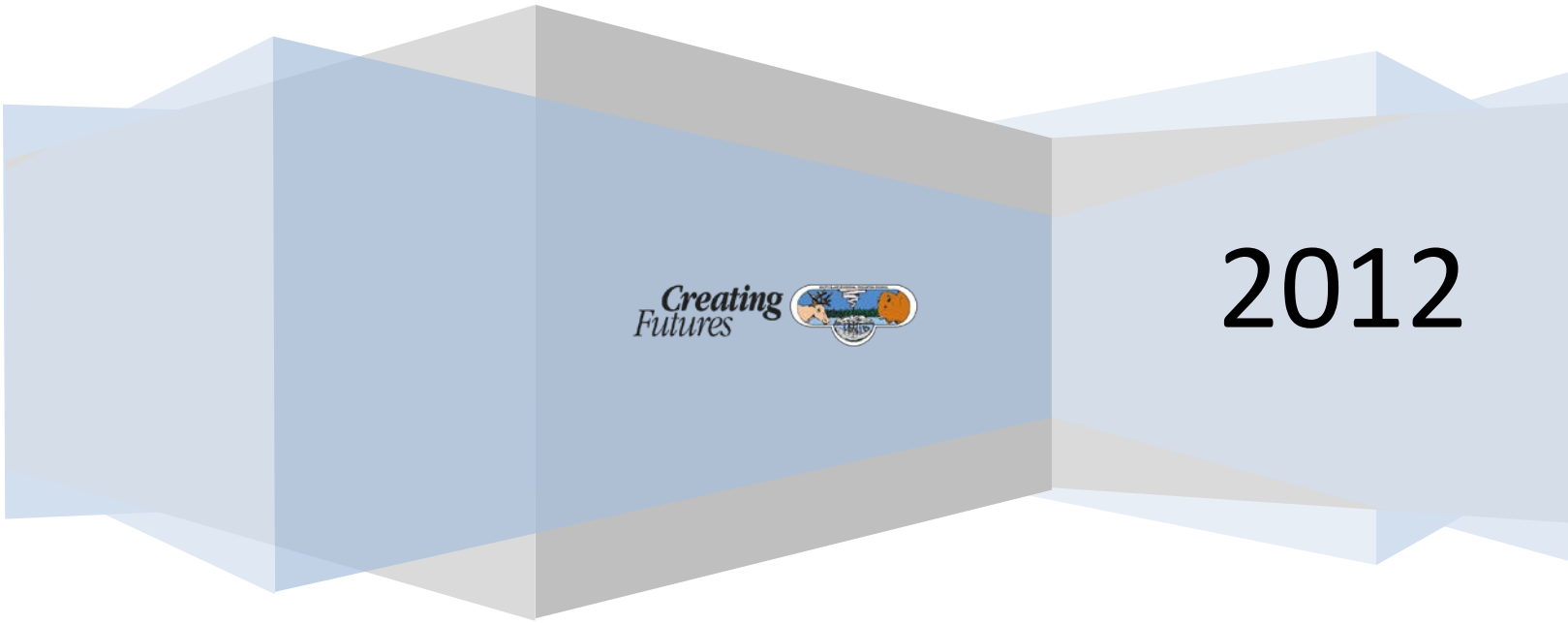
South Slave Divisional Education Council

Experiential Science 20

Curriculum Package

February 2012



Unit: Introduction to Oceanography (Emphasis: Nature of Science- 30 hrs.)

Focusing Question: What are the chemical, geomorphological and physical characteristics that make the oceans a dynamic environment?

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 FORMATION OF WATER ON EARTH AND THE BASIC PROPERTIES AND CHEMISTRY OF SALT WATER.	
Students will gain an understanding of the processes resulting in the formation of water on Earth	• Researching and summarizing the various theories on the origin of the oceans and sources of ocean water (including the sources and processes that control the amount of salt in the oceans).
Students will gain an understanding of the basic properties of fresh and saltwater	• Comparing and contrasting the characteristics of fresh and salt water in terms of salinity, density, cohesion and adhesion. • Investigating and listing relative concentrations of common ionic and molecular compounds found in saltwater in descending order (sodium chloride, calcium chloride and their respective ions) and mapping these common ions back to the periodic table indicating their ionic state and relationships. • Investigating and examining the interrelation of density vs. salinity vs. temperature of saltwater. • Analyzing the salinity of water samples taken from various locations along a freshwater to saltwater traverse (or from stock solutions) to establish a salinity profile (e.g. lake to river to ocean), using accepted testing protocols and procedures. • Determining the salinity of an unknown sample and make conjecture about its source based on a known salinity profile.
Students will gain an understanding of saltwater chemistry	• Conducting basic experiments from a water column to determine the qualitative and quantitative values and constructing representative profiles of: o Alkalinity o Salinity o Ammonia nitrate o Carbon dioxide o Dissolved oxygen o Nitrate nitrogen o pH o Temperature
Students will gain an understanding of the role of dissolved solids and turbidity in an aquatic environment	• Defining the term “dissolved solids” to describe and explain the role of dissolved solids in marine ecology. • Sampling and analysing the amount of dissolved solids in various saltwater samples from local sources or stock solutions using accepted procedures and protocols. • Defining the term “turbidity” and investigate the potential processes responsible for turbidity at a particular site (cursive/recursive data). • Conducting simple experiments in the field or laboratory, using a Secchi disk or light, to determine the relative turbidity of a water column. • Investigating the rate of sediment deposition using data collected from an estuary or coastal area (or simulation) to illustrate varying degrees of turbidity as it occurs seasonally.

Unit: Introduction to Oceanography (Emphasis: Nature of Science- 30 hrs.)
Focusing Question: What are the chemical, geomorphological and physical characteristics that make the oceans a dynamic environment?

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 heat transfer within and between the hydrosphere and the atmosphere	• Describing, explaining and drawing a representation of the water (hydrological) cycle, on a local scale (including a description of heat transfer within the cycle). • Conducting and modelling simple experiments, which demonstrate the water cycle in a cold weather ocean. • Performing laboratory experiments to demonstrate the heat capacity of fresh and salt water and its role as a heat sink. • Investigating, describing and illustrating the process of heat transfer between the atmosphere and hydrosphere, within an ocean system, and report on how this impacts on the traditional hunting and gathering practices of Aboriginal peoples.
GENERAL OUTCOME: STUDENTS WILL INVESTIGATE THE MARINE CURRENTS AND OCEAN DYNAMICS.	
Students will gain an understanding of water masses and currents in ocean systems	• Describing (in general terms) and plotting on a global map: o Water masses o Ocean currents. • Designing a simulation, using an aquarium, to demonstrate current formation and patterns. • Explaining and illustrating using block diagrams, the conveyor belt system (including the importance of conveyor belt systems to ecological and meteorological stability). • Investigating and mapping regional water currents in the Arctic Ocean and adjacent bodies of water to gain an understanding of the conveyor belt system. • Discussing with local Elders or other subject matter experts, local currents, their effect on traditional activities throughout the year and their predictability
Students will gain an understanding of mixing within surface and subsurface marine currents	• Investigating and explaining the processes which generate or suppress waves in the open ocean such as: o Fetch o Wind speed o Wind speed duration o Depth of water column o Geographical features o Thickness of ice • Constructing and using a wave tank to model, compare and contrast, the properties of waves in: o Open conditions o Broken sea ice conditions o Interface conditions with solid ice • Conducting a simple experiment to demonstrate the circular movement of water due to the Coriolis Effect including the determination of the intensity of circular water movement and how this would apply to oceans on a global scale. • Investigating, explaining and modelling the processes and importance of an Echman Spiral to the mixing of the vertical water column. • Investigating and describing how technology can be used to study ocean currents (satellite images, false / real colour images and Global Ocean Observing Systems).

Unit: Introduction to Oceanography (Emphasis: Nature of Science- 30 hrs.)
Focusing Question: What are the chemical, geomorphological and physical characteristics that make the oceans a dynamic environment?

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 Arctic Ocean dynamics	• Presenting meteorological data from a given time frame that illustrates seasonal energy input trends (including modeling how the tilt of the Earth qualitatively affects the energy input seasonally). • Illustrating and reporting on the potential impact of changes in energy input into a marine system and the effect on the dynamics of the system, using software simulations. (e.g. SIMEARTH). • Describing and demonstrating the albedo effect using simple field or laboratory models to illustrate the qualitative reflective index and heat absorption capacity of representative surfaces, such as: barren land, open water, ice / snow covered surfaces. • Consulting with community Elders or other subject matter experts, to develop a presentation on the tools and strategies used for safe ocean travel throughout the seasons. • Plotting and describing, on polar projections, the major types and distribution of sea ice found in the Arctic Ocean, such as: Single year / annual ice, Multi-year ice, Ice flows Ice bergs • Investigating and documenting Arctic ocean ice growth data / patterns over the past fifty years for general trends including constructing simple models to demonstrate the trends and potential future outcomes of ice formation. • Researching and presenting a case study on the potential global impact and importance of polar ice to global oceans, the biosphere, and the historical and cultural importance of ice for northern Aboriginal peoples (including consultation with Elders or other subject matter experts, to determine how variations in ice patterns affect community life in the Arctic).
GENERAL OUTCOME: STUDENTS WILL INVESTIGATE MARINE GEOMORPHOLOGY AND THE EFFECT OF TIDES ON THE MARINE SYSTEM.	
Students will gain an understanding of seabed geomorphology	• Describing, explaining, and modeling representative seabed geomorphological features such as: Seafloor, Continental shelf / shelf, Canyons, Abyssal plains, Basins, Slope, Seamount • Identifying and locating general geomorphological features using hydrological maps of the Arctic Ocean and its approaches (including an investigation of the various technologies used to study seafloor morphology).
Students will gain an understanding of how tides work and their effect on a local environment	• Illustrating, through simple models: How the relative gravitational forces of the Moon and the Sun cause daily, monthly, and seasonal tidal bulges in oceans; How geography accentuates tidal forces to create extreme tides (including specific areas in Canada, such as Iqaluit, NU and the Bay of Fundy, NS). • Interpreting and applying tide charts to determine the tidal cycle and range of tides over a month long period for a given location. • Interviewing community Elders or other subject matter experts, to develop a presentation on the significance of tidal fluctuation throughout the seasons to Aboriginal culture, including the seasonal cycles.
Students will gain an understanding of the careers and occupations related to oceanography	• Researching and preparing a career and occupational profile related to oceanography in the NWT and Canada

Unit: Ocean Ecology (Emphasis: Nature of Science- 35hrs.)
Focusing Question: How do organisms interact with each other, their ecological community and humans to survive?

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 SPECIES RELATIONSHIPS, NUTRIENT CYCLES AND REPRESENTATIVE FOOD WEBS	
Students will gain an understanding of basic Arctic marine ecology	• Reviewing the working definitions of and the relationships between: o Species o Population o Community o Ecosystem o Biodiversity • Describing, explaining and illustrating general biological energy transfer processes in the Arctic marine environment by modelling representative Arctic marine food webs (including how biodiversity contributes to ecosystem stability). • Illustrating and explaining the general cycling of matter, biotic and abiotic, in the Arctic marine environment including: o Carbon o Oxygen o Nitrogen o Silicates
Students will gain an understanding of nutrient and energy flow in a local ecosystem	• Investigating and describing the nutrient cycle of the local ecosystem by illustrating the flow of: o Carbon o Nitrogen o Oxygen • Describing and illustrating representative local food chains and a food web of the Arctic ecosystem including sources of food traditionally used by Aboriginal peoples.
GENERAL OUTCOME: STUDENTS WILL INVESTIGATE THE ROLE OF REPRESENTATIVE MARINE SPECIES AND THE PROTOCOLS FOR COLLECTING ECOLOGICAL DATA.	
Students will gain an understanding of the diversity of the marine species in the ecosystem	• Investigating the role of taxonomy and its application to the study of ecology by: o Investigating the Lamarckian classification structure o Listing and sorting representative local species when conducting field studies o Collecting and cataloguing representative samples of Arctic marine flora and fauna using recognized protocols to create a local taxonomic key, species check list and collection o Sketch representative micro and macro marine species to develop a pictorial taxonomic key. • Investigating the role of micro-organisms in an Arctic marine system by: o Describing and illustrating the general roles of bacteria and the key indicators for the presence of bacteria. o Describing and illustrating the ecological roles of: (Phytoplankton, Zooplankton; Life-cycle trends of phytoplankton and zooplankton) o Explaining the role of ice algae and spring blooms to the overall productivity of the system. • Investigating the role of intertidal zones by o Conducting a field study, with transects, to: (Identify and map the supralittoral to sub literal zone, including zones of freezing; Collect, catalogue and preserve samples and determine the relative abundance and zonal profiles of flora and fauna using recognized protocols)

Unit: Ocean Ecology (Emphasis: Nature of Science- 35hrs.)
Focusing Question: How do organisms interact with each other, their ecological community and humans to survive?

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 the diversity of the marine species in the ecosystem (Continued from above)	o Conducting a simulated field study of representative intertidal profiles of various slopes, where students predict the location and relative abundance of representative flora and fauna based on previous profiles o Comparing the tidal ranges experienced by different northern communities and discussing how this would affect traditional activities such as harvesting molluscs, hunting or travelling on ice. o Comparing and contrasting the adaptive features of representative intertidal flora and fauna, which allow them to survive in the Arctic. o Developing a basic food web diagram based on their intertidal study. • Investigating the role of representative benthic (ocean bottom) and pelagic (open ocean) invertebrates by: o Determining the key morphological characteristics and typical life cycles of representative invertebrates such as: molluscs, bivalves, gastropods, crustaceans and echinoderms o Developing a food web highlighting representative invertebrates and their relationship to other species o Consulting with Elders or other subject matter experts to determine how invertebrates are used by humans and their importance to local culture. • Investigating the role of marine fishes by: o Describing and explaining the key characteristics and habitat preferences of major representative species in the Arctic Ocean and adjacent waters including anadromous species o Investigating and plotting the key migration routes of representative fishes in northern Canada o Comparing and contrasting the life cycle of anadromous and marine fishes o Illustrating a food web highlighting representative fishes and their relationship to other species o Researching and discussing with Elders or other subject matter experts, the importance of various fish species to local communities, the predictability of fish behaviour, and harvesting techniques o Discussing in a "Town Hall" forum, the importance of fish to Arctic society from commercial, non-commercial and traditional points of view including the ecological practices used to ensure sustainability for future generations (using case studies of representative fish populations to evaluate past, present and future fish stocks in northern waters). • Investigating the role of marine mammals by: o Identifying, describing and plotting the distribution of the key marine mammal species found in Arctic water and its approaches o Describing and explaining the key behavioural characteristics and habitat preferences of major representative species in the Arctic Ocean and adjacent waters (including illustrating migration routes and seasonal patterns of key marine mammals) o Consulting with Elders or other subject matter experts to determine how marine mammal behaviour is used to ensure survival of the community (e.g. migration routes, feeding areas, seasonal patterns)

Unit: Ocean Ecology (Emphasis: Nature of Science- 35hrs.)
Focusing Question: How do organisms interact with each other, their ecological community and humans to survive?

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 the diversity of the marine species in the ecosystem (Continued from above)	o Describing and explaining the key adaptive morphological features for survival of: (Whales, Seal, Walrus, Polar bears) o Describing and discussing the behavioural and life cycle events of representative Arctic marine mammals and the necessity of a stable and predictable ecosystem o Illustrating a food web highlighting representative fishes and their relationship to other species. • Investigating the role of marine seabirds by: o Identifying, describing and plotting the distribution of key marine seabird species found in Arctic water and those found locally (including the location of key breeding colonies in and around the Arctic Ocean) o Describing and explaining (Key behavioural characteristics, habitat preferences and migratory routes of representative seabird species in the Arctic Ocean and adjacent waters; Key adaptive morphological features for survival of representative seabirds) o Conducting a real or simulated bird survey in a particular region using recognized protocols. o Investigating, describing and illustrating the primary life cycle events of representative Arctic marine seabirds and the necessity of a stable and predictable ecosystem (food, open water, etc.) o Illustrating a food web highlighting representative seabirds and their relationship to other species.
GENERAL OUTCOME: STUDENTS WILL INVESTIGATE THE IMPACT OF HUMANS AND INDUSTRY ON THE ARCTIC MARINE SYSTEM AND THE CAREERS AND OCCUPATIONS RELATED TO MARIN RESOURCE MANAGEMENT.	
Students will gain an understanding of the impact of contaminants on Arctic ecosystems	• Defining the term “bioaccumulation” to describe, explain and illustrate the general processes and mechanisms of bioaccumulation in the Arctic marine ecosystem, including organic chlorides and heavy metals. • Researching and presenting a case study on the effects of representative toxins on the biological “health” of marine species, the level of toxins in traditional foods, and the impact of toxins on the health of humans in northern Canada. E.g. NWMB Inuit Bowhead Knowledge study. • Developing a model, which demonstrates the bioaccumulation process and the migration of toxins through the marine environment and potential transference to humans (including an investigation of the known sources and pathways of contaminants in areas of the Arctic). • Presenting a research project on a contaminated site to: o Investigate and describe the various reclamation and remediation processes for cleaning up contaminants in a specific area o Explain the past and present historical use of the site being studied o Develop a reclamation plan in accordance with Territorial and Federal environmental regulations o Develop a before and after model of the reclaimed site o Present a “Green Plan” for the site reclamation in a “mock” public forum.
Students will gain an understanding of the careers and occupations related to marine habitats and resource governance and management	• Researching and preparing a career and occupational profile related to the marine resources in the NWT and across Canada.

Unit: Habitats, Population Dynamics and Management (Emphasis: Science, Technology, Society and the Environment- 40hrs.)

Focusing Question: How do ecological studies of habitats, populations and resource management 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:*
(A) GENERAL OUTCOME: STUDENTS WILL INVESTIGATE MARINE HABITATS AND GAIN AN UNDERSTANDING OF THE MECHANISMS THAT SUPPORT THE PLANTS AND ANIMALS LIVING IN IT.	
HABITAT: OPEN OCEAN Students will gain an understanding of the open ocean habitat	• Describing the general characteristics of an open ocean. • Investigating the relationship between the geomorphological features of the open ocean seafloor and the distribution of species found in these areas. • Developing a species profile and catalogue of representative plankton, vertebrates (mammals, fishes, birds) and invertebrates (free swimming and benthic) that live in an open ocean habitat including: o Representative species life history o Basic mechanisms for survival and reproductive behaviour that allow pelagic (vertebrates and invertebrates) organisms to survive throughout the seasons. • Researching and plotting areas of high productivity in open oceans based on biological (species diversity / season migratory uses) and or geographical indicators, such as: upwellings, polynyas, current patterns, and ice-free zones. • Comparing and contrasting the seasonal productivity of an open ocean in the Arctic with a warm water ocean (e.g. Pacific or Indian Ocean) including the technology used to study this habitat. • Illustrating representative food chains and a food web of pelagic and benthic species including sources of food traditionally used by Aboriginal peoples. • Investigating and discussing with community Elders or other subject matter experts, to document: o How open oceans have changed over time o How changing ice conditions and microclimates can impact the biological diversity of an ecological community and affect the traditional Aboriginal way of life (consider: seal breeding grounds, polar bear migration, establishment of polynyas).
Students will gain an understanding of open ocean population dynamics	• Explaining the role of contributing factors which control a population including: o Natality o Immigration o Mortality o Emigration o Survivorship o Age distribution • Investigating, and discussing with community Elders or other subject matter experts the general population trends representative species over time. • Investigating and modelling methodologies and techniques for determining the natality, immigration, mortality, emigration, survivorship and age distribution of various representative population. • Researching the environmental impact of human activities on the ecology and population dynamics of representative open ocean species (e.g. garbage, pollution, year round use of sea-lanes). • Comparing and contrasting the risks and benefits to society and the environment of applying scientific knowledge and technology to increase human activities in Arctic water. E.g. larger ships with icebreaking capacity, use of the NW passage, increased deep-sea resource exploration.

Unit: Habitats, Population Dynamics and Management (Emphasis: Science, Technology, Society and the Environment- 40hrs.)

Focusing Question: How do ecological studies of habitats, populations and resource management 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 open ocean population dynamics (CONTINUED)	• Discussing, using a mock "Town Hall" forum, the pros and cons of a commercial activity in Arctic waters and the needs for a sustainable economy and ecosystem. Include an evaluation (comparing and contrasting) of the historical and contemporary harvesting practices of open ocean species.
HABITAT: MARINE COASTAL AREAS Students will gain an understanding of marine coastal areas	• Describing the general characteristics of a coastal habitat. • Conducting research and field studies to: o Describe, map or model the geomorphological features of the coast, including transition zones o Create a species profile and catalogue of plants and animals that live or use this habitat o Discuss how major coastal features affect marine plant and animal distribution o Discuss with Elders or other subject matter experts, how and why the coastal area(s) have changed over time. • Explaining, describing and illustrating (creating simple models) o The dynamic effects of erosion and deposition on coastal areas due to wave action, ice movement, ice growth, and permafrost melting on a seasonal and long-term basic o The use of modern technology to study and assess Arctic coastal regions o How changing coastlines can impact entire communities and their traditional way of life. E.g. Tuktoyuktuk and Paulatuk coastal erosion rates, Holman Island. • Researching and discussing with Elders or other subject matter experts, how local coastal areas are used by Aboriginal people. E.g. food sources, materials, ice formation, seasonal traditional sites. Connect this to a representative food chain and food web of a typical coastal area.
Students will gain an understanding of coastal population dynamics	• Investigating, and discussing with community Elders or other subject matter experts the general population trends of representative species over time. • Investigating and modelling methodologies and techniques for determining the natality, immigration, mortality, emigration, survivorship and age distribution of various representative populations. • Evaluating, using a mock "Town Hall" forum or public hearing, the risks and benefits of coastal alteration (pollution, building retaining walls, dredging, sewage treatment facilities, large-scale housing developments) to the ecology of the habitat, population shifts and the traditional activities of the coastal peoples.
HABITAT: ESTUARIES Students will gain an understanding of estuaries	• Describing the general characteristics of an estuary habitat • Researching and or conducting field studies of a representative estuary to: o Describe and model the geomorphological features of a typical estuary, the adjacent transition landforms, and its annual cycles o Create a species profile and catalogue of plants and animals that live or use this habitat. o Describe, in a variety of ways, a representative food web of an estuary ecosystem including sources of traditional food and resources used by Aboriginal peoples. o Investigate an estuaries' subsoil profile to gain information on the biological and geological history of the area.

Unit: Habitats, Population Dynamics and Management (Emphasis: Science, Technology, Society and the Environment- 40hrs.)

Focusing Question: How do ecological studies of habitats, populations and resource management 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:*
HABITAT: ESTUARIES Students will gain an understanding of estuaries (Continued)	• Discussing the productivity of an estuary and its biological importance, including an explanation of the biological and geological role of estuaries. • Researching and discussing with Elders or other subject matter experts, to understand: o How and why the local estuarine environment has changed over time o How this has impacted local traditional activities o The locations of estuaries (plotted on a regional map) o Why these ecosystems warrant special protection o How estuaries are used by Aboriginal peoples (e.g. food, materials, seasonal traditional sites) • Investigating the alteration of an estuary by: o Reviewing case studies to investigate how alteration can impact entire biological communities and affect traditional ways of life o Conducting simulations of estuary growth and change using scale models • Describing how technology and historical data are used to monitor changes.
Students will gain an understanding of estruine population dynamics	• Investigating, and discussing with community Elders or other subject matter experts the general population trends of a representative species over time. • Investigating and modelling methodologies and techniques for determining the natality, immigration, mortality, emigration, survivorship and age distribution of various representative populations. • Investigating and modelling the potential environmental impact of human activities (garbage, pollution, encroachment and development resulting in the altering of cycles including water flow) on the ecology, population dynamics and traditional activities of peoples who depend on an estuary. E.g. draining, dredging, encroachment, hydro dams construction, roads. Include the presentation of evidence for or against the alteration (dams, climate change, altering flood cycles) of an estuary ecosystem.
HABITAT: FJORDS Students will gain an understanding of fjord ecology	• Describing the general characteristics of a fjord habitat • Researching and or conducting field studies of a representative northern fjord to: o Describe, record and model the geomorphological features of a typical fjord and the adjacent transition landforms. o Create a species profile and catalogue of plants and animals that live or use this habitat; o Describe the primary features of a fjord and how these features affect plant and animal distribution o Discuss with Elders or other subject matter experts, how fjords are used for traditional activities and the significance of this ecozone; o Plot fjord distribution on a map of the Canadian Arctic o Describe the unique flow of nutrients through the fjord ecosystem including a representative food web describing sources of food and resources traditionally used by Aboriginal peoples o Conduct simulations of a fjord environment, using scale models to determine the rate of water exchange and the behaviour of waves.

Unit: Habitats, Population Dynamics and Management (Emphasis: Science, Technology, Society and the Environment- 40hrs.)

Focusing Question: How do ecological studies of habitats, populations and resource management 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 population dynamics	• Investigating, and discussing with community Elders or other subject matter experts the general population trends of representative species over time. • Investigating and modelling methodologies and techniques for determining the natality, immigration, mortality, emigration, survivorship and age distribution of various representative populations. • Researching, using a variety of sources, the environmental impact of oil spills if one were to occur in a fjord or sound. E.g. Case study of the Exxon Valdez disaster. • Investigating how industrial effluent can have long-term ecological implications for a fjord ecosystem. E.g. Tailings pond collapse at the Nanasivik mine site.
HABITAT: POLYNYAS Students will gain an understanding of polynyas by	• Describing the general characteristics of a polynya habitat • Researching, investigating and modelling a representative polynya to: o Describe the dynamic effects responsible for creating a polynyas o Identify and predict (using bathymetric charts) potential areas where upwellings might occur o Plot the areas where polynyas occur in the Canadian Arctic and investigate why these phenomena exist in particular Areas o Compare local knowledge and or other sources of information, to predict the occurrence of polynyas o Demonstrate how the strength of a current or upwelling can dramatically affect the size and predictability of a Polynya o Create a species profile and catalogue the organisms that live or use this habitat throughout the year o Describing and illustrating representative food chains and a food web in a polynya including sources of food traditionally used by Aboriginal peoples and the annual productivity of a polynyas o Discuss the unique features of this system and how it supports the survival of various marine organisms. o Discuss, evaluate and defend why polynyas are unique and warrant special protection o Compare and contrast the productivity and species diversity of a polynya to an open ocean throughout the seasons • Researching and discussing with Elders or other subject matter experts, the predictability of a polynya and how this impacts local traditional activities. • Researching and conducting a laboratory / field studies to: o Discuss with Elders or other subject matter experts, how polynyas are used to ensure the survival of Aboriginal peoples (e.g. food, materials, seasonal traditional sites) o Investigate how increased human activities in a polynya could impact on the entire biological community and affect the traditional way of life o Investigate how technology and historical data are used to monitor the activity of a polynya.

Unit: Habitats, Population Dynamics and Management (Emphasis: Science, Technology, Society and the Environment- 40hrs.)

Focusing Question: How do ecological studies of habitats, populations and resource management 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 polynya population dynamics	• Investigating, and discussing with community Elders or other subject matter experts the general population trends of representative species over time. • Investigating and modelling methodologies and techniques for determining the natality, immigration, mortality, emigration, survivorship and age distribution of various representative populations. • Researching to: o Compare and contrast the environmental impact of human activities on the ecology and traditional activities of peoples who live near polynyas. E.g. tanker traffic, over use from hunting, ecotourism o Gain information on the biological, geographical and historical aspects of a polynya and the surrounding area. E.g. Foxx Basin and surrounding communities o Investigate the effects of an oil spill on a polynya ecosystem through laboratory experiments.
HABITAT: SALT MARSHES AND LAGOONS Students will gain an understanding of salt marshes and lagoons	• Describing the general characteristics of salt marsh and lagoon habitats. • Researching and conducting field studies to: o Describe and model the geomorphological features (including the adjacent transition landforms) o Create a species profile and catalogue of plants and animals that live and or use salt marsh and lagoon habitats o Describe and illustrate the primary features of this habitat and discuss how these features affect plant and animal distribution and habitat selection (e.g. adaptations to variations in salinity, pH, and dry seasons) o Present the adaptive features of a plant or animal that allows them to survive in this ecosystem o Demonstrate the ecological roles of salt marshes and lagoons and their role as a geochemical stabilizer. • Researching and discussing with Elders or other subject matter experts, during field investigations to: o Describe and present representative food chains and a food web of salt marshes and lagoons o Determine how salt marshes and lagoons are used by Aboriginal peoples (e.g. food, materials, seasonal traditional sites) o Determine how and why salt marshes and lagoons have changed over time and how the changes impact local traditional activities o Plot the distribution of these habitats, locally, to illustrate areas of productivity based on biological (species diversity/seasonal migration) and geographical (topography, tidal ranges, storm surges, river flooding) indicators o Determine why specific salt marshes and lagoons warrant special protection o Describing and applying the protocols and technology used to study, monitor and assess salt marsh and lagoon habitats

Unit: Habitats, Population Dynamics and Management (Emphasis: Science, Technology, Society and the Environment- 40hrs.)

Focusing Question: How do ecological studies of habitats, populations and resource management 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 salt marsh and lagoon population dynamics	• Investigating, and discussing with community Elders or other subject matter experts the general population trends of representative species over time. • Investigating and modelling methodologies and techniques for determining the natality, immigration, mortality, emigration, survivorship and age distribution of various representative populations. • Investigating and discussing how the alteration or destruction of salt marshes and lagoons can impact entire biological communities, traditional ways of life, and seasonal bird migration success. Include an evaluation (compare and contrast) of the risks and benefits to society and the environment of applying scientific knowledge and technology to alter salt marsh and lagoon habitats. E.g. draining, dredging, encroachment, ecotourism.
HABITAT: TIDAL FLATS Students will gain an understanding of tidal flats	• Describing the general characteristics of a tidal flat habitat. • Researching and conducting field studies to: o Describe and model the geomorphic features (including the adjacent transition landforms) o Create a species profile and catalogue of plants and animals that live or use the tidal flat habitat o Illustrate a representative food web of tidal flats including sources of traditional food and resources used by Aboriginal peoples o Describe and illustrate the primary features of this habitat and discuss how these features affect plant and animal distribution and habitat selection (e.g. adaptations to variations in salinity, freezing, and ice compression) o Present the adaptive features of a plant or animal that allow them to survive in this habitat o Plot tidal flat distribution to illustrate areas of productivity based on biological (species diversity/seasonal migration) and geographical (topography, tidal ranges, storm surges) indicators o Discuss with Elders or other subject matter experts, how tidal flats are used by Aboriginal peoples (e.g. food, materials, seasonal traditional sites) • Describing and applying the protocols and technology used to study, monitor and assess tidal flat habitats.
Students will gain an understanding of population dynamics associated with tidal flats	• Investigating, and discussing with community Elders or other subject matter experts the general population trends of representative species over time. • Investigating and modelling methodologies and techniques for determining the natality, immigration, mortality, emigration, survivorship and age distribution of various representative population. • Investigating using cases studies, how GIS technologies are used to assess long-term change and short term catastrophic such as an oil spill or extremes in weather.

Unit: Habitats, Population Dynamics and Management (Emphasis: Science, Technology, Society and the Environment- 40hrs.)

Focusing Question: How do ecological studies of habitats, populations and resource management 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:*
B: GOVERNANCE AND RESOURCE MANAGEMENT **GENERAL OUTCOME:** STUDENTS WILL GAIN AN UNDERSTANDING OF THE ISSUES OF GOVERNANCE AND MANAGEMENT, AND CAREERS AND OCCUPATIONS RELATING TO MARINE HABITATS AND RESOURCES.	
Students will gain an understanding of marine regulatory bodies	• Identifying, and explaining: o The roles and mandate of the Department of Fisheries and Oceans o The roles and responsibilities of local, territorial, and federal governments in governing Canada's oceans. • Explaining and discussing the environmental regulatory process for developments that could potentially impact on the ocean habitats. • Establishing a mock panel to develop an Integrated Management Plan (IMP) based on a case study related to the Arctic environment including an explanation of the processes and rationale for the establishment of an IMP. • Explaining and describing the role of the Marine Mammal Act and documenting how different organizations and groups have come together to set and evaluate the goals for a sustainable ecology and economy. • Explaining and discussing the role of the Migratory Bird Act, and the provisions for subsistence hunting. • Investigating and analyzing international treaties, policies, and agreements currently in place and how these could affect future events in the Canadian Arctic (e.g. whaling treaties, shipping regulations). • Explaining the role of governments; including land claims agreements, in the monitoring and protection of coastal areas. • Developing a proposal to support a Marine Protected Area for an environmentally sensitive area in the Canadian Arctic including an explanation of the rationale and protocols for the establishment of Marine Protected Areas.
Students will gain an understanding of marine mammal and fish stock management processes to ensure sustainable development	• Investigating case studies methodologies for marine mammal management to: o Evaluate the effectiveness / sustainability of a management plan and the role of the Marine Mammal Act o Provide an alternate plan for managing a resource to ensure sustainability. • Investigating Subsistence / Sport Fishing to: o Conduct a survey to determine the number and types of fish that are harvested locally o Discuss the changes in fish stocks with local Elders or other subject matter experts to gain information about variations in fish stocks over time and the monitoring processes used to document these changes o Examine and discuss the local, Territorial and Federal regulations that govern the harvesting of fish o Determine if fish harvesting (subsistence, sport, commercial) practices in their local area are significant enough to affect local fish populations. o Investigate the possibility of sport or commercial fishing as a viable means of promoting economic growth in their community including a review of the relevant sections of the *Fisheries Act* and associated regulations with respect to sport fishing. o

Unit: Habitats, Population Dynamics and Management (Emphasis: Science, Technology, Society and the Environment- 40hrs.)

Focusing Question: How do ecological studies of habitats, populations and resource management 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 marine mammal and fish stock management processes to ensure sustainable development (Continued)	• Investigating Commercial Fishing to: o Discuss the relevant sections of the Fisheries Act and associated regulations with respect to commercial fishing o Research and evaluate commercial fishing in the Arctic to determine the species that are harvested, their populations and quotas (including an examination of current practices) to evaluate the sustainability of fish stocks o Explain the monitoring and evaluation process that ensures a sustainable fish stock for future generations.
Students will gain an understanding of the careers and occupations related to marine habitats and resource governance and management	• Researching and preparing a career and occupational profile related to the marine resources in the NWT and across Canada.
Unit: Petrology and the Ocean Environment (Emphasis: Science, Technology, Society and the Environment- 20hrs.) **Focusing Question:** How do we discover, extract, refine and use petroleum products and what is their impact on society?	
GENERAL OUTCOME: STUDENTS WILL GAIN A GENERAL UNDERSTANDING OF THE PETROLEUM INDUSTRY INCLUDING THE PROCESSES INVOLVED IN MANUFACTURING PETROLEUM PRODUCTS, THE ENVIRONMENTAL IMPACT OF THIS INDUSTRY AND THE CAREERS AVAILABLE RELATED TO THE PETROLEUM RESOURCE INDUSTRY.	
Students will gain an understanding of the petroleum resources industry	• Distinguishing, explaining and defining renewable, non-renewable, and recyclable resources. • Describing and illustrating using block models, the sequence of events through which the following petroleum resource deposits are believed to have formed: o Gas (methane) hydrate deposits o Mackenzie Valley oil and gas deposits o Beaufort Sea oil and gas deposits o Oil sands deposits (Northern Alberta) o Lignite coal deposits • Illustrating and modelling to explain the importance of host rock characteristics in creating petroleum resource reservoirs/traps (include rock types, structures, porosity and permeability) • Identifying and describing the technologies and techniques used to gain information about the location and extent of on-shore and offshore petroleum resource deposits including a plot (on a circumpolar map) of known locations of potential and existing deposits.
Students will gain an understanding of the processing of petroleum resources	• Describing, illustrating and modelling the methods of extraction employed in the development of a petroleum resource deposit. • Explaining how a variety of factors (including but not limited to: price, concentration, accessibility/transportation, size, environmental considerations) determine the feasibility of a petroleum resource deposit. • Describing and illustrating the separation step of the refining process of petroleum resources into useable commodities including experimenting to demonstrate simple distillation of a mixture in solution.

Unit: Petrology and the Ocean Environment (Emphasis: Science, Technology, Society and the Environment- 20hrs.)

Focusing Question: How do we discover, extract, refine and use petroleum products and what is their impact on society?

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 the environmental issues surrounding the petroleum resource industry	• Describing and discussing the environmental impact of petroleum resource development and production in terms of: o Transportation of oil and gas products o Man-made islands and surface alteration o Oil and gas leaks/spills, including potential distribution by ocean currents o Accumulative effects on marine and land mammals o Effects of H2S on the local environment (burn-off of sour gas) o Other current issues related to the topic. • Employing research and group discussions to: o Propose strategies for the conservation of petroleum resources o Evaluate the feasibility of the proposed strategies o Discuss the pros and cons of the various strategies – those in place now and those proposed for the future (including the short and long-term value of petroleum resource conservation). • Evaluating alternative renewable forms of energy (e.g. wind, geothermal, solar, biomass, heat pumps) by considering: o Availability o Cost and efficiency o Environmental impact o Other relevant “cultural” considerations
Students will gain an understanding of the careers and occupations related to the petroleum resource industry	• Researching and preparing a career and occupational profile related to the petroleum resource industry in the NWT and across Canada.