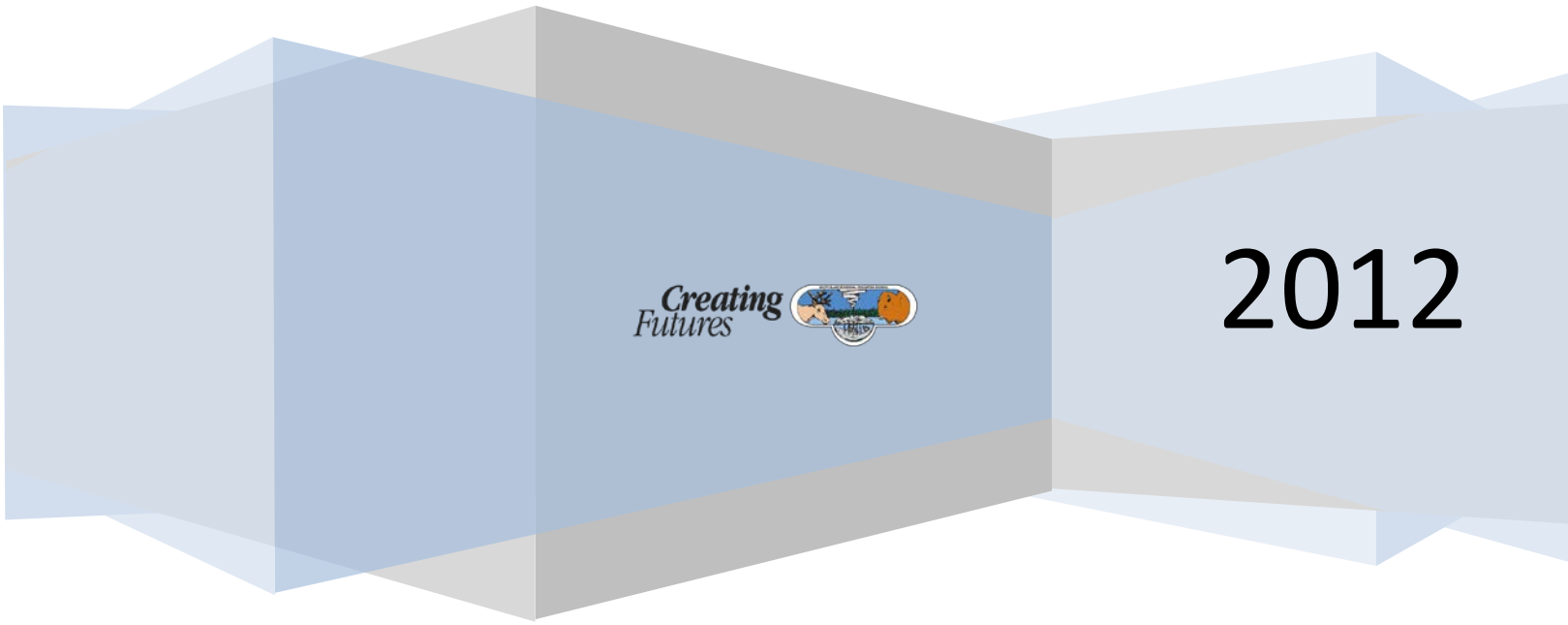
South Slave Divisional Education Council

Biology 20

Curriculum Package

February 2012



Unit A: Energy & Matter Exchange in the Biosphere

Specific Outcomes	Achievement Indicators – Measurable outcomes
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
Focusing Questions: How are carbon, oxygen, nitrogen and phosphorus cycled in the biosphere? How is the flow of energy balanced in the biosphere? How have human activities and technological advances affected the balance of energy and matter in the biosphere?	
1 GENERAL OUCOME: STUDENTS WILL EXPLAIN THE CONSTANT FLOW OF ENERGY THROUGH THE BIOSPHERE AND ECOSYSTEMS.	
Knowledge: students will explain the constant flow of energy through the biosphere and ecosystems	• Explain, in general terms, the one-way flow of energy through the biosphere and how stored energy in the biosphere, as a system, is eventually "lost" as heat; e.g. o Photosynthesis/chemosynthesis o Cellular respiration (muscle-heat generation, decomposition) o Energy transfer by conduction, radiation and convection • Explain how energy in the biosphere can be perceived as a balance between both photosynthetic and chemosynthetic activities and cellular respiratory activities; i.e. o Energy flow in photosynthetic environments o Energy flow in deep sea vent (chemosynthetic) ecosystems and other extreme environments • Explain the structure of ecosystem trophic levels, using models such as food chains and food webs • Explain, quantitatively, flow of energy and exchange of matter in aquatic and terrestrial ecosystems, i.e models such as pyramids of numbers, biomass, energy.
Science, Technology and Society (STS) (Nature of Science Emphasis)	• Explain that the process of scientific investigation includes analyzing evidence and providing explanations based upon scientific theories and concepts o Evaluate the evidence for the influence of ice and snow on the trapping of solar energy (albedo effect) and hypothesize on the consequences of fluctuations for biological systems o Explain how metabolic heat release from harvested grain can be reduced by drying processes prior to grain storage and explain the scientific principles involved in this technology o Explain, in terms of energy flow, the advantage of vegetarianism in densely populated countries.
SKILLS OUTCOMES: (embed throughout the unit)	
Initiating and Planning: Formulate questions about observed relationships and plan investigations of questions, ideas, problems and issues	• Propose a relationship between producers and available energy of a system • Predict a relationship between solar energy storage by plants and varying light conditions
Performing and Recording: Conduct investigations into relationships among observable variables and use a broad range of tools and techniques to gather and record data and information	• Perform an experiment to demonstrate solar energy storage by plants • Draw by hand or using technology, annotated diagrams of food chains, food webs and ecological pyramids
Analyzing and Interpreting: Analyze data and apply mathematical and conceptual models to develop and assess possible solutions	• Analyze data on the diversity of plants, animals and decomposers of an endangered ecosystem, e.g., wetlands, short grass prairie, and predict long-term outcomes • Compare alternative ways of presenting energy flow data for ecosystems; i.e., pyramids of energy, biomass and numbers • Analyze data on the storage of solar energy by plants

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Specific Outcomes	Achievement Indicators – Measurable outcomes
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
Communication and Teamwork: Work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results	• Use appropriate International System of Units (SI) notation fundamental and derived units and significant digits • Use appropriate numeric, symbolic, graphical and linguistic modes of representation to communicate ideas, plans and results • Use appropriate notation units in the data presented in an energy pyramid • Work cooperatively as a team to investigate, synthesize and present information on the effect of organism diversity on an ecosystem
2 GENERAL OUCOME: STUDENTS WILL EXPLAIN THE CYCLING OF MATTER THROUGH THE BIOSPHERE	
Knowledge: students will explain the cycling of matter through the biosphere	• Explain and summarize the biogeochemical cycling of carbon, oxygen, nitrogen and phosphorus and relate this to general reuse of all matter in the biosphere • Explain water's primary role in the biogeochemical cycles, considering its chemical and physical properties; i.e., universal solvent, hydrogen bonding.
Explain that science and technology have both intended and unintended consequences for humans and the environment **Science, Technology and Society** (STS) (Nature of Science Emphasis):	• Discuss the influence of human activities on the biogeochemical cycling of phosphorus, sulfur, iron and nitrogen: o Feedlot operations o Composting o Fertilizer applications o Waste and sewage disposal o Vehicle and refinery emissions o Acid deposition o Persistent organic pollutants • Discuss the use of water by society, the impact such use has on water quality and • Quantity in ecosystems, and the need for water purification and conservation: o Manufacturing and processing o Petrochemical industry o Agricultural systems o Mining industry o Domestic daily water consumption • Analyze the relationship between heavy metals released into the environment and matter exchange in natural food chains/webs and analyze the impact of this relationship on quality of life.
SKILLS OUTCOMES: (embed throughout the unit)	
Initiating and Planning: Formulate questions about observed relationships and plan investigations of questions, ideas, problems and issues	• Design an experiment to compare the carbon dioxide production of plants with that of animals • Hypothesize how alterations in the carbon cycle, resulting from the burning of fossil fuels, might affect other cycling phenomena • Predict disruptions in the nitrogen and phosphorus cycles that are caused by human activities
Performing and Recording: Conduct investigations into relationships between and among observable variables and use a broad range of tools and techniques to gather and record data and information	• Measure and record the pH and the amount of nitrates, phosphates, iron or sulfites in water samples

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It is expected that students will:	*The following set of indicators may be used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
Analyzing and Interpreting: Analyze data and apply mathematical and conceptual models to develop and assess possible solutions	• Analyze data collected on water consumption and loss in plants and animals
Communication and Teamwork: Work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results	• Work cooperatively in a group to investigate the influence of human activities on the biogeochemical cycles and use appropriate multimedia to present the information to a group
3 GENERAL OUCOME: STUDENTS WILL EXPLAIN THE BALANCE OF ENERGY AND MATTER EXCHANGE IN THE BIOSPHERE, AS AN OPEN SYSTEM, AND EXPLAIN HOW THIS MAINTAINS EQUILIBRIUM	
Knowledge: students will explain the balance of energy and matter exchange in the biosphere, as an open system, and explain how this maintains equilibrium	• Explain the interrelationship of energy, matter and ecosystem productivity (biomass production); e.g. o Antarctic Ocean versus tropical seas o Tropical rain forest versus desert o Taiga versus tundra o Intertidal zone versus deep-sea benthos o Arctic versus Antarctic • Explain how the equilibrium between gas exchanges in photosynthesis and cellular respiration influences atmospheric composition • Describe the geologic evidence (stromatolites) and scientific explanations for change in atmospheric composition, with respect to oxygen and carbon dioxide, from anoxic conditions to the present, and describe the significance to current biosphere equilibrium.
Explain that science and technology are developed to meet societal needs and expand human capability **Science, Technology and Society** (STS) (Social and Environmental Contexts Emphasis)	• Explain that science and technology have both intended and unintended consequences for humans and the environment
SKILLS OUTCOMES: (embed throughout the unit)	
Initiating and Planning: Formulate questions about observed relationships and plan investigations of questions, ideas, problems and issues	• Predict the effects of changes in carbon dioxide and oxygen concentration on the atmospheric equilibrium due to a significant reduction of photosynthetic organisms through human activity
Performing and Recording: Conduct investigations into relationships between and among observable variables and use a broad range of tools and techniques to gather and record data and information	• Collect evidence from various print and electronic sources on how human activities can have a disrupting influence on photosynthetic and cellular respiratory activities
Analyzing and Interpreting: Analyze data and apply mathematical and conceptual models to develop and assess possible solutions	• Design and evaluate a model of a closed biological system in equilibrium with respect to carbon dioxide, water and oxygen exchange

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It is expected that students will:	*The following set of indicators may be used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
Communication and Teamwork: Work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results	• Work collaboratively as a group to investigate, synthesize and present information on the effects of changes to stratospheric ozone levels on society, agriculture, plants and animals

Unit B: Ecosystems and Population Change

Focusing Questions:

What are the major biotic and abiotic characteristics that distinguish aquatic and terrestrial ecosystems?
What data would one need to collect in a field study to illustrate the major abiotic characteristics and diversity of organisms?
What mechanisms are involved in the change of populations over time?
In what ways do humans apply their knowledge of ecosystems to assess and limit the impact of human activities?

1 GENERAL OUTCOME: STUDENTS WILL EXPLAIN THAT THE BIOSPHERE IS COMPOSED OF ECOSYSTEMS, EACH WITH DISTINCTIVE BIOTIC AND ABIOTIC CHARACTERISTICS.	
Knowledge: Students will explain that the biosphere is composed of ecosystems, each with distinctive biotic and abiotic characteristics.	• Define species, population, community and ecosystem and explain the interrelationships among them • Explain how terrestrial and aquatic ecosystems support a diversity of organisms through a variety of habitats and niches; e.g. o Terrestrial: canopy, sub-canopy, forest floor, soil o Aquatic: littoral, limnetic, profundal and benthic zones • Identify biotic and abiotic characteristics and explain their influence in an aquatic and a terrestrial ecosystem in the local region; stream, lake, prairie, boreal forest, vacant lot, sports field • Explain how limiting factors influence organism distribution and range; e.g. o Abiotic factors: soil, relative humidity, moisture, ambient temperature, sunlight, nutrients, oxygen o Biotic factors: competitors, predators and parasites • Explain the fundamental principles of taxonomy and binomial nomenclature, using modes of nutrition at the kingdom level and morphological characteristics at the genus species level.
Explain how science and technology have both intended and unintended consequences for humans and the environment **Science, Technology and Society** (STS) (Social and Environmental Contexts Emphasis)	• Explain how conventions of mathematics, nomenclature and notation provide a basis for organizing and communicating scientific theory, relationships and concepts
SKILLS OUTCOMES: (embed throughout the unit)	
Initiating and Planning: Formulate questions about observed relationships; plan investigations of questions, ideas, problems and issues; and define and delimit problems to facilitate investigation	• Hypothesize the role of biotic and abiotic factors in ecosystems; e.g., competition and chinooks • Plan a field study to gather and evaluate biotic and abiotic characteristics associated with an ecosystem, such as the effects that dominate plants have on abiotic conditions such as soil and microclimate

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Unit B: Ecosystems and Population Change

Specific Outcomes	Achievement Indicators – Measurable outcomes
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
Performing and Recording: Conduct investigations into relationships between and among observable variables and use a broad range of tools and techniques to gather and record data and information	• Perform a field study to measure, quantitatively, appropriate abiotic characteristics of an ecosystem and to gather, both quantitatively and qualitatively, evidence for analysis of the diversity of life in the ecosystem studied
Analyzing and Interpreting: Analyze data and apply mathematical and conceptual models to develop and assess possible solutions	• Apply classification and binomial nomenclature systems in a field study • Analyze the interrelationship of biotic and abiotic • Characteristics that make up the ecosystem studied • Evaluate the accuracy and reliability of instruments used for measurement and identify the degree of error in the field-study data
Communication and Teamwork: Work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results	• Work collaboratively to gather and share data on a field trip • Work collaboratively to make clear and logical arguments to defend a decision on a given issue • Develop, present, and defend a strategy to improve wildlife habitats
2 GENERAL OUTCOMES: STUDENTS WILL EXPLAIN THE MECHANISMS INVOLVED IN THE CHANGE OF POPULATIONS OVER TIME	
Knowledge: Students will explain the mechanisms involved in the change of populations over time.	• Explain that variability in a species results from heritable mutations and that some mutations may have a selective advantage • Discuss the significance of sexual reproduction to individual variation in populations and to the process of evolution • Compare Lamarckian and Darwinian explanations of evolutionary change • Summarize and describe lines of evidence to support the evolution of modern species from ancestral forms; i.e., the fossil record, Earth's history, biogeography, homologous and analogous structures, embryology, biochemistry • Explain speciation and the conditions required for this process • Describe modern evolutionary theories; i.e., punctuated equilibrium, gradualism.
Explain that scientific knowledge and theories develop through hypotheses, the collection of evidence, investigation and the ability to provide explanations **Science, Technology and Society** (STS) (Nature of Science Emphasis)	• Discuss the nature of science as a way of knowing (contributions of Buffon, Lyell, Malthus and Wallace to evolution and contributions of Aristotle, Galileo and Popper to the philosophy of science) • Describe how paleontology and the role of evidence in the accumulation of knowledge have provided invaluable data for theories explaining observable variations in organisms over time (Burgess Shale) • Discuss geologic evidence and probable causes for past mass extinctions and contrast these to the forces driving the current decline in species.
SKILLS OUTCOMES: (embed throughout the unit)	
Initiating and Planning: Formulate questions about observed relationships; plan investigations of questions, ideas, problems and issues	• Design an investigation to measure or describe an inherited variation in a plant or an animal population • Hypothesize the adaptive significance of the variations in a range of homologous structures in extant and extinct organisms
Performing and Recording: Conduct investigations into relationships between and among observable variables and use a broad range of tools and techniques to gather and record data and information	• Gather data, actual or simulated, on organisms to demonstrate how inherited characteristics change over time, as illustrated by Darwin's finches, peppered moths, bacteria and domesticated plants and animals

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Unit B: Ecosystems and Population Change

Specific Outcomes	Achievement Indicators – Measurable outcomes
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
Analyzing and Interpreting: Analyze data and apply mathematical and conceptual models to develop and assess possible solutions	• Analyze data, actual or simulated, on plants and animals to demonstrate how morphology changes over time; e.g., Darwin's finches, peppered moths, bacteria, domesticated plants or animals • Analyze DNA sequences from online or other sources to infer the relationship between different organisms at various classification levels • State a conclusion or generalization based on research data, suggesting how it supports or refutes an explanation for biological change, and identify new questions or problems that arise from what was learned
Communication and Teamwork: Work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results	• Use appropriate numeric, symbolic, graphical and linguistic modes of representation to communicate ideas, plans and results

Unit C: Photosynthesis and Cellular Respiration

Focusing Questions:
How does light energy from the environment enter living systems?
How is the energy from light converted to chemical potential in organic matter?
How is the energy in organic matter released for use by living systems?
How do humans in their application of technologies impact photosynthesis and cellular respiration?

1 GENERAL OUTCOME: STUDENTS WILL RELATE PHOTOSYNTHESIS TO STORAGE OF ENERGY IN ORGANIC COMPOUNDS	
Knowledge: students will relate photosynthesis to storage of energy in organic compounds	• Explain, in general terms, how energy is absorbed by pigments, transferred through the reduction of nicotinamide adenine dinucleotide phosphate (NADP) to NADPH, and then transferred as chemical potential energy to ATP by chemiosmosis; and describe where in the chloroplast these processes occur • Explain, in general terms, how the products of light-dependent reactions, NADPH and ATP, are used to reduce carbon in light-independent reactions for production of glucose; and describe where in the chloroplast these processes occur.
Explain how scientific knowledge may lead to the development of new technologies, and new technologies may lead to or facilitate scientific discovery **Science, Technology and Society** (STS) (Science/Technology Emphasis)	• Explain that the appropriateness, risks and benefits of technologies need to be assessed for each potential application from a variety of perspectives, including sustainability
SKILLS OUTCOMES: (embed throughout the unit)	
Initiating and Planning: Formulate questions about observed relationships; plan investigations of questions, ideas, problems and issues	• Identify a testable factor that would affect the rate of photosynthesis • Predict and hypothesize the effect of changes in carbon dioxide and oxygen concentration on photosynthesis
Performing and Recording: Conduct investigations into relationships between and among observable variables and use a broad range of tools and techniques to gather and record data and information	• Use local histories obtained from Aboriginal Elders to describe the importance of plant productivity to human sustainability • Measure rates of evapotranspiration under various environmental conditions and relate these rates to photosynthetic activity • Investigate and integrate, from print and electronic sources, information on the C_3 and C_4 photosynthetic mechanisms or on the applications of cellular biochemistry in medicine or industry

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Unit C: Photosynthesis and Cellular Respiration

Specific Outcomes	Achievement Indicators – Measurable outcomes
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
Analyzing and Interpreting: Analyze data and apply mathematical and conceptual models to develop and assess possible solutions	• Collect and interpret data from chromatography experiments and calculate reference flow (R_f) values • Draw an analogy between the storage of energy by photosynthesis and the storage of energy by solar generating systems • Explain how data supports or refutes the hypothesis on how changes in carbon dioxide and oxygen concentration affect photosynthesis • Collect and interpret experimental data that demonstrates that plant leaves produce starch in the presence of light
Communication and Teamwork: Work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results	• Work cooperatively as a group to investigate, synthesize and present information on the effects of herbicides on the biochemistry of photosynthesis
2 GENERAL OUTCOMES: STUDENTS WILL EXPLAIN THE ROLE OF CELLULAR RESPIRATION IN RELEASING POTENTIAL ENERGY FROM ORGANIC COMPOUNDS.	
Knowledge: Students will explain the role of cellular respiration in releasing potential energy from organic compounds.	• Explain, in general terms, how glucose is oxidized during glycolysis and the Krebs cycle to produce reducing power in NADH and FADH; and describe where in the cell these processes occur • Explain, in general terms, how chemiosmosis converts the reducing power of NADH and FADH to store chemical potential energy as ATP; and describe where in the mitochondrion these processes occur • Distinguish, in general terms, between aerobic and anaerobic respiration and fermentation in plants, animals and yeast • Summarize and explain the role of ATP in cellular metabolism; e.g. o Active transport o Cytoplasmic streaming o Phagocytosis o Biochemical synthesis o Muscle contraction o Heat production.
Explain that science and technology are developed to meet societal needs and expand human capability **Science, Technology and Society** (STS) (Social and Environmental Contexts Emphasis)	• Explain that science and technology have both intended and unintended consequences for humans and the environment
SKILLS OUTCOMES: (embed throughout the unit)	
Initiating and Planning: Formulate questions about observed relationships; plan investigations of questions, ideas, problems and issues	• Identify factors affecting the rate of cellular respiration • Design an experiment to demonstrate that heat is a by-product of cellular respiration • Predict and hypothesize the effect of oxic and anoxic conditions on the rate of cellular respiration in unicellular organisms such as yeast and bacteria

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Unit C: Photosynthesis and Cellular Respiration

Specific Outcomes	Achievement Indicators – Measurable outcomes
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
Performing and Recording: Conduct investigations into relationships between and among observable variables and use a broad range of tools and techniques to gather and record data and information	• Use experimental methods to demonstrate, quantitatively, the oxygen consumption of germinating seeds • Measure temperature change over time of germinating and non-germinating seeds • Investigate and integrate, from print and electronic sources, information on the action of metabolic toxins on cellular respiration
Analyzing and Interpreting: Analyze data and apply mathematical and conceptual models to develop and assess possible solutions	• Evaluate the reliability, accuracy and validity of sources used to collect information on metabolic toxins and cellular respiration • Interpret data on the oxygen consumption of an animal and relate this to metabolic rate • Interpret data that illustrate the effect of oxic and anoxic conditions on cellular respiration • Relate the Aboriginal metaphor “the trees are the lungs of Mother Earth” to the complementary role of the carbon and oxygen cycles
Communication and Teamwork: Work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results	• Create a concept map or flow chart to illustrate how the carbon, hydrogen and oxygen atoms in glucose are ultimately released as carbon dioxide and water • Work cooperatively to research and investigate cellular respiration in oxic and anoxic conditions and metabolic toxins

Unit D: Human Systems

Focusing Questions: How do specialized structures function in the overall biochemical balance of the living system? What conditions result if these structures do not function normally? How does knowledge of living systems and medical technology support the prevention and treatment of disorders?	
1 GENERAL OUTCOME: STUDENTS WILL EXPLAIN HOW THE HUMAN DIGESTIVE AND RESPIRATORY SYSTEMS EXCHANGE ENERGY AND MATTER WITH THE ENVIRONMENT	
Knowledge: students will explain how the human digestive and respiratory systems exchange energy and matter with the environment	• Identify the principal structures of the digestive and respiratory systems; i.e., mouth, esophagus, stomach, sphincters, small and large intestines, liver, pancreas, gall bladder; nasal passages, pharynx, larynx, epiglottis, trachea, bronchi, bronchioles, alveoli, diaphragm, rib muscles, pleural membranes • Describe the chemical nature of carbohydrates, lipids and proteins and their enzymes; i.e., carbohydrates, lipases and proteases • Explain enzyme action and factors influencing their action; i.e., temperature, pH, substrate concentration, feedback inhibition, competitive inhibition • Describe the chemical and physical processing of matter through the digestive system into the circulatory system • Explain the exchange of matter and the transfer of thermal energy between the body and the environment, using the mechanism of breathing in gas exchange, removal of foreign material and heat loss.
Explain that the goal of technology is to provide solutions to practical problems **Science, Technology and Society** (STS) (Science and Technology Emphasis)	• Explain that the products of technology are devices, systems and processes that meet given needs; however, these products cannot solve all problems

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Unit D: Human Systems

Specific Outcomes	Achievement Indicators – Measurable outcomes
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
SKILLS OUTCOMES: (embed throughout the unit)	
Initiating and Planning: Formulate questions about observed relationships; plan investigations of questions, ideas, problems	• Design an investigation to examine food energy through calorimetry, to examine enzyme action or to examine the mechanics of breathing
Performing and Recording: Conduct investigations into relationships between and among observable variables and use a broad range of tools and techniques to gather and record data and information	• Observe, through dissection or computer simulations, the digestive and respiratory systems of a representative mammal and identify the major structural components • Perform experiments, using qualitative tests, to detect the presence of carbohydrates, proteins and lipids • Perform an experiment to investigate the influence of enzyme concentration, temperature or pH on the activity of enzymes such as pepsin and pancreatin • Perform an experiment to examine the mechanics of breathing, such as lung volume, breathing rate
Analyzing and Interpreting: Analyze data and apply mathematical and conceptual models to develop and assess possible solutions	• analyze and draw conclusions and assess validity of data from an investigation on calorimetry or enzyme action • Analyze and draw conclusions and assess validity of data from an investigation on the mechanics of breathing
Communication and Teamwork: Work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results	• Use appropriate notation and units to present data from investigations on digestion and respiration • Work cooperatively with team members to investigate how Aboriginal peoples and ranchers have used their observations of the excrement of game and farm animals to assess the health of these animals • Work cooperatively with team members to research the contributions from various cultures to our current understanding of digestion or respiration and healing, such as research on the use of traditional remedies to treat respiratory illness
2 GENERAL OUTCOME: STUDENTS WILL EXPLAIN THE ROLE OF THE CIRCULATORY AND DEFENCE SYSTEMS IN MAINTAINING AN INTERNAL EQUILIBRIUM.	
Knowledge: Students will explain the role of the circulatory and defence systems in maintaining an internal equilibrium.	• Identify the principal structures of the heart and associated blood vessels; i.e., atria, ventricles, septa, valves, aorta, venae cavae, pulmonary arteries and veins, sinoatrial node, atrioventricular node, Purkinje fibres • Describe the action of the heart, blood pressure and the general circulation of blood through coronary, pulmonary and systemic pathways • Describe the structure and function of blood vessels; i.e., arteries, veins and capillaries • Describe the main components of blood and their role in transport, clotting and resisting the influence of pathogens; i.e., plasma, erythrocytes, platelets, leucocytes • Explain the role of the circulatory system at the capillary level in aiding the digestive, excretory, respiratory and motor systems' exchange of energy and matter with the environment • Explain the role of blood in regulating body temperature

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Unit D: Human Systems

Specific Outcomes	Achievement Indicators – Measurable outcomes
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
Knowledge: Students will explain the role of the circulatory and defence systems in maintaining an internal equilibrium. CONTINUED	• Describe and explain, in general terms, the function of the lymphatic system • List the main cellular and noncellular components of the human defence system and describe their role; i.e., skin, macrophage, helper T cell, B cell, killer T cell, suppressor T cell, memory T cell • Describe the ABO and Rh blood groups on the basis of antigens and antibodies.
Explain how Canadian society supports scientific research and technological development to facilitate a sustainable society, economy and environment **Science, Technology and Society** (STS) (Social and Environmental Contexts Emphasis)	• Explain that decisions regarding the application of scientific and technological developments involve a variety of perspective, including social, cultural, environmental, ethical and economic considerations
SKILLS OUTCOMES: (embed throughout the unit)	
Initiating and Planning: Formulate questions about observed relationships; plan investigations of questions, ideas, problems	• Design procedures to investigate factors affecting heart rate and blood pressure; e.g., physical activity, emotion, gender and chemicals such as caffeine
Performing and Recording: Conduct investigations into relationships between and among observable variables and use a broad range of tools and techniques to gather and record data and information	• Measure blood pressure and observe blood flow in capillaries in an organism or through demonstration in a virtual laboratory • Determine the morphology and abundance of cellular components in a prepared human blood slide • Select and integrate information from various sources to observe the principal features of a mammalian circulatory system and the direction of blood flow, and identify structures from drawings; e.g., valves, chambers • Research and design a simulation or model of the functioning of the main components of the human immune system • Compile and display information on blood pressure, heart rate and blood composition • Carry out a heart dissection to identify the major parts and to determine the directional flow of blood through the organ
Analyzing and Interpreting: Analyze data and apply mathematical and conceptual models to develop and assess possible solutions	• Determine, from available data, the relationship between blood pressure and exercise • Investigate lifestyle behaviour, physical fitness and heart rate recovery, using available data, and account for discrepancies • Identify the limitations and evaluate the dependability of devices used to measure blood pressure • Explore solutions to practical problems associated with the circulatory system, such as organ and tissue transplants and artificial blood • Determine blood groups from samples of artificial blood or electronic resources • Predict compatibility of ABO and Rh blood types between donor and recipient
Communication and Teamwork: Work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results	• Work cooperatively with team members to measure and record blood pressure, heart rate or any other factor relating to the circulatory system

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Unit D: Human Systems

Specific Outcomes	Achievement Indicators – Measurable outcomes
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
3 GENERAL OUTCOME: STUDENTS WILL EXPLAIN THE ROLE OF THE EXCRETORY SYSTEM IN MAINTAINING AN INTERNAL EQUILIBRIUM IN HUMANS THROUGH THE EXCHANGE OF ENERGY AND MATTER WITH THE ENVIRONMENT.	
Knowledge: Students will explain the role of the excretory system in maintaining an internal equilibrium in humans through the exchange of energy and matter with the environment.	• Identify the principal structures in the excretory system; i.e., kidneys, ureters, urinary bladder, urethra • Identify the major and associated structures of the nephron, including the glomerulus, Bowman's capsule, tubules, loop of Henle, collecting duct, afferent and efferent arterioles, and capillary net, and explain their function in maintaining plasma compositions (i.e., water, pH, ions) • Describe the function of the kidney in excreting metabolic wastes and expelling them into the environment • Identify the role of antidiuretic hormone (ADH) and aldosterone in water and sodium ion reabsorption, excretion and blood pressure regulation.
Explain that the goal of science is knowledge about the natural world **Science, Technology and Society** (STS) (Nature of Science Emphasis)	• Examine how lifestyle factors contribute to hypertension and affect kidney function: o Drugs, such as alcohol and nicotine o Sedentary lifestyle o Dietary excesses or deficiencies o Stress • Explain how an understanding of nephron function is applied to renal and peritoneal dialysis • Identify specific pathologies of the excretory system and the scientific knowledge connected with the treatment o Identify physiological complexities/challenges of organ & tissue transplants.
SKILLS OUTCOMES: (embed throughout the unit)	
Initiating and Planning: Formulate questions about observed relationships; plan investigations of questions, ideas, problems	• Predict how blood pressure affects urine composition and volume
Performing and Recording: Conduct investigations into relationships between and among observable variables and use a broad range of tools and techniques to gather and record data and information	• Research and create a flowchart to describe how humans maintain homeostasis with respect to water and ions; e.g., o When water intake is increased or decreased o When diuretic compounds, such as caffeine or alcohol, are ingested o When excessive sodium is ingested o After periods of intense exercise, fever, hemorrhage (PR–NS1) • Perform a kidney dissection to identify major structures of the organ
Analyzing and Interpreting: Analyze data and apply mathematical and conceptual models to develop and assess possible solutions	• Observe the principal features of a mammalian excretory system and identify structures from drawings obtained from various print and electronic sources • Collect and interpret data in analysis of simulated urine, identify limitations of the data, compare the data to theoretical values and produce a generalization • Assess technological solutions to kidney failure, i.e. peritoneal dialysis, hemodialysis/kidney transplant, & identify potential strengths/weaknesses of each
Communication and Teamwork: Work collaboratively to address problems & apply skills/conventions of science to communicate info/ideas & assessing results	• Work cooperatively with team members to assess and record simulated urine composition

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Unit D: Human Systems

Specific Outcomes	Achievement Indicators – Measurable outcomes
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
4 GENERAL OUTCOME: STUDENTS WILL EXPLAIN THE ROLE OF THE MOTOR SYSTEM IN THE FUNCTION OF OTHER BODY SYSTEMS	
Knowledge: students will explain the role of the motor system in the function of other body systems	• Explain how the motor system supports body functions (i.e., digestive, circulatory, respiratory, excretory and locomotory), referencing smooth, cardiac and striated muscle • Describe, in general, the action of actin and myosin in muscle contraction and heat production.
Explain that concepts, models and theories are often used in interpreting and explaining observations and in predicting future observations **Science, Technology and Society** (STS) (Nature of Science Emphasis)	• Analyze the effects of exercise on muscle fibre • Describe the relationship between fitness and efficiency of muscle action • Assess the physiological effects on the motor system of anabolic steroids and energy enhancing drugs such as creatine phosphate
Explain that the goal of technology is to provide solutions to practical problems	• Identify specific pathologies of the motor system, such as muscle atrophy, fatigue, strain and tendonitis, and identify technologies used to treat the conditions.
SKILLS OUTCOMES: (embed throughout the unit)	
Initiating and Planning: Formulate questions about observed relationships; plan investigations of questions, ideas, problems	• Design an investigation to determine the relationship between muscle activity, energy consumption and fatigue
Performing and Recording: Conduct investigations into relationships between and among observable variables and use a broad range of tools and techniques to gather and record data and information	• Identify smooth, cardiac and striated muscle tissue under magnification • Design and construct a model of a muscle fibre
Analyzing and Interpreting: Analyze data and apply mathematical and conceptual models to develop and assess possible solutions	• Obtain and interpret data to demonstrate a direct correlation between energy use by muscle cells and heat production
Communication and Teamwork: Work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results	• Use appropriate SI notation and fundamental and derived units • Work cooperatively with team members to measure and record body temperature