

**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
<i>It is expected that students will:</i>	<p><i>The following set of indicators may be used to assess student achievement for each corresponding Prescribed Learning Outcome.</i></p> <p><i>Students who have fully met the Prescribed Learning Outcome are able to:</i></p>
A1 demonstrate safe procedures	<ul style="list-style-type: none"> <li><input type="checkbox"/> identify a variety of dangers in procedures (e.g., cuts from sharp objects; explosions or burns from handling chemicals or heating materials)</li> <li><input type="checkbox"/> identify appropriate equipment for an lab activity (e.g., Bunsen burner vs. hotplate; glassware for chemicals)</li> <li><input type="checkbox"/> 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)</li> <li><input type="checkbox"/> use proper techniques for handling and disposing of lab materials (e.g., using special containers for caustic chemicals)</li> <li><input type="checkbox"/> 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)</li> </ul>
A2 perform experiments using the scientific method	<ul style="list-style-type: none"> <li><input type="checkbox"/> describe the elements of a valid experiment: <ul style="list-style-type: none"> <li>- formulate an hypothesis</li> <li>- make a prediction</li> <li>- identify controlled versus experimental variables</li> <li>- observe, measure, and record using appropriate units</li> <li>- interpret data</li> <li>- draw conclusions</li> </ul> </li> <li><input type="checkbox"/> use information and conclusions as a basis for further comparisons, investigations, or analyses</li> <li><input type="checkbox"/> communicate results using a variety of methods</li> </ul>
A3 represent and interpret information in graphic form	<ul style="list-style-type: none"> <li><input type="checkbox"/> identify and use the most appropriate type of graphic, model, or formula to convey information, including <ul style="list-style-type: none"> <li>- Bohr model or diagram</li> <li>- convection model or diagram</li> <li>- Lewis diagrams</li> <li>- chemical formulae</li> <li>- line graphs of displacement, time interval, and velocity</li> <li>- diagrams (e.g., food webs/pyramids, nutrient cycles, plate boundaries)</li> </ul> </li> <li><input type="checkbox"/> distinguish between dependent and independent variables in a graph</li> <li><input type="checkbox"/> use appropriate scale and axis to create a graph</li> <li><input type="checkbox"/> extrapolate and interpolate points on a graph</li> <li><input type="checkbox"/> extract information from maps, bar graphs, line graphs, tables, and diagrams (e.g., periodic table)</li> </ul>

PRESCRIBED LEARNING OUTCOMES	SUGGESTED ACHIEVEMENT INDICATORS
A4 demonstrate scientific literacy	<ul style="list-style-type: none"> <li><input type="checkbox"/> identify the main points in a science-related article or illustration</li> <li><input type="checkbox"/> describe the qualities of the scientifically literate person, such as               <ul style="list-style-type: none"> <li>- awareness of assumptions (their own and authors')</li> <li>- respect for precision</li> <li>- ability to separate fundamental concepts from the irrelevant or unimportant</li> <li>- recognizing that scientific knowledge is continually developing and often builds upon previous theories</li> <li>- recognizing cause and effect</li> </ul> </li> <li><input type="checkbox"/> use given criteria for evaluating evidence and sources of information (e.g., identify supporting or refuting information and bias)</li> <li><input type="checkbox"/> explain how science and technology affect individuals, society, and the environment</li> </ul>
A5 demonstrate ethical, responsible, cooperative behaviour	<ul style="list-style-type: none"> <li><input type="checkbox"/> describe and demonstrate               <ul style="list-style-type: none"> <li>- ethical behaviour (e.g., honesty, fairness, reliability)</li> <li>- open-mindedness (e.g., ongoing examination and reassessment of own beliefs)</li> <li>- willingness to question and promote discussion</li> <li>- skills of collaboration and co-operation</li> <li>- respect for the contributions of others</li> </ul> </li> </ul>
A6 describe the relationship between scientific principles and technology	<ul style="list-style-type: none"> <li><input type="checkbox"/> give examples of scientific principles that have resulted in the development of technologies (e.g., velocity/acceleration—technologies related to transportation and athletics)</li> <li><input type="checkbox"/> 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)</li> </ul>
A7 demonstrate competence in the use of technologies specific to investigative procedures and research	<ul style="list-style-type: none"> <li><input type="checkbox"/> select and carefully use balances and other measurement tools (e.g., thermometers, timing devices, electronic devices)</li> <li><input type="checkbox"/> proficiently use the Internet as a research tool</li> </ul>

## 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
<p><i>It is expected that students will:</i></p>	<p><i>The following set of indicators may be used to assess student achievement for each corresponding Prescribed Learning Outcome.</i></p> <p><i>Students who have fully met the Prescribed Learning Outcome are able to:</i></p>
<p>B1 explain the interaction of abiotic and biotic factors within an ecosystem</p>	<ul style="list-style-type: none"> <li><input type="checkbox"/> define <i>abiotic, biotic, biome, and ecosystem</i></li> <li><input type="checkbox"/> identify distinctive plants, animals, and climatic characteristics of Canadian biomes (tundra, boreal forest, temperate deciduous forest, temperate rainforest, grasslands)</li> <li><input type="checkbox"/> identify biotic and abiotic factors in a given scenario or diagram</li> <li><input type="checkbox"/> describe the relationships between abiotic and biotic elements within an ecosystem, including <ul style="list-style-type: none"> <li>- air, water, soil, light, temperature (abiotic)</li> <li>- bacteria, plants, animals (biotic)</li> </ul> </li> <li><input type="checkbox"/> 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)</li> <li><input type="checkbox"/> explain various relationships with respect to food chains, food webs, and food pyramids, including <ul style="list-style-type: none"> <li>- producer</li> <li>- consumer (herbivore, carnivore, omnivore)</li> <li>- predation (predator-prey cycle)</li> <li>- decomposers</li> <li>- symbiosis (mutualism, commensalism, parasitism)</li> </ul> </li> <li><input type="checkbox"/> illustrate the cycling of matter through abiotic and biotic components of an ecosystem by tracking <ul style="list-style-type: none"> <li>- carbon (with reference to carbon dioxide – CO<sub>2</sub>, carbonate CO<sub>3</sub><sup>2-</sup>, oxygen – O<sub>2</sub>, photosynthesis, respiration, decomposition, volcanic activity, carbonate formation, greenhouse gases from human activity, combustion)</li> <li>- nitrogen (with reference to nitrate – NO<sub>3</sub><sup>-</sup>, nitrite – NO<sub>2</sub><sup>-</sup>, ammonium – NH<sub>4</sub><sup>+</sup>, nitrogen gas – N<sub>2</sub>, nitrogen fixation, bacteria, lightning, nitrification, denitrification, decomposition)</li> <li>- phosphorus (with reference to phosphate – PO<sub>4</sub><sup>3-</sup>, weathering, sedimentation, geological uplift)</li> </ul> </li> <li><input type="checkbox"/> 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</li> </ul>

PRESCRIBED LEARNING OUTCOMES	SUGGESTED ACHIEVEMENT INDICATORS
	<ul style="list-style-type: none"> <li><input type="checkbox"/> using examples, explain why ecosystems with similar characteristics can exist in different geographical locations (i.e., significance of abiotic factors)</li> <li><input type="checkbox"/> identify the effects on living things within an ecosystem resulting from changes in abiotic factors, including               <ul style="list-style-type: none"> <li>- climate change (drought, flooding, changes in ocean current patterns, extreme weather)</li> <li>- water contamination</li> <li>- soil degradation and deforestation</li> </ul> </li> </ul>
<p>B2 assess the potential impacts of bioaccumulation</p>	<ul style="list-style-type: none"> <li><input type="checkbox"/> define, using examples, the terms <i>bioaccumulation</i>, <i>parts per million (ppm)</i>, <i>biodegradation</i>, and <i>trophic levels</i> (with reference to producers and to primary, secondary, and tertiary consumers)</li> <li><input type="checkbox"/> identify a variety of contaminants that can bioaccumulate (e.g., pesticides, heavy metals, PCBs)</li> <li><input type="checkbox"/> describe the mechanisms and possible impacts of bioaccumulation (e.g., eradication of keystone species, reproductive impacts)</li> <li><input type="checkbox"/> 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)</li> <li><input type="checkbox"/> 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)</li> </ul>
<p>B3 explain various ways in which natural populations are altered or kept in equilibrium</p>	<ul style="list-style-type: none"> <li><input type="checkbox"/> explain how species adapt or fail to adapt to environmental conditions, with reference to the following:               <ul style="list-style-type: none"> <li>- natural selection</li> <li>- proliferation</li> <li>- predator/prey cycle</li> <li>- ecological succession</li> <li>- climax community</li> <li>- extinction</li> <li>- adaptive radiation</li> </ul> </li> <li><input type="checkbox"/> describe the impact of natural phenomena (e.g., drought, fire, temperature change, flooding, tsunamis, infestations—pine beetle, volcanic eruptions) on ecosystems</li> <li><input type="checkbox"/> give examples of how foreign species can affect an ecosystem (e.g., Eurasian milfoil, purple loosestrife, scotch broom, American bullfrog, European starling in BC)</li> <li><input type="checkbox"/> give examples of how traditional ecological knowledge (TEK) can affect biodiversity (e.g., spring burning by Cree in northern Alberta)</li> <li><input type="checkbox"/> research and report on situations in which disease, pollution, habitat destruction, and exploitation of resources affect ecosystems</li> </ul>

**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
<p><i>It is expected that students will:</i></p>	<p><i>The following set of indicators may be used to assess student achievement for each corresponding Prescribed Learning Outcome.</i></p> <p><i>Students who have fully met the Prescribed Learning Outcome are able to:</i></p>
<p>C1 differentiate between atoms, ions, and molecules using knowledge of their structure and components</p>	<ul style="list-style-type: none"> <li><input type="checkbox"/> demonstrate knowledge of the three subatomic particles, their properties, and their location within the atom (e.g., by creating models)</li> <li><input type="checkbox"/> define and give examples of <i>ionic bonding</i> (e.g., metal and non-metal) and <i>covalent bonding</i> (e.g., two non-metals, diatomic elements)</li> <li><input type="checkbox"/> with reference to elements 1 to 20 on the periodic table, draw and interpret Bohr models, including protons, neutrons, and electrons, of             <ul style="list-style-type: none"> <li>- atoms (neutral)</li> <li>- ions (charged)</li> <li>- molecules - covalent bonding (e.g., O<sub>2</sub>, CH<sub>4</sub>)</li> <li>- ionic compounds (e.g., CaCl<sub>2</sub>)</li> </ul> </li> <li><input type="checkbox"/> identify valence electrons using the periodic table (excluding lanthanides and actinides)</li> <li><input type="checkbox"/> distinguish between paired and unpaired electrons for a single atom</li> <li><input type="checkbox"/> draw and interpret Lewis diagrams showing single bonds for simple ionic compounds and covalent molecules (e.g., NaCl, MgO, BaBr<sub>2</sub>, H<sub>2</sub>O, CH<sub>4</sub>, NH<sub>3</sub>)</li> <li><input type="checkbox"/> distinguish between lone pairs and bonding pairs of electrons in molecules</li> </ul>

PRESCRIBED LEARNING OUTCOMES	SUGGESTED ACHIEVEMENT INDICATORS
C2 classify substances as acids, bases, or salts, based on their characteristics, name, and formula	<ul style="list-style-type: none"> <li><input type="checkbox"/> identify acids and bases using indicators (e.g., methyl orange, bromthymol blue, litmus, phenolphthalein, indigo carmine)</li> <li><input type="checkbox"/> explain the significance of the pH scale, with reference to common substances</li> <li><input type="checkbox"/> differentiate between acids, bases, and salts with respect to chemical formulae and properties</li> <li><input type="checkbox"/> recognize the names and formulae of common acids (e.g., hydrochloric, sulphuric, nitric, acetic)</li> <li><input type="checkbox"/> use the periodic table to               <ul style="list-style-type: none"> <li>- explain the classification of elements as metals and nonmetals</li> <li>- identify the relative reactivity of elements in the alkali metal, alkaline earth metal, halogen, and noble gas groups</li> <li>- distinguish between metal oxide solutions (basic) and non-metal oxide solutions (acidic)</li> </ul> </li> <li><input type="checkbox"/> 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)</li> <li><input type="checkbox"/> convert names to formulae and formulae to names for covalent compounds, using prefixes up to “deca”</li> </ul>
C3 distinguish between organic and inorganic compounds	<ul style="list-style-type: none"> <li><input type="checkbox"/> define <i>organic compounds</i> and <i>inorganic compounds</i></li> <li><input type="checkbox"/> distinguish between organic and inorganic compounds, based on their chemical structures</li> <li><input type="checkbox"/> recognize a compound as organic or inorganic from its name, from its chemical formula, or from a diagram or model</li> </ul>
C4 analyse chemical reactions, including reference to conservation of mass and rate of reaction	<ul style="list-style-type: none"> <li><input type="checkbox"/> define and explain the <i>law of conservation of mass</i></li> <li><input type="checkbox"/> represent chemical reactions and the conservation of atoms using molecular models</li> <li><input type="checkbox"/> write and balance (using the lowest whole number coefficients) chemical equations from formulae, word equations, or descriptions of experiments</li> <li><input type="checkbox"/> identify, give evidence for, predict products of, and classify the following types of chemical reactions:               <ul style="list-style-type: none"> <li>- synthesis (combination)</li> <li>- decomposition</li> <li>- single and double replacement</li> <li>- neutralization (acid-base)</li> <li>- combustion</li> </ul> </li> <li><input type="checkbox"/> explain how factors such as temperature, concentration, presence of a catalyst, and surface area can affect the rate of chemical reactions</li> </ul>

PRESCRIBED LEARNING OUTCOMES	SUGGESTED ACHIEVEMENT INDICATORS
C5 explain radioactivity using modern atomic theory	<ul style="list-style-type: none"> <li><input type="checkbox"/> define <i>isotope</i> in terms of atomic number and mass number, recognizing how these are communicated in standard atomic notation (e.g., Uranium-238: <math>{}_{92}^{238}\text{U}</math>)</li> <li><input type="checkbox"/> relate radioactive decay (e.g., alpha – <math>\alpha</math>, beta – <math>\beta</math>, gamma – <math>\gamma</math>) to changes in the nucleus</li> <li><input type="checkbox"/> relate the following subatomic particles to radioactive decay: <ul style="list-style-type: none"> <li>- proton (<math>{}_{1}^{1}\text{p}</math>)</li> <li>- neutron (<math>{}_{0}^{1}\text{n}</math>)</li> <li>- electron (<math>{}_{-1}^{0}\text{e}</math>)</li> <li>- alpha particle (<math>{}_{2}^{4}\alpha</math>) (<math>{}_{2}^{4}\text{He}</math>)</li> <li>- beta particle (<math>{}_{-1}^{0}\beta</math>)</li> </ul> </li> <li><input type="checkbox"/> explain half-life with reference to rates of radioactive decay</li> <li><input type="checkbox"/> compare fission and fusion</li> <li><input type="checkbox"/> complete and balance nuclear equations to illustrate radioactive decay, fission, and fusion</li> </ul>

## GRADE 10 PHYSICAL SCIENCE: MOTION

PRESCRIBED LEARNING OUTCOMES	SUGGESTED ACHIEVEMENT INDICATORS
<p><i>It is expected that students will:</i></p>	<p><i>The following set of indicators may be used to assess student achievement for each corresponding Prescribed Learning Outcome.</i></p> <p><i>Students who have fully met the Prescribed Learning Outcome are able to:</i></p>
<p>C6 explain the relationship of displacement and time interval to velocity for objects in uniform motion</p>	<ul style="list-style-type: none"> <li><input type="checkbox"/> define <i>displacement</i> (change in position, <math>\Delta x</math>), <i>time interval</i> (<math>\Delta t</math>), and <i>velocity</i> (<math>v_{av}</math>)</li> <li><input type="checkbox"/> analyse graphically the relationship between displacement and time interval for an object travelling in uniform motion</li> <li><input type="checkbox"/> use the formula <math>v_{av} = \Delta x / \Delta t</math> to calculate the average velocity (<math>v_{av}</math>), displacement (change in position, <math>\Delta x</math>), and time interval (<math>\Delta t</math>) for an object in uniform motion, given appropriate data</li> <li><input type="checkbox"/> 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)</li> </ul>
<p>C7 demonstrate the relationship between velocity, time interval, and acceleration</p>	<ul style="list-style-type: none"> <li><input type="checkbox"/> define <i>acceleration</i> ( positive, negative, and zero)</li> <li><input type="checkbox"/> give examples of positive, negative, and zero acceleration, including <ul style="list-style-type: none"> <li>- falling objects</li> <li>- accelerating from rest</li> <li>- slowing down or stopping</li> <li>- uniform motion</li> </ul> </li> <li><input type="checkbox"/> given initial velocity (<math>v_i</math>), final velocity (<math>v_f</math>), and the time interval (<math>\Delta t</math>), calculate acceleration using the formula <math>a = \Delta v / \Delta t</math>, where <math>\Delta v = v_f - v_i</math> (e.g., for falling objects)</li> </ul>

**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, paleoglaciatiion, 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
<p><i>It is expected that students will:</i></p>	<p><i>The following set of indicators may be used to assess student achievement for each corresponding Prescribed Learning Outcome.</i></p> <p><i>Students who have fully met the Prescribed Learning Outcome are able to:</i></p>
<p>D1 explain the characteristics and sources of thermal energy</p>	<ul style="list-style-type: none"> <li><input type="checkbox"/> define <i>heat</i> and <i>thermal energy</i></li> <li><input type="checkbox"/> explain and illustrate how thermal energy is transferred through conduction, convection, and radiation, with reference to <ul style="list-style-type: none"> <li>- kinetic molecular theory</li> <li>- practical examples (e.g., home heating, cooking methods, loss of body heat, insulation)</li> </ul> </li> <li><input type="checkbox"/> describe Earth's energy sources including <ul style="list-style-type: none"> <li>- residual thermal energy from Earth's formation</li> <li>- energy from radioactive decay</li> <li>- solar energy (with reference to absorption and radiation in the atmosphere)</li> </ul> </li> </ul>
<p>D2 explain the effects of thermal energy within the atmosphere</p>	<ul style="list-style-type: none"> <li><input type="checkbox"/> define <i>atmospheric pressure</i> and explain how it is measured</li> <li><input type="checkbox"/> identify weather conditions that typically accompany areas of low and high pressure in the atmosphere</li> <li><input type="checkbox"/> 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)</li> </ul>
<p>D3 evaluate possible causes of climate change and its impact on natural systems</p>	<ul style="list-style-type: none"> <li><input type="checkbox"/> describe how natural phenomena can affect climate (e.g., biosphere processes, volcanic eruptions, Coriolis effect, El Niño and La Niña)</li> <li><input type="checkbox"/> describe how climate can be influenced by human activities (e.g., greenhouse gases, depletion of ozone layer)</li> <li><input type="checkbox"/> describe how climate change affects natural systems (e.g., shrinking of the permafrost region, melting of ice shelves/caps/glaciers)</li> </ul>

## GRADE 10 EARTH AND SPACE SCIENCE: PLATE TECTONICS

PRESCRIBED LEARNING OUTCOMES	SUGGESTED ACHIEVEMENT INDICATORS
<p><i>It is expected that students will:</i></p>	<p><i>The following set of indicators may be used to assess student achievement for each corresponding Prescribed Learning Outcome.</i></p> <p><i>Students who have fully met the Prescribed Learning Outcome are able to:</i></p>
<p>D4 analyse the processes and features associated with plate tectonics</p>	<ul style="list-style-type: none"> <li><input type="checkbox"/> define <i>plate tectonics, plate boundary, earthquake, trench, volcano, spreading ridge, subduction zone, hot spot</i></li> <li><input type="checkbox"/> relate tectonic plate movement to the composition of the following layers of the Earth, as determined by seismic waves (primary, secondary, and surface waves): <ul style="list-style-type: none"> <li>- crust</li> <li>- lithosphere</li> <li>- asthenosphere</li> <li>- mantle</li> <li>- outer core</li> <li>- inner core</li> </ul> </li> <li><input type="checkbox"/> describe tectonic plate boundaries, including <ul style="list-style-type: none"> <li>- transform boundaries</li> <li>- divergent boundaries</li> <li>- convergent boundaries (oceanic-oceanic crust, oceanic-continental crust, and continental-continental crust)</li> </ul> </li> <li><input type="checkbox"/> identify tectonic mapping symbols</li> <li><input type="checkbox"/> explain how plate movement produces the following features: <ul style="list-style-type: none"> <li>- epicentres and shallow-focus to deep-focus earthquakes</li> <li>- volcanism at subduction zones (e.g., volcanic island arcs, volcanic belts) and at spreading ridges</li> <li>- mountain ranges and mid-ocean ridges</li> <li>- hot spot chains (e.g., Hawaiian Islands, Yellowstone)</li> </ul> </li> <li><input type="checkbox"/> 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)</li> <li><input type="checkbox"/> explain how mantle convection and ridge push and slab pull are believed to contribute to plate motion</li> </ul>
<p>D5 demonstrate knowledge of evidence that supports plate tectonic theory</p>	<ul style="list-style-type: none"> <li><input type="checkbox"/> describe evidence for continental drift theory (e.g., fossil evidence, mountain belts, paleoglaciaticion)</li> <li><input type="checkbox"/> relate the following to plate tectonic theory: <ul style="list-style-type: none"> <li>- the world distribution of volcanoes, earthquakes, mountain belts, trenches, mid-ocean ridges, and rift valleys</li> <li>- hot spot and subduction zone eruptions</li> <li>- magnetic reversals and age of rocks relative to spreading ridges</li> </ul> </li> </ul>