to the benefit of self, society, and the environment

GRADE 10 PROCESSES OF SCIENCE

PRESCRIBED LEARNING OUTCOMES	SUGGESTED ACHIEVEMENT INDICATORS
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each corresponding Prescribed Learning Outcome.* *Students who have fully met the Prescribed Learning Outcome are able to:*
A1 demonstrate safe procedures	❑ identify a variety of dangers in procedures (e.g., cuts from sharp objects; explosions or burns from handling chemicals or heating materials) ❑ identify appropriate equipment for an lab activity (e.g., Bunsen burner vs. hotplate; glassware for chemicals) ❑ identify and use appropriate personal protective equipment (e.g., hand and eye protection) and procedures (e.g., hair tied back, clear work area, no loose clothing, no horseplay) ❑ use proper techniques for handling and disposing of lab materials (e.g., using special containers for caustic chemicals) ❑ describe appropriate emergency response procedures (e.g., how to use a fire extinguisher/blanket, eye wash station, first aid for cuts and burns, knowing who to contact and how)
A2 perform experiments using the scientific method	❑ describe the elements of a valid experiment: - formulate an hypothesis - make a prediction - identify controlled versus experimental variables - observe, measure, and record using appropriate units - interpret data - draw conclusions ❑ use information and conclusions as a basis for further comparisons, investigations, or analyses ❑ communicate results using a variety of methods
A3 represent and interpret information in graphic form	❑ identify and use the most appropriate type of graphic, model, or formula to convey information, including - Bohr model or diagram - convection model or diagram - Lewis diagrams - chemical formulae - line graphs of displacement, time interval, and velocity - diagrams (e.g., food webs/pyramids, nutrient cycles, plate boundaries) ❑ distinguish between dependent and independent variables in a graph ❑ use appropriate scale and axis to create a graph ❑ extrapolate and interpolate points on a graph ❑ extract information from maps, bar graphs, line graphs, tables, and diagrams (e.g., periodic table)

PRESCRIBED LEARNING OUTCOMES	SUGGESTED ACHIEVEMENT INDICATORS
A4 demonstrate scientific literacy	❑ identify the main points in a science-related article or illustration ❑ describe the qualities of the scientifically literate person, such as - awareness of assumptions (their own and authors') - respect for precision - ability to separate fundamental concepts from the irrelevant or unimportant - recognizing that scientific knowledge is continually developing and often builds upon previous theories - recognizing cause and effect ❑ use given criteria for evaluating evidence and sources of information (e.g., identify supporting or refuting information and bias) ❑ explain how science and technology affect individuals, society, and the environment
A5 demonstrate ethical, responsible, cooperative behaviour	❑ describe and demonstrate - ethical behaviour (e.g., honesty, fairness, reliability) - open-mindedness (e.g., ongoing examination and reassessment of own beliefs) - willingness to question and promote discussion - skills of collaboration and co-operation - respect for the contributions of others
A6 describe the relationship between scientific principles and technology	❑ give examples of scientific principles that have resulted in the development of technologies (e.g., velocity/acceleration—technologies related to transportation and athletics) ❑ identify a variety of technologies and explain how they have advanced our understanding of science (e.g., seismographic instruments and GPS—plate tectonics and Earth's layers)
A7 demonstrate competence in the use of technologies specific to investigative procedures and research	❑ select and carefully use balances and other measurement tools (e.g., thermometers, timing devices, electronic devices) ❑ proficiently use the Internet as a research tool

GRADE 10

KEY ELEMENTS: LIFE SCIENCE

By the end of the grade, students will have assessed the significance of natural phenomena and human factors within ecosystems.

Vocabulary

abiotic, aeration, adaptive radiation, bioaccumulation, biodegradation, biome, biotic, climax community, carbonate, commensalism, decomposers, denitrification, ecological succession, ecosystem, food chains, food pyramids, food webs, heavy metals, keystone species, lightning, mutualism, nitrification, natural selection, nutrients, parasitism, PCBs, pesticides, pH, phosphorus, photosynthesis, potassium, predation, proliferation, symbiosis, trophic levels

Knowledge

- abiotic and biotic elements in ecosystems
- cycling of carbon, nitrogen, oxygen, and phosphorus
- ecosystems with similar characteristics in different geographical locations
- effects of altering an abiotic factor
- species adaptation
- food webs and pyramids
- mechanisms and possible impacts of bioaccumulation
- traditional ecological knowledge (TEK)
- impact of natural phenomena, foreign species, disease, pollution, habitat destruction, and exploitation of resources on ecosystems

Skills and Attitudes

- use given criteria for evaluating evidence and sources of information (e.g., identify supporting or refuting information and bias)
- formulate a reasoned position
- demonstrate ethical behaviour
- relate cause to effect
- assess human impact
- show respect and sensitivity for the environment
- conduct experiments

GRADE 10 LIFE SCIENCE: SUSTAINABILITY OF ECOSYSTEMS

PRESCRIBED LEARNING OUTCOMES	SUGGESTED ACHIEVEMENT INDICATORS
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each corresponding Prescribed Learning Outcome.* *Students who have fully met the Prescribed Learning Outcome are able to:*
B1 explain the interaction of abiotic and biotic factors within an ecosystem	❑ define *abiotic*, *biotic*, *biome*, and *ecosystem* ❑ identify distinctive plants, animals, and climatic characteristics of Canadian biomes (tundra, boreal forest, temperate deciduous forest, temperate rainforest, grasslands) ❑ identify biotic and abiotic factors in a given scenario or diagram ❑ describe the relationships between abiotic and biotic elements within an ecosystem, including - air, water, soil, light, temperature (abiotic) - bacteria, plants, animals (biotic) ❑ design and analyse experiments on the effects of altering biotic or abiotic factors (e.g., nutrients in soil: compare two plant types with the same nutrients, compare one plant type with different nutrients) ❑ explain various relationships with respect to food chains, food webs, and food pyramids, including - producer - consumer (herbivore, carnivore, omnivore) - predation (predator-prey cycle) - decomposers - symbiosis (mutualism, commensalism, parasitism) ❑ illustrate the cycling of matter through abiotic and biotic components of an ecosystem by tracking - carbon (with reference to carbon dioxide – CO_2, carbonate CO_3^{2-}, oxygen – O_2, photosynthesis, respiration, decomposition, volcanic activity, carbonate formation, greenhouse gases from human activity, combustion) - nitrogen (with reference to nitrate – NO_3^-, nitrite – NO_2^-, ammonium – NH_4^+, nitrogen gas – N_2, nitrogen fixation, bacteria, lightning, nitrification, denitrification, decomposition) - phosphorus (with reference to phosphate – PO_4^{3-}, weathering, sedimentation, geological uplift) ❑ identify factors that affect the global distribution of the following biomes: tropical rainforest, temperate rainforest, temperate deciduous forest, boreal forest, grasslands, desert, tundra, polar ice

PRESCRIBED LEARNING OUTCOMES	SUGGESTED ACHIEVEMENT INDICATORS
	❑ using examples, explain why ecosystems with similar characteristics can exist in different geographical locations (i.e., significance of abiotic factors) ❑ identify the effects on living things within an ecosystem resulting from changes in abiotic factors, including - climate change (drought, flooding, changes in ocean current patterns, extreme weather) - water contamination - soil degradation and deforestation
B2 assess the potential impacts of bioaccumulation	❑ define, using examples, the terms *bioaccumulation*, *parts per million* (*ppm*), *biodegradation*, and *trophic levels* (with reference to producers and to primary, secondary, and tertiary consumers) ❑ identify a variety of contaminants that can bioaccumulate (e.g., pesticides, heavy metals, PCBs) ❑ describe the mechanisms and possible impacts of bioaccumulation (e.g., eradication of keystone species, reproductive impacts) ❑ compare the impact of bioaccumulation on consumers at different trophic levels (e.g., red tide in oysters and humans; heavy metals in fish and humans; PCBs in fish, birds, whales) ❑ research and analyse articles on the causes and effects of bioaccumulation (e.g., mercury contamination in Inuit communities and the Grassy Narrows First Nation community)
B3 explain various ways in which natural populations are altered or kept in equilibrium	❑ explain how species adapt or fail to adapt to environmental conditions, with reference to the following: - natural selection - proliferation - predator/prey cycle - ecological succession - climax community - extinction - adaptive radiation ❑ describe the impact of natural phenomena (e.g., drought, fire, temperature change, flooding, tsunamis, infestations—pine beetle, volcanic eruptions) on ecosystems ❑ give examples of how foreign species can affect an ecosystem (e.g., Eurasian milfoil, purple loosestrife, scotch broom, American bullfrog, European starling in BC) ❑ give examples of how traditional ecological knowledge (TEK) can affect biodiversity (e.g., spring burning by Cree in northern Alberta) ❑ research and report on situations in which disease, pollution, habitat destruction, and exploitation of resources affect ecosystems

GRADE 10

KEY ELEMENTS: PHYSICAL SCIENCE

By the end of the grade, students will have demonstrated understanding of chemical reactions and radioactivity, and explained motion in terms of displacement, time interval, velocity, and acceleration.

Chemical Reactions and Radioactivity

Vocabulary

acids, alpha particle, atomic number, atoms, bases, beta particle, Bohr diagrams, bromothymol blue, catalyst, combustion, compounds, concentration, conservation of mass, covalent bonding, decomposition, electron, fission, fusion, gamma radiation, half-life, indigo carmine, inorganic, ionic bonding, ions, isotope, Lewis diagrams, light, litmus paper, mass number, methyl orange, molecules, neutralization (acid-base), neutron, organic, phenolphthalein, polyatomic, proton, radioactive decay, salts, single and double replacement, surface area, symbolic equations, synthesis, valence electron

Knowledge

- acids, bases, and salts
- common ionic and covalent compounds
- organic and inorganic compounds
- chemical reactions (synthesis, decomposition, single and double replacement, neutralization, combustion)
- conservation of mass
- radioactivity

Skills and Attitudes

- draw and interpret Bohr models
- draw and interpret Lewis diagrams for compounds containing single bonds
- name and write chemical formulae for common ionic and covalent compounds, using appropriate terminology
- use standardized tests for acids and bases
- write and balance chemical equations
- write and balance nuclear equations
- use molecular models
- use the periodic table and ion charts
- demonstrate respect for precision

KEY ELEMENTS: PHYSICAL SCIENCE

Motion

Vocabulary

acceleration, displacement, slope, time interval, uniform motion, velocity

Knowledge

- relationship of displacement and time interval to velocity
- motion of objects
- uniform motion
- acceleration due to gravity
- acceleration: positive, negative, and zero

Skills and Attitudes

- calculate using $v_{av} = \Delta x/\Delta t$
- calculate using $a = \Delta v/\Delta t$, where $\Delta v = v_f - v_i$
- demonstrate respect for precision

GRADE 10 PHYSICAL SCIENCE: CHEMICAL REACTIONS AND RADIOACTIVITY

PRESCRIBED LEARNING OUTCOMES	SUGGESTED ACHIEVEMENT INDICATORS
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each corresponding Prescribed Learning Outcome.* *Students who have fully met the Prescribed Learning Outcome are able to:*
C1 differentiate between atoms, ions, and molecules using knowledge of their structure and components	❑ demonstrate knowledge of the three subatomic particles, their properties, and their location within the atom (e.g., by creating models) ❑ define and give examples of *ionic bonding* (e.g., metal and non-metal) and *covalent bonding* (e.g., two non-metals, diatomic elements) ❑ with reference to elements 1 to 20 on the periodic table, draw and interpret Bohr models, including protons, neutrons, and electrons, of - atoms (neutral) - ions (charged) - molecules - covalent bonding (e.g., O_2, CH_4) - ionic compounds (e.g., $CaCl_2$) ❑ identify valence electrons using the periodic table (excluding lanthanides and actinides) ❑ distinguish between paired and unpaired electrons for a single atom ❑ draw and interpret Lewis diagrams showing single bonds for simple ionic compounds and covalent molecules (e.g., NaCl, MgO, $BaBr_2$, H_2O, CH_4, NH_3) ❑ distinguish between lone pairs and bonding pairs of electrons in molecules

PRESCRIBED LEARNING OUTCOMES	SUGGESTED ACHIEVEMENT INDICATORS
C2 classify substances as acids, bases, or salts, based on their characteristics, name, and formula	❑ identify acids and bases using indicators (e.g., methyl orange, bromthymol blue, litmus, phenolphthalein, indigo carmine) ❑ explain the significance of the pH scale, with reference to common substances ❑ differentiate between acids, bases, and salts with respect to chemical formulae and properties ❑ recognize the names and formulae of common acids (e.g., hydrochloric, sulphuric, nitric, acetic) ❑ use the periodic table to - explain the classification of elements as metals and nonmetals - identify the relative reactivity of elements in the alkali metal, alkaline earth metal, halogen, and noble gas groups - distinguish between metal oxide solutions (basic) and non-metal oxide solutions (acidic) ❑ use the periodic table and a list of ions (including polyatomic ions) to name and write chemical formulae for common ionic compounds, using appropriate terminology (e.g., Roman numerals) ❑ convert names to formulae and formulae to names for covalent compounds, using prefixes up to "deca"
C3 distinguish between organic and inorganic compounds	❑ define *organic compounds* and *inorganic compounds* ❑ distinguish between organic and inorganic compounds, based on their chemical structures ❑ recognize a compound as organic or inorganic from its name, from its chemical formula, or from a diagram or model
C4 analyse chemical reactions, including reference to conservation of mass and rate of reaction	❑ define and explain the *law of conservation of mass* ❑ represent chemical reactions and the conservation of atoms using molecular models ❑ write and balance (using the lowest whole number coefficients) chemical equations from formulae, word equations, or descriptions of experiments ❑ identify, give evidence for, predict products of, and classify the following types of chemical reactions: - synthesis (combination) - decomposition - single and double replacement - neutralization (acid-base) - combustion ❑ explain how factors such as temperature, concentration, presence of a catalyst, and surface area can affect the rate of chemical reactions

PRESCRIBED LEARNING OUTCOMES	SUGGESTED ACHIEVEMENT INDICATORS
C5 explain radioactivity using modern atomic theory	❑ define *isotope* in terms of atomic number and mass number, recognizing how these are communicated in standard atomic notation (e.g., Uranium-238: ${}^{238}_{92}U$) ❑ relate radioactive decay (e.g., alpha – α , beta – β , gamma – γ) to changes in the nucleus ❑ relate the following subatomic particles to radioactive decay: - proton (${}^{1}_{1}p$) - neutron (${}^{1}_{0}n$) - electron (${}^{0}_{-1}e$) - alpha particle (${}^{4}_{2}\alpha$) (${}^{4}_{2}He$) - beta particle (${}^{0}_{-1}\beta$) ❑ explain half-life with reference to rates of radioactive decay ❑ compare fission and fusion ❑ complete and balance nuclear equations to illustrate radioactive decay, fission, and fusion

GRADE 10 PHYSICAL SCIENCE: MOTION

PRESCRIBED LEARNING OUTCOMES	SUGGESTED ACHIEVEMENT INDICATORS
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each corresponding Prescribed Learning Outcome.* *Students who have fully met the Prescribed Learning Outcome are able to:*
C6 explain the relationship of displacement and time interval to velocity for objects in uniform motion	❑ define *displacement* (change in position, Δx), *time interval* (Δt), and *velocity* (v_{av}) ❑ analyse graphically the relationship between displacement and time interval for an object travelling in uniform motion ❑ use the formula $v_{av} = \Delta x/\Delta t$ to calculate the average velocity (v_{av}), displacement (change in position, Δx), and time interval (Δt) for an object in uniform motion, given appropriate data ❑ design and conduct one or more experiments to determine the velocity of an object in uniform motion (e.g., using carts, balls, skateboards, bicycles, canoes in still water)
C7 demonstrate the relationship between velocity, time interval, and acceleration	❑ define *acceleration* (positive, negative, and zero) ❑ give examples of positive, negative, and zero acceleration, including - falling objects - accelerating from rest - slowing down or stopping - uniform motion ❑ given initial velocity (v_i), final velocity (v_f), and the time interval (Δt), calculate acceleration using the formula $a = \Delta v/\Delta t$, where $\Delta v = v_f - v_i$ (e.g., for falling objects)

GRADE 10

KEY ELEMENTS: EARTH AND SPACE SCIENCE

By the end of the grade, students will have described the processes associated with energy transfer within the Earth's geosphere and atmosphere and will have examined processes and features associated with plate tectonics.

Energy Transfer in Natural Systems

Vocabulary

atmosphere, conduction, convection, Coriolis effect, El Niño, greenhouse gases, heat, kilopascals, kinetic molecular theory, La Niña, ozone layer, permafrost, prevailing winds, thermal energy, tornado

Knowledge

- heat and thermal energy
- conduction and convection
- energy absorption and radiation in the atmosphere
- differential heating and prevailing winds
- changes in air density
- measurement of air pressure
- human and natural influences on climate
- climate affects natural systems

Skills and Attitudes

- illustrate energy transfer
- use given criteria for evaluating evidence and sources of information (e.g., identify supporting or refuting information and bias)

KEY ELEMENTS: EARTH AND SPACE SCIENCE

Plate Tectonics

Vocabulary

asthenosphere, continental drift theory, converging/diverging plates, earthquakes, epicentre, fault, hot spot, inner core, lithosphere, mantle, mantle convection, outer core, paleoglaciation, plate boundary, plate tectonic theory, primary waves, ridge push and slab pull, rift valley, secondary waves, spreading ridge, subduction zone, surface waves, tectonic plate, transform fault, trench, volcanic belt, volcanic island arc, volcanoes

Knowledge

- plate movement and associated features and processes
- diverging, converging, and transform plate boundaries
- deep-focus to shallow-focus earthquakes
- continental drift theory
- magnetic reversals

Skills and Attitudes

- illustrate plate movement
- identify tectonic mapping symbols
- use given criteria for evaluating evidence and sources of information (e.g., identify supporting or refuting information and bias)

GRADE 10 EARTH AND SPACE SCIENCE: ENERGY TRANSFER IN NATURAL SYSTEMS

PRESCRIBED LEARNING OUTCOMES	SUGGESTED ACHIEVEMENT INDICATORS
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each corresponding Prescribed Learning Outcome.* *Students who have fully met the Prescribed Learning Outcome are able to:*
D1 explain the characteristics and sources of thermal energy	❑ define *heat* and *thermal energy* ❑ explain and illustrate how thermal energy is transferred through conduction, convection, and radiation, with reference to - kinetic molecular theory - practical examples (e.g., home heating, cooking methods, loss of body heat, insulation) ❑ describe Earth's energy sources including - residual thermal energy from Earth's formation - energy from radioactive decay - solar energy (with reference to absorption and radiation in the atmosphere)
D2 explain the effects of thermal energy within the atmosphere	❑ define *atmospheric pressure* and explain how it is measured ❑ identify weather conditions that typically accompany areas of low and high pressure in the atmosphere ❑ describe how energy transfer influences atmospheric convection, atmospheric pressure, and prevailing winds (e.g., differential heating of land and water causes changes in air density and affects prevailing winds)
D3 evaluate possible causes of climate change and its impact on natural systems	❑ describe how natural phenomena can affect climate (e.g., biosphere processes, volcanic eruptions, Coriolis effect, El Niño and La Niña) ❑ describe how climate can be influenced by human activities (e.g., greenhouse gases, depletion of ozone layer) ❑ describe how climate change affects natural systems (e.g., shrinking of the permafrost region, melting of ice shelves/caps/glaciers)

GRADE 10 EARTH AND SPACE SCIENCE: PLATE TECTONICS

PRESCRIBED LEARNING OUTCOMES	SUGGESTED ACHIEVEMENT INDICATORS
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each corresponding Prescribed Learning Outcome.* *Students who have fully met the Prescribed Learning Outcome are able to:*
D4 analyse the processes and features associated with plate tectonics	❑ define *plate tectonics*, *plate boundary*, *earthquake*, *trench*, *volcano*, *spreading ridge*, *subduction zone*, *hot spot* ❑ relate tectonic plate movement to the composition of the following layers of the Earth, as determined by seismic waves (primary, secondary, and surface waves): - crust - lithosphere - asthenosphere - mantle - outer core - inner core ❑ describe tectonic plate boundaries, including - transform boundaries - divergent boundaries - convergent boundaries (oceanic-oceanic crust, oceanic-continental crust, and continental-continental crust) ❑ identify tectonic mapping symbols ❑ explain how plate movement produces the following features: - epicentres and shallow-focus to deep-focus earthquakes - volcanism at subduction zones (e.g., volcanic island arcs, volcanic belts) and at spreading ridges - mountain ranges and mid-ocean ridges - hot spot chains (e.g., Hawaiian Islands, Yellowstone) ❑ identify sources of heat within the Earth that produce mantle convection and hot spot activity (i.e., heat within the core and excess radioactivity within the mantle) ❑ explain how mantle convection and ridge push and slab pull are believed to contribute to plate motion
D5 demonstrate knowledge of evidence that supports plate tectonic theory	❑ describe evidence for continental drift theory (e.g., fossil evidence, mountain belts, paleoglaciation) ❑ relate the following to plate tectonic theory: - the world distribution of volcanoes, earthquakes, mountain belts, trenches, mid-ocean ridges, and rift valleys - hot spot and subduction zone eruptions - magnetic reversals and age of rocks relative to spreading ridges