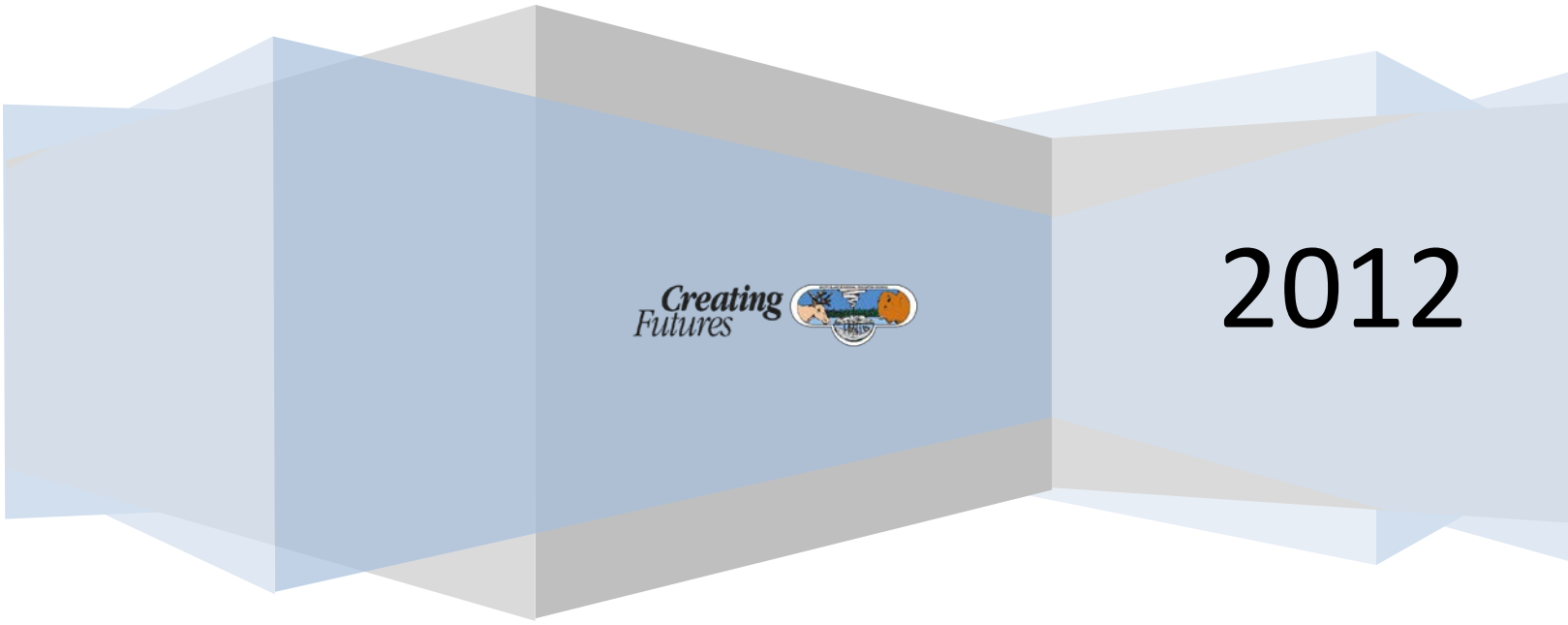
South Slave Divisional Education Council

Experiential Science 30

Curriculum Package

February 2012



Unit: Structural Geology (Emphasis: Science, Technology, Society and the Environment- 30hrs.)

Focusing Question: How do the forces of the Earth shape the crust and how do we study these processes?

Specific Outcomes	Achievement Indicators
It is expected that students will:	*The following set of indicators is used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
GENERAL OUTCOME: STUDENTS WILL INVESTIGATE THE THEORY OF PLATE TECTONICS AND THE MECHANISMS INVOLVED IN CRUSTAL PLATE MOVEMENT.	
Students will gain an understanding of the Theory of Plate Tectonics	• Investigating and describing the Theory of Plate Tectonics. • Identifying the evidence that supports the Theory of Plate Tectonics, including: o Location of volcanoes and earthquakes (Plotting the areas of major/current tectonic activity on a world map ("Ring of Fire"); Plotting the locations of tectonic activity in the Arctic (e.g. Liard River hot springs, Axle Heiberg Island geothermal vents) o Ocean floor spreading (Investigating current research that helps explain possible causes of crustal plate movement; Constructing models that demonstrate how convection circulation of molten material provides the driving force of plate tectonics) o Paleontological patterns in plant and animal distribution (Collecting evidence from the fossil record and or rock types that support the notion of crustal plate motion and continental drift.)
Students will gain an understanding of the mechanisms of plate tectonics	• Describing, illustrating and modelling, using block diagrams, the general characteristics of plate boundaries: • Divergent, Convergent – collision, subduction, Transform – sliding • Describing the origins and "life cycle" of magma and its correlation to volcanic activities resulting from: Rift eruptions (divergent plate boundaries, Subduction zone eruptions (convergent plate boundaries), Hot spots (intra-plate settings) • Describing and illustrating the geologic formations that occur at crustal plate boundaries and including: Island arcs/trenches (ocean-ocean boundary), Volcanic mountain ranges (ocean-continent boundary), Folded mountain ranges (continent-continent boundary) • Investigating the process of seafloor spreading by: Describing and illustrating the tectonic activity that takes place at these locations, Illustrating and constructing a paleomagnetic map of normal and reversed polarity in seafloor rock strata, Discussing and drawing conclusions about the evidence that supports the process of seafloor spreading
Students will gain an understanding of regional plate tectonics	• Plotting and modelling, using block models, to illustrate examples of landforms that exist in northern Canada resulting from magmatic activity including: Magma calderas, Uplifted Mountains (e.g. Nahanni Mountain Range) The formation of geothermal vents / hot springs (e.g. Liard River system)
GENERAL OUTCOME: STUDENTS WILL INVESTIGATE SEISMOLOGY AND THE MECHANISMS INVOLVED IN EARTH MOVEMENT	
Students will gain an understanding of seismology	• Defining and differentiating the terms: o Seismology o Seismograph o Seismogram • Explaining and describing the characteristics of inner and outer core, mantle and crust of the Earth including: o Density o Composition o Thickness o The Mohorovicic ("Moho") discontinuity

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It is expected that students will:	*The following set of indicators is used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
Students will gain an understanding of seismology (Continued)	• Explaining and demonstrating, using models, to illustrate the Elastic-Rebound Theory including (deformation vs. time graph): o Elastic deformation o Ductile deformation o Elastic limit o Failure o Fault o Epicentre o Focus.
Students will gain an understanding of earthquakes	• Illustrating, using block diagrams and models, the relationship between the focus of an earthquake, its epicenter and seismic wave fronts. • Explaining and illustrating, how the energy from earthquakes is transmitted through the Earth by seismic waves, including: o Longitudinal = P-waves o Transverse = S-waves o Surface = L-waves • Describing and illustrating the different modes of travel, travel times and types of motion associated with each type of seismic wave (P, S, and L-waves). • Constructing a cross sectional diagram of the Earth, to illustrate and explain how P-waves and S-waves move through the various internal layers and indicate those areas where the waves do not travel (shadow zones). • Consulting with Elders or other subject matter experts to understand the traditional explanations of earthquakes and related activities.
Students will gain an understanding of methods and technologies used to study earthquakes	• Consulting with Elders or other subject matter experts on traditional methods of earthquake prediction (animal behavior or past events). • Summarizing the historical use of the seismograph and its contribution to the understanding of the internal structures of the Earth. • Designing and constructing a working model of a seismograph (seismometer) to explore how the movement of seismic energy is measured and recorded. • Constructing an earthquake table to test and record (using the student-built seismograph), scale models under different seismic conditions. • Comparing and contrasting earthquake magnitude and intensity and the scales used to measure each. Include tables showing the expected results for each scale and present your findings to the class: o Magnitude - Richter Scale or Moment Magnitude Scale o Intensity – Modified Mercalli scale • Researching, plotting and explaining the importance of: o Seismic stations located in Canada o Seismic risk zones in Canada • Conducting a seismic risks analysis for your local area using: o Geographic location o Topography o Ground strength o Rock type o Proximity to faults o Design of buildings

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It is expected that students will:	*The following set of indicators is used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
Students will gain an understanding of methods and technologies used to study earthquakes (Continued)	• Investigating and explaining various contemporary methods of earthquake prediction including: o Dilatancy data, (strain accumulation) o Seismic gap o Changes in hydrostatic pressure in gas wells
GENERAL OUTCOME: STUDENTS WILL INVESTIGATE STRUCTURAL GEOLOGY AND THE STRUCTURES THAT RESULT FROM EARTH MOVEMENT	
Students will gain an understanding of structural geology	• Defining and illustrating, using clay, block models and graphs, the terms and geological processes of: o Deformation (Plastic (ductile), Brittle) o Force (Stress: Compressional, Tensional, and Shear) o Strain • Comparing and contrasting the three major structures resulting from brittle deformation: o Fractures o Faults o Joints • Conducting field or laboratory investigation to measure the strike and dip of a plain or rock surface and become familiar with the mapping symbols used on field maps. • Constructing block models to illustrate the various types of faults: o Dip-slip (Normal, Reverse, Thrust) o Strike-slip (Left lateral, Right lateral) o Transform faults • Explaining, using block models, the compressional, tensional, and shear forces that result in the three major types of faults.
Students will gain an understanding of structural landforms	• Recognizing and identifying, from maps, photographs, diagrams or models, examples of o Dome o Basin o Anticline o Syncline o Horst o Graben • Researching and developing a working definition of the term unconformity.
GENERAL OUTCOME: STUDENTS WILL INVESTIGATE THE FIELD SKILLS REQUIRED TO DOCUMENT EARTH STRUCTURES AND THE CAREERS AND OCCUPATIONS RELATED TO STRUCTURAL GEOLOGY AND SEISMOLOGY.	
Students will gain an understanding of the use of field mapping to gain geological information of a study area	• Researching previous field work to develop a historical profile • Conducting a field or laboratory investigation to collect: o Surface information from maps o Surface features from the field o Subsurface structures, from: (Diamond drill hole data, Cross-section data) • Creating 3D models to illustrate the interrelationships between surface (plan) maps, cross sections and the subsurface structures present. • Developing a geological profile of the area.
Students will gain an understanding of careers and occupations related to structural geology	• Researching and preparing a career and occupational profile related to structural geology for positions available in the NWT and Canada.

Unit: Introduction to limnology (Emphasis: Nature of Science- 35hrs.)

Focusing Question: How does the study of limnology allow us to monitor and assess a freshwater ecosystem?

Specific Outcomes	Achievement Indicators
It is expected that students will:	*The following set of indicators is used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
GENERAL OURCOME: STUDENTS WILL INVESTIGATE THE CHARACTERISTICS OF FRESHWATER ECOSYSTEMS AND CATCHMENTS.	
Students will gain an understanding of the physical and chemical characteristics of water and their importance to an aquatic system	• Investigating the unique density characteristics of water. • Investigating the properties of water that allow it to exist as a solid, liquid or gas. • Investigating the viscosity properties of water. • Investigating specific heat / heat capacity as a temperature buffer. • Investigating the absorption of radiant energy. • Investigating surface tension. • Investigating the solvent properties of water.
Students will gain an understanding of inland waters and catchments of northern Canada	• Investigating and plotting on a map the land area of the major catchment zones affecting northern Canada. • Determining the area of each catchment. • Identifying and labelling major lakes and rivers in each catchment. • Investigating and creating a geological overlay map of major rock and mineral types for each catchment area. • Listing key ions found in each rock and mineral type (indicators of pH) • Identifying and plotting key topographical features for each catchment area. • Determining the general resident time of water in each catchment
Students will gain an understanding of freshwater system morphology	• Describing and investigating the movement of water through a catchment basin: o Surface systems (Precipitation, topography and run off, Streams, lakes, wetlands, rivers to ocean) o Subsurface systems (Infiltration in soil: Permafrost, Discontinuous permafrost, Different soil types); Percolation rates, Groundwater (Surface, Unconfined aquifer, Confined aquifer) • Describing and illustrating the general morphological characteristics of a lake. • Describing and illustrating the general zones found in a typical lake. • Describing and illustrating the general morphological characteristics of a stream and river. • Describing and illustrating the general zones found in a typical stream and river. • Researching catchment resident time for a watershed, using a variety of methods. • Conducting a field investigation to map the general characteristics of a lake and stream / river study site using recognized protocols.
Students will gain an understanding of lentic ecosystems (still water)	• Describing the origins, formation, general physical characteristics, and structure of: o Glacial lakes o Coastal lakes o Tectonic lakes o Riverine lakes o Volcanic lakes o Karst Lakes • Drawing storyboards, to illustrate the formation and general life cycle of a local lake. • Indicating, using standard GIS protocols (satellite, aerial photographs, map (1:50,000)), the distribution of lake types in a 100 km radius of the local community.
Students will gain an understanding of the physical and chemical characteristics responsible for lake stratification, mixing and morphology	• Investigating the general features that lead to lake stratification such as: o Thermoclines (Describing lakes as heat sinks, Demonstrating representative seasonal vertical profiles, Illustrating and explaining the general concept of turnover)

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It is expected that students will:	*The following set of indicators is used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
Students will gain an understanding of the physical and chemical characteristics responsible for lake stratification, mixing and morphology (Continued)	o Chemoclines (Describing and explaining a chemocline, Illustrating and explaining the variations and strengths of chemoclines as a function of depth, Describing the Chemical composition of representative chemoclines, Plotting lakes of Canada which have unique chemoclines, Represent vertical profiles of Salt / ion concentration of representative lakes) o Wave structures and lake behaviour in relation to: (Fetch dynamics and the behaviour wave, Surface waves, their creation and propagation, Surface currents (convergent and divergent),Seiches and seasonal trends, Other Mechanisms responsible for the mixing of lakes) o Describing and illustrating the general characteristics of northern lakes including: (Meromictic, Amictic, Cold monomictic, Dimictic, Discontinuous cold polymictic, Cold polymictic) o Investigating the effects of climate change on aquatic systems including changes in: (Ice duration and thickness, Stratification and mixing, Light transmission, Surface, Subsurface, Heat transfer) • Describing and illustrating the relative nutrient status / productivity of representative lake types in Canada: o Oligotrophic o Mesotrophic o Eutrophic • Investigating and researching the typical nutrient and productivity levels to classify these as oligotrophic, mesotrophic or eutrophic lakes: o Meromictic o Amictic o Cold monomictic o Dimictic o Discontinuous cold polymictic o Cold polymictic
Students will gain an understanding of lotic ecosystems (moving water)	• Describing and illustrating the physical characteristics, structure and formation of: o Rivers and streams o Flood plains • Conducting a field study, in an established area, to plot the physical features and general topography of a lotic system. • Comparing and contrasting data, from the established study site, to document changes that have occurred and use this data to predict future trends. • Describing and demonstrating the processes of nutrient and sediment transport through a lotic system. • Comparing and contrasting the relative productivity of rivers of varying size, velocity and grade.
Students will gain an understanding of northern wetlands	• Conducting a field study to describe and illustrate: o Topographical features o Physical characteristics (biotic / abiotic) • Investigating and describing the form and function of wetlands in an ecosystem including, bogs, fens, marshes, and swamps. • Research and describe the general nutrient status / productivity of a wetland above and below the tree line.

Unit: Introduction to limnology (Emphasis: Nature of Science- 35hrs.)

Focusing Question: How does the study of limnology allow us to monitor and assess a freshwater ecosystem?

Specific Outcomes	Achievement Indicators
It is expected that students will:	*The following set of indicators is used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
Students will gain an understanding of lotic and lentic biogeochemical cycles	• Conducting a field study to test study plot water samples for: o pH o Alkalinity o Carbon dioxide o Dissolved oxygen o Hardness (buffering capacity) o Nitrates o Phosphates o Turbidity • Creating a model or pictorial representation to represent the role of organic and inorganic carbon in a freshwater system.
Students will gain an understanding of lotic and lentic biogeochemical cycles (Continued)	• Investigating using case studies, to explain the connection between the carbon cycle and global warming. • Describing and representing oxygen levels in terms of: o Solubility vs. temperature o Dissolved oxygen content in vertical profile o Annual oxygen cycles and productivity • Describing and representing phosphorous levels in terms of: o Organic and inorganic transformation o Annual cyclic concentrations o A limiting factor and its effect on annual productivity. • Describing and representing nitrogen levels in terms of: o Transformation processes o Annual cycles and concentrations o A limiting factor and its effects on productivity o A case study on the impact of human induced changes on regional and global nitrogen cycles. • Describing and representing iron, manganese and sulphur in terms of: o Annual cycles and concentrations o A limiting factor and productivity
Students will gain an understanding of the significance of light in lotic and lentic systems	• Describing and using experimental models to demonstrate qualitative variations rates of absorption and transmission of light as they relate to turbidity and depth of the water column. • Conducting field investigations or laboratory experiments to model light penetration in a water column by: o Using a Secchi disc to determine the depth of light penetration. o Investigating seasonal variations in light concentrations. o Investigating the effect of ice depth and snow cover on the transmission of light o Interpreting representative quantitative data to explain the seasonal variation in primary productivity o Describing the annual light budget at the equator, mid-latitude and at high latitudes to explain primary productivity cycles.
Students will gain an understanding of the process of eutrophication	• Describing and illustrating the processes of aging of lakes, ponds and, waterways • Investigating the acceleration of eutrophication due to climate change. • Investigating through a case study, the effects of human influences on the acceleration of eutrophication.

Unit: Freshwater Ecology (Emphasis: Science, Technology, Society and the Environment- 40hrs.)

Focusing Question: How can the study of freshwater ecology broaden our understanding of this environment and ensure a sustainable future?

Specific Outcomes	Achievement Indicators
It is expected that students will:	*The following set of indicators is used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
Students will gain an understanding of careers and occupations related to limnology	• Researching and preparing a career and occupational profile related to limnology for positions available in the NWT and Canada.
GENERAL OUTCOME: STUDENTS WILL INVESTIGATE THE FUNDAMENTALS OF FRESHWATER ECOLOGY.	
Students will gain an understanding of "What is freshwater ecology"?	• Explaining the basic principles of freshwater ecology. • Conducting field investigations to apply the basic approaches to studying freshwater ecology.
Students will gain an understanding of aquatic flora and fauna by conducting a series of field studies to investigate and collect data from a study plot	• Phytoplankton to: o Apply various recognized sampling techniques to collect samples o Conduct laboratory exercises to identify types of plankton o Determine the relative population of species in the study plot o Catalogue the diversity and population density of species to acquire base line / long term data. • Zooplankton to: o Apply various recognized sampling techniques to collect samples o Conduct laboratory exercises to identify types of plankton o Determine the relative population of species in the study plot o Catalogue the diversity and population density of species to acquire base line / long term data. • Bacteria to: o Identify the presence of bacteria using various sampling techniques. • Benthic plants to: o Apply various recognized sampling techniques to document population data and catalogue samples o Conduct field and laboratory exercises to identify types of benthic plants and their distribution o Determine the relative population of species in the study plot o Catalogue the diversity and population density of species to acquire base line / long term data. • Zoobenthos to: o Apply various recognized sampling techniques to document population data and catalogue samples o Conduct field and laboratory exercises to identify types of zoobenthos and their distribution o Determine the relative population of species in the study plot o Catalogue the diversity and population density of species to acquire base line / long term data. • Aquatic insects to: o Apply various recognized sampling techniques to document population data and catalogue samples o Conduct field and laboratory exercises to identify types of aquatic insects and their distribution o

Unit: Freshwater Ecology (Emphasis: Science, Technology, Society and the Environment- 40hrs.)

Focusing Question: How can the study of freshwater ecology broaden our understanding of this environment and ensure a sustainable future?

Specific Outcomes	Achievement Indicators
It is expected that students will:	*The following set of indicators is used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
Students will gain an understanding of aquatic flora and fauna by conducting a series of field studies to investigate and collect data from a study plot (Continued)	o Estimate the relative population of species in the study plot o Catalogue the diversity and population density of species to acquire base line / long term data. • Fish and water birds to: o Apply various recognized sampling techniques to document population data and catalogue samples o Conduct field and laboratory exercises to identify types of fish and aquatic birds and their distribution (seasonal) o Estimate the relative population of species in the study plot o Catalogue the diversity and population density of species to acquire base line / long term data.
Students will gain an understanding of long term ecological studies	• Documenting field and laboratory using recognized protocols. • Collating and summarize field and laboratory data from the study plot. • Analyse data over a number of years to identify any potential trends that may exist in the study plot. • Present their findings to a group, using a variety of media.
GENERAL LEARNING OUTCOMES: STUDENTS WILL INVESTIGATE POPULATION ECOLOGY.	
Students will gain an understanding of population ecology	• Investigating and identifying common limiting factors in a freshwater aquatic system. • Explaining and describing population growth and regulation including: o Limiting factors o Predator – prey relationships o Parasitism o Inter- intra species competition o Human and non-human environmental influences.
Students will gain an understanding of species-species interactions	• Identifying the species of plants and animals found in their study plot. • Constructing a model to illustrate a food web using all of the species found / identified in the study plot. • Discussing and evaluating the ecological stability of the study area.
Students will gain an understanding of population distribution	• Investigating the geographical distribution of species found in their study plot or geographical region. • Plotting the distribution of these species on a series of maps to construct overlays. • Investigating the seasonal distribution of migratory species in the region.
Students will gain an understanding of fish ecology	• Identifying the species of fish found in the region. • Plotting the distribution and range of fishes found locally. • Describing and illustrating the specific habitat requirement of fish species found locally.
Students will gain an understanding of careers and occupations related to freshwater ecology	• Researching and preparing a career and occupational profile related to freshwater ecology for positions available in the NWT and across Canada.

Unit: Freshwater Resource Management (Emphasis: Science, Technology, Society and the Environment- 20hrs.)

Focusing Question: How can freshwater resources be managed to ensure a sustainable future for generations to come?

Specific Outcomes	Achievement Indicators
It is expected that students will:	*The following set of indicators is used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
GENERAL OUTCOME: STUDENTS WILL INVESTIGATE THE PHILOSOPHY OF FRESHWATER RESOURCE MANAGEMENT.	
Students will gain an understanding of water management	• Explain the role of government agencies in the monitoring and protection of waterways. • Investigating the processes for monitoring water levels and analysing water samples.
Students will gain an understanding of fisheries and fisheries management	• Explaining the role of government agencies in the regulation and monitoring of fish stocks. • Investigating the various techniques used to assess and monitor a fish stock. • Using data from a case study, with a given scenario, to assess a fish stock over a given period of time. • Interpreting case study data to predict the biomass of indicator species in a specific region.
GENERAL OUTCOME: STUDENTS WILL INVESTIGATE GOVERNANCE AND ETHICS RELATING TO FRESHWATER RESOURCES.	
Students will understand the foundations of a sustainable future, economics and ethics	• Investigating the renewable resources that can be managed by humans including: o Describing and illustrating how the freshwater resources of the region (local watershed) are used and managed by people. o Developing a management program that would ensure that freshwater is available for future generations. o Describing and illustrating the origins, distribution and consumption rates of the municipal water supply. o Using municipal populations projection / data to estimate the future water needs of the community in 10, 20, 50 years from now. o Describing and explaining water conservation practices regionally and locally. o Describing and plotting the location of dam sites and the affected watershed. o Researching and presenting findings, to a mock board of inquiry, on the impact of dam construction and their effect on the environment and on traditional lifestyles / subsistence living. o Describing the local management practices for sport and commercial fisheries. o Investigating and evaluating the economic, ethical and long-term implications of various water management boards' decisions.
Students will gain an understanding of non-renewable resources extraction and the role of freshwater	• Investigating the environmental impact processes required for mineral and petroleum resource development / operations / transportation. • Describing the roles and responsibilities of the Water Board.
GENERAL OUTCOME: STUDENTS WILL INVESTIGATE THE ISSUES AND IMPACTS OF CONTAMINANTS ON THE FRESHWATER SYSTEM AND THE ETHICS OF FRESHWATER RESOURCE MANAGEMENT.	
Students will gain an understanding of contaminants in freshwater	• Investigating natural contaminants and their sources. • Illustrating and describing the fate of natural contaminants in solution and as they precipitate into the sediment. • Investigating the sources of man-made contaminants. • Illustrating and describing the effects of bioaccumulation of man-made contaminants in an aquatic environment. • Researching and presenting, the historical perspective of the effects / concerns of bioaccumulation of toxin(s) in your region.

Unit: Freshwater Resource Management (Emphasis: Science, Technology, Society and the Environment- 20hrs.)

Focusing Question: How can freshwater resources be managed to ensure a sustainable future for generations to come?

Specific Outcomes	Achievement Indicators
It is expected that students will:	*The following set of indicators is used to assess student achievement for each related specific learning outcome. Students who have fully met the specific learning outcomes are able to:*
Students will gain an understanding of contaminants in freshwater (Continued)	• Discussing the pros and cons of industrial development in an environmentally sensitive watershed including: o Possible toxins o Biodegradation of toxins o Bioaccumulation o Environmental health issues o Aquatic management concerns o Long and short term economic benefits to the community.
Students will gain an understanding of ethical issues concerning freshwater resources	• Discussing the need and ways of balancing one's cultural values and to ensuring a sustainable future • Researching and discussing, with elders or other subject matter experts, the historical values and traditions used by • Aboriginal people of harvesting the freshwater ecosystems to ensure sustainability. • Comparing and contrasting the traditional values and practices of harvesting fish, and the cost benefits to the ecosystems and economy of ecotourism vs. industrial harvesting of a fish stock. • Preparing a defence to support the advantages or disadvantages of ecotourism to the local economy
Students will gain an understanding of careers and occupations related to freshwater resource management	• Researching and preparing a career and occupational profile related to freshwater resource management for positions