

# ARCTIC MARINE SCIENCE CURRICULUM

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## MODULE 5

### HUMAN USE & GOVERNANCE

# TEACHER'S GUIDE

2001

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**MODULE 5**

**TEACHER'S GUIDE**

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## SPECIFIC LEARNING OUTCOMES

### SLO

- SLO 5-01 Explain the concept of sustainability and apply its principles in the decision-making process.
- SLO5-02 Describe what is meant by "common law" with respect to marine resources and how Aboriginal land claims are impacting on common law.
- SLO 5-03 Examine and discuss the Inuvialuit Land Claims and how it relates to the management of Arctic waters.
- SLO 5-04 Examine and discuss the Nunavut Land Claims and how it relates to the management of Arctic waters.
- SLO 5-05 Identify organizations that have been formed as a result of land claims agreements and their roles.
- SLO 5-06 Identify the roles of the three territories in governance of the Arctic Ocean.
- SLO 5-07 Investigate the responsibilities of hamlet councils and HTOs (Nunavut), HTC's (ISR) in oceans management.
- SLO 5-08 Identify and describe examples of regulatory bodies that are responsible for governance of Arctic marine resources.
- SLO 5-09 Identify the role of DFO in governance of the Arctic Ocean.
- SLO 5-10 Discuss the role of DFO as stated in the Oceans Act.
- SLO 5-11 Explain the rationale for establishing a Marine Protected Area (MPA).
- SLO 5-12 Investigate the processes to establish a Marine Protected Area (MPA).
- SLO 5-13 Explain the rationale for establishing Integrated Management Plans Marine Protected Area (MPA).
- SLO 5-14 Investigate the processes required to establish an integrated management plan for a community in a coastal area.
- SLO 5-15 Investigate and analyze international treaties, policies, and agreements that have an effect on Arctic marine waters.
- SLO 5-16 Investigate the migratory bird act as it pertains to subsistence hunting.
- SLO 5-17 Identify and discuss traditional, historic and modern shipping routes through Arctic waters.
- SLO 5-18 Identify and discuss the effects environmental, social and economic implications of shipping in Arctic waters.
- SLO 5-19 Explain the role of the Marine Mammal Act in reference to subsistence hunting.
- SLO 5-20 Assess the potential implications of an oil spill in the Arctic.
- SLO 5-21 Identify and discuss the environmental, social, and economic implications of oil and gas exploration and production in the Arctic.
- SLO 5-22 Analyze issues/decisions in terms of implications for the economy, the environment, and society, considering a variety of perspectives.

- SLO 5-23 Examine and discuss subsistence fishing, sport fishing, and commercial harvesting of fish stocks.
- SLO 5-24 Examine the historical and modern day importance of fishing to inhabitants of the Arctic.
- SLO 5-25 Examine and discuss sustainability of Arctic fisheries and issues related to regulation and monitoring of fish stocks.
- SLO 5-26 Discuss and define tourism and ecotourism.
- SLO 5-27 Research and identify areas of the Arctic that are frequented by tourists.
- SLO 5-28 Examine and discuss environmental, social, and economic implications of ecotourism.
- SLO 5-29 Research and discuss evidence and theories of climate change.
- SLO 5-30 Explain the role of greenhouse gases in climate change.
- SLO 5-31 Identify causes of ozone depletion and its effects on Arctic marine ecosystems.
- SLO 5-32 Describe the effects of ozone depletion on phytoplankton.
- SLO 5-33 Explain the roles of evidence, theories, and paradigms in the development of scientific knowledge.
- SLO 5-34 Recognize both the power and limitations of science as a way of answering questions about the world and explaining phenomena.
- SLO 5-35 Confidently evaluate evidence and consider alternative perspectives, ideas, and explanations.
- SLO 5-36 Identify and evaluate the applications and limitations of science and technology in society.
- SLO 5-37 Analyze issues/decisions in terms of advantages and disadvantages for sustainability, considering a variety of perspectives.
- SLO 5-38 Identify the contaminants and pathways found in the Arctic Ocean.
- SLO 5-39 Determine the effects of migration patterns on the spread of contaminants through Arctic ecosystems.
- SLO 5-40 Determine the effects of ocean currents on the spread of contaminants.
- SLO 5-41 Determine the effects of atmospheric currents on the spread of contaminants.
- SLO 5-42 Explain how the Arctic is a sink for organic chloride.

## RECOMMENDED RESOURCES

### **Print**

Aquilina, Alfred P. *The Mackenzie, yesterday and beyond*. North Vancouver: Hancock House Publishers Ltd. 1981.

Grace, Eric, et al. Sciencepower 10. Toronto, ON: McGraw-Hill Ryerson, 2000.

J.S. Peepre and Associates, and Patricia Halladay Graphic Design, Bufo Incorporated. *Herschel Island – Qikiqtaruk Interpretive Manual*. Yukon Territory, March 1992.

Ritter, Bob, et al. Nelson Science 10. Scarborough, ON: Nelson Thomson Learning, 2001.

### **Video**

*Inuit Observations on Climate Change*. Winnipeg: International Institute for Sustainable Development, 2000.

### **Websites (including on-line documents)**

Referenced throughout Module.

#### Nunavut Research Institute

This is a link to the research studies at the institute for those looking for more detailed information.

[http://pooka.nunanet.com/~research/docs/98compendium.htm#\\_Toc487013545](http://pooka.nunanet.com/~research/docs/98compendium.htm#_Toc487013545)

#### Canadian Arctic Profiles

This web site provides information on a variety of topics relating to the Canadian Arctic. The site is dynamic and the range of topics and the depth of treatment will be augmented over time under the auspices of the Digital Collection Program of Industry Canada.

<http://collections.ic.gc.ca/arctic/english.htm>

## PART 1 - GOVERNANCE OF MARINE RESOURCES

### INTRODUCTION

Making sense out of the multitude of organizations, different levels of government, etc. who have jurisdiction over arctic marine waters is a daunting task. An important aspect of this section is to develop in students an appreciation for the complexity of governance issues related to the oceans, as opposed to a detailed knowledge of all of the parties involved. It is also important to emphasize the recent trend towards co-management, and most recently, integrated management.

A case study approach has been taken in this module to try and illustrate some of the key concepts and give them a context, rather than an attempt to provide comprehensive general information on every topic. This area of study is one that is undergoing rapid changes that it would be impossible to provide information that would not be immediately out-of-date.

Factors such as the recent establishment of Nunavut, the evolving *Canada's Oceans Strategy*, and a new emphasis on integrated management make it difficult to stay up-to-date with constantly changing information. For this reason it is crucial to access current resources in order to be dealing with up-to-date information. A number of websites have been provided to facilitate this, but the best idea is to utilize resource people who are part of unfolding developments.

In addition, this section provides students with an opportunity to make choices and delve into issues that are particularly relevant to them or their community. The information in the student guide will provide a starting point, but will need to be supplemented.

### 1.1 SUSTAINABILITY

SLO 5-01: Explain the concept of sustainability and apply its principles in the decision-making process.

Essential Question: ***What is sustainability or sustainable development and why is it important to the management of marine resources?***

Recommended Time: 1 class

#### Concept Overview

The concept of sustainability or sustainable development is crucial to the discussion on the management of marine resources. PRIOR to reading the material in the student text, have students use the template provided in *Appendix 1* to record their current understanding of sustainability.

## 1.2 MANAGING OCEAN RESOURCES IN THE ARCTIC - AN INTRODUCTION

SLO5-02: Describe what is meant by "common law" with respect to marine resources and how Aboriginal land claims are impacting on common law.

Essential Question: *Who owns the ocean's resources?*

Recommended Time: 1/2 class

This section activates student thinking regarding the complexity of the management of marine resources. The important discussion regarding sovereignty over marine resources introduces this topic on a global level, but highlights the role of Nunavut in changing rules that existed in the past. Students need to appreciate that the changing status of water rights is a very complex issue, and one that is constantly evolving (especially in Nunavut).

### **Discussion**

After reading the information in the student text, have them discuss the following questions, in groups, and then have the groups share their discussions with the class. Ensure that group roles are assigned, e.g. recorder and reporter.

1. Why is it important for Canada to have a clear definition of its territorial waters?
2. Why would the creators of the Nunavut Final Agreement have felt it was important to change the status of water rights in their territory?

This discussion will help students appreciate the importance of sovereignty over marine resources and examples such as oil and gas development and shipping can help students to broaden their perspectives. These discussions will continue throughout the module.

### 1.3 THE ROLE OF LAND CLAIMS AGREEMENTS

- SLO 5-03: Examine and discuss the Inuvialuit Land Claims and how it relates to the management of Arctic waters.
- SLO 5-04: Examine and discuss the Nunavut Land Claims and how it relates to the management of Arctic waters.
- SLO 5-05: Identify organizations that have been formed as a result of land claims agreements and their roles.
- SLO 5-06: Identify the roles of the three territories in governance of the Arctic Ocean.
- SLO 5-07: Investigate the responsibilities of hamlet councils and HTOs (Nunavut), HTC (ISR) in oceans management.

Essential Question: *What role do land claims play in the management of ocean resources?*

Recommended Time: 2 classes

#### **Summarizing Information**

To help students begin to make sense out of the information in the student texts regarding land claims agreements, the organizations that resulted, and some major roles they hold, have students create their own summaries. These can be in any format, but a table for each agreement, such as the following, are very useful. This type of summary will then allow for quick access of information and comparison.

<b>INUVIALUIT FINAL AGREEMENT (1984)</b>		
A basic goal of the Inuvialuit Land Rights Settlement is to protect and preserve the Arctic wildlife, environment and biological productivity through the application of conservation principles and practices.		
<b>COMMITTEES/GROUPS ESTABLISHED</b>	<b>COMPOSITION OF GROUPS</b>	<b>RESPONSIBILITIES OF GROUPS</b>
Environmental Impact Screening Committee	Equal numbers of Inuvialuit and government appointees and a government-appointed chairman with a tie-breaking vote.	Assess the impacts of any development
Environmental Impact Review Board	Equal numbers of Inuvialuit and government appointees and a government-appointed chairman with a tie-breaking vote.	Advises the appropriate government agency whether the project should go ahead
Fisheries Joint Management Committee (FJMC)	Two Inuvialuit and two government members and a tie-breaking chairman selected by the committee itself	Advises the minister of Fisheries and Oceans as to quotas, regulations, and research and allocates subsistence quotas among communities
Hunters and Trappers Committees (HTC)		Sub allocate quotas, set local by-laws, and serve as the liaison between the community and the FJMC

Additional organizations that students are familiar with can be added, such as:

Wildlife Management Advisory Council (NWT)

Wildlife Management Advisory Council (YK) (see [www.taiga.net/wmac](http://www.taiga.net/wmac))

<b><u>THE NUNAVUT FINAL AGREEMENT (1993) CENTRAL AND EASTERN ARCTIC</u></b>		
Gives beneficiaries the right of free access and hunting, within the limits of stock conservation, on all land and territorial waters regardless of any other status, which means that parks and conservation areas are accessible to Inuit for harvest purposes, whereas they may be off-limits to non-Inuit		
Nunavut Planning Commission	Composed equally of government and Inuit representatives	Provides for land-use planning, contains strong statements that habitat and wildlife will be managed according to the principles of conservation
Nunavut Wildlife Management Board (NWMB)	Composed of one member appointed by the GNWT, three members appointed by the federal government, four members from designated Inuit organizations, and a tie-breaking chairman selected by the NWMB itself (effectively bringing together 4 levels of government)	Mandate to control all aspects of marine harvesting and conservation in the Nunavut Settlement Area  Delegates some responsibilities to HTOs
Marine Council	Nunavut Impact Review Board, the Nunavut Water Board, the Nunavut Planning Commission	An advisory body
Hunters and Trappers Associations (HTAs)		Have considerable input into decisions related to harvesting, catch allocation, economic development based on marine resources, and marine research programs

Additional organizations that students are familiar with can be added, such as:

Nunavut Impact Review Board  
Nunavut Impact Screening Committee  
Regional Wildlife Associations (i.e. Kivalliq, Baffin)

### **Guest Speaker**

Guest speakers are the best way to make the complicated information related to land claims agreements come to life for students. If possible, invite someone to speak who is well versed in some of the complexities of either the Inuvialuit or Nunavut Final agreement to class. Students should prepare questions prior to the visit.

In addition, ask an Elder to class to share their feelings about land claims agreements and the impact on their own life, as well as the impact they foresee for their grandchildren.

*Assessment Suggestion:* Have students write an essay to compare and contrast the Inuvialuit and Nunavut Final Agreements related to governance of oceans, using specific examples from their reading and/or the table. Ask students to speculate on why these differences exist (e.g. changing times, including such things as greater acknowledgement of aboriginal rights and the importance of TEK, and a stronger voice on the part of aboriginal people).

Use the following rubric to assess student work:

### **Scoring Rubric for Extended Response**

<b>SCORE</b>	<b>CRITERIA</b>
<b>4</b>	The work thoroughly identifies and describes each agreement and the similarities and differences between them. The work is clear, concise and contains examples and/or elaboration. It proposes several insightful possibilities for the differences between the agreements and includes evidence of higher order thinking. *
<b>3</b>	The work thoroughly identifies and describes each agreement and the similarities and differences between them. The work is clear, concise and contains examples and/or elaboration. It proposes a plausible reason for the differences between the agreements.
<b>2</b>	The work generally identifies and describes each agreement and the similarities and differences between them. The work may be unclear at times and/or contain minor errors. It does not contain any plausible reasons for differences between the agreements. It contains examples and/or elaboration.
<b>1</b>	The work only partially identifies and describes each agreement and the similarities and differences between them and/or contains major errors. It is unclear and contains no examples or elaboration to support the answer.

*\*Higher order thinking refers to students making connections to prior learning or to the real world, applying knowledge in new ways, sharing insights, or anything that goes one step beyond simply a correct and complete answer.*

## 1.4 GOVERNMENT DEPARTMENTS AND RESPONSIBILITIES

- SLO 5-08: Identify and describe examples of regulatory bodies that are responsible for governance of Arctic marine resources.
- SLO 5-09: Identify the role of DFO in governance of the Arctic Ocean..
- SLO 5-10: Discuss the role of DFO as stated in the Oceans Act.
- SLO 5-11: Explain the rationale for establishing a Marine Protected Area (MPA).
- SLO 5-12: Investigate the processes to establish a Marine Protected Area (MPA).
- SLO 5-13: Explain the rationale for establishing Integrated Management Plans Marine Protected Area (MPA).
- SLO 5-14: Investigate the processes required to establish an integrated management plan for a community in a coastal area.

Essential Questions: *What are the major regulatory bodies that are responsible for governance in the Arctic waters? How is the role of DFO evolving? What are integrated management plans and marine protected areas and how are they developed?*

Recommended Time: 3 classes

### **Making Sense Out of It All Activity**

Have students create a chart using the heading provided in the sample table below. Using the information in the student text in this and the previous section as a starting point, have students summarize the wide range of organizations that have been created as a result of land claims. Have students supplement the chart with additional information related to their own land claims area (or an area selected as a focus for study). Phone books, the Internet, and community members can be sources of information.

LOCAL	TERRITORIAL/ LAND CLAIMS	NATIONAL	INTERNATIONAL
Hunters and Trappers Associations	Inuvialuit Final Agreement	Canadian Arctic Resources Committee	World Wildlife Federation
Wildlife Officers	Nunavut Land Claims Agreement	Natural Resources Canada	International Arctic Science Committee
	Government of the Northwest Territories	Fisheries and Oceans Canada, including Coast Guard	Inuit Circumpolar Conference
	Government of Nunavut	Canadian Polar Commission	Arctic Council
	Government of Yukon	Environment Canada, Canadian Wildlife Service	
		Heritage Canada	
		Indian and Northern Affairs Canada	
Co-Management Boards			

### **What's the Acronym?**

Have students create their own dictionaries of the many acronyms that are a part of their readings and discussions. Add to this dictionary as the module progresses. This can be used as the basis for a fun quiz.

### **Guest Speakers**

An important, if somewhat confusing point is the role of the three territories in the governance of the Arctic Ocean. Have guest speakers come into the class to help lead students in a discussion of how and where (and if) the operation of the territorial government in their own region with regard to oceans management would be different from the information already discussed related to land claims groups.

### **Marine Protected Area/Integrated Management Plan**

Have students identify and study a Marine Protected Area (MPA) or Integrated Management Plan (IMP) that is currently under development. Two integrated management projects have been described in the student text.

The class may choose to have some students investigate an MPA while the rest investigate IMPs. This will serve as an excellent illustration of integrated management at work, with all of its strengths and weaknesses. If possible, have people representing some of the different groups working to establish the MPA or IMP share their work and their perspectives with the class.

DFO has an "Oceans Canada" website that contains up-to-date information on integrated management and the activities currently underway. Details on these activities can be easily accessed on the Oceans Program Activity tracking (OPAT) system (this is where the information in the student text was obtained). This information includes:

- Maps (an easily downloadable software piece is required to view the maps)
- Objectives
- Partners involved
- Achievements
- Key contacts

Oceans Canada website:

<http://www.oceansconservation.com/newenglish/htmdocs/ims/im.htm>

This site contains a link to the OPAT system.

*Alternatives:* The class may choose to take on other related tasks such as develop a proposal for establishing a MPA or IMP themselves and/or conduct a mock public forum on the pros and cons of establishing the MPA/IMP in your area. The International Marine Mammal Association also has a simulation activity - The MPA Puzzle (under development) that puts students in charge of the fictional *Salty Basin*, with representative upstream, onshore/coastal, nearshore and offshore habitats; as well as historic and culturally significant elements. Find out more at:

[www.imma.org](http://www.imma.org)

## 1.5 INTERNATIONAL DEVELOPMENTS

- SLO 5-15: Investigate and analyze international treaties, policies, and agreements that have an effect on Arctic marine waters.
- SLO 5-16: Investigate the migratory bird act as it pertains to subsistence hunting.
- SLO 5-17: Identify and discuss traditional, historic and modern shipping routes through Arctic waters.
- SLO 5-18: Identify and discuss the effects environmental, social and economic implications of shipping in Arctic waters.
- SLO 5-19: Explain the role of the Marine Mammal Act in reference to subsistence hunting.

Essential Questions: *What are some of the major international developments that have an impact on the management of Arctic marine resources? What are the environmental, social and economic implications of shipping in Arctic waters?*

Recommended Time: 4 classes

Have students read the Press Release on the Migratory Bird Act and answer the questions provided.

1. Describe how the changes to the Migratory Bird Act reflect a new perspective on aboriginal use of resources. (*Acknowledges the traditions and unique status of aboriginal people, utilizes an aspect of co-management*)
2. Why are changes like this important to aboriginal people in the Arctic? (*Will allow for this continuation of traditional lifestyles and culture*)
3. What other laws, treaties, etc. have an impact on how residents of the Arctic are able to utilize the ocean's resources? (*Have students share their knowledge of areas such as whaling regulations - already discussed in module 3, the Marine Mammal Act, etc.*)

### **Marine Mammal Protection Act**

Students can also read the following article for a vivid description of the negative impacts of the United States Marine Mammal Protection Act (MMPA):

*Needless Barriers to the Inuit Way of Life and The United States Marine Mammal Protection Act: Challenges to Inuit Sustainable Resource Use in Canada.*

Source:

*Silarjualiriniq - Inuit in Global Issues  
Published by the Inuit Circumpolar Conference (Canada)*

*Number 3, January to March 2000*

*This journal is published four times a year and is also posted at:*

[www.inuitcircumpolar.com](http://www.inuitcircumpolar.com)

## **Background Information**

### **Inuit Tapirisat and Marine Mammal Protection Act**

The MMPA was enacted by the US in 1972. It forbids the harvest or import of marine mammals or products made from the, with an exemption for Alaskan natives for subsistence purposes and the sale of traditional handicrafts. The intention of the act was to protect the Atlantic Harp seal population from extinction. Yet at the time this population numbered approximately 2.5 million in Atlantic Canada coastal waters. Today this population exceeds 5 million, again just in Canadian waters. The Act was then broadened to cover and therefore protect, all marine mammals, whether they are endangered or not. The MMPA has closed the entire US market to Canadian marine mammal products. ITC and the Inuit of Canada understand the need for protective legislation, but such legislation must have specific targets and it must account for and respect the sustainable seal and other marine mammal harvesting as practiced by Canadian Inuit. The MMPA is outdated and not consistent with principles of sustainable economic development now being promoted by all Arctic countries. The Act came up for re-authorization by all US government in 1999 meaning that amendments could be considered. It is not clear at the time of printing what amendments have been made (if any), however, it is certain that Inuit throughout the circumpolar region will continue to work towards an amendment that would permit the import of products from non-endangered species such as ringed seals.

[www.tapirisat.ca](http://www.tapirisat.ca)

## **Taking Action**

Have students develop position papers or letters that illustrate problems that exist with a current piece of legislation and send the letters to officials or make presentations at meetings in an attempt to improve the situation.

## **Oceans Explorations Chat Room**

<http://www.oceansconservation.com/discussion/htmdocs/chat.htm>

Have students visit the DFO website to participate in the Oceans Exploration chat room. They can join a chat session or tune into the schedule to see a list of scheduled chats. Some suggested topics are:

- What areas of oceans management should the Government of Canada be focusing its efforts on?
- What, in your view, are the most important issues related to oceans (over fishing, global warming, exploration, etc.)
- How should these issues be addressed?

## **Research Activity**

Have students plan and carry out a research activity to investigate a topic related to governance. Ideas can be generated from the readings, but should also be supplemented by the following:

- Investigate and analyze international treaties, policies and agreements that have an effect on Arctic Marine waters (those already mentioned or new ones, e.g. related to whaling)

- Investigate, in more detail, the DFO mandate, organization, regulatory powers, etc. (this could allow for participation in the current development of the Canada's Oceans Strategy)

*Assessment Suggestions:* Students should be required to orally present the results of their research. The following tools can be used for assessment:

Assessing Active Listening: Observation Checklist (*Appendix 2*)

### **Sources of Information:**

<http://www.oceanscanada.com>

This is the main website for the Federal Department of Fisheries and Oceans. It contains extensive information on the Oceans Act, and the emerging Canada's Oceans Strategy (students can submit their thoughts on oceans management) as well as valuable electronic documents such as: *The Role of the Federal Government in the Oceans Sector (1997)*, *Role of the Provincial and Territorial Governments in the Oceans Sector (1997)*, and *Towards Canada's Oceans Strategy*. It also contains a comprehensive listing of websites to a variety of areas, including legislation. The Northern and Central version of this DFO site can be found at [www.dfo-mpo.gc.ca/regions/central](http://www.dfo-mpo.gc.ca/regions/central)

<http://www.nunavut.com>

This comprehensive website provides extensive information on Nunavut. The Nunacom font can also be downloaded here for viewing on-line documents in syllabics. This may be of interest in other regions.

<http://www.newparksnorth.org/queen.htm>

This site features an electronic magazine "New Parks North", an annual progress report on natural and cultural heritage initiatives in Northern Canada.

<http://www.renres.gov.yk.ca>

This site features information related to renewable resource use in the Yukon.

[www.oceansconservation.com](http://www.oceansconservation.com)

Information on what DFO is doing to conserve Canada's Oceans.

<http://www.carc.org/pubs>

The Canadian Arctic Resources Centre publishes an on-line journal called Northern Perspectives. The following articles deal specifically with oceans management:

Northern Perspectives: Volume 23, Number 1, Spring 1995

Marine Conservation in the Canadian Arctic: A Regional Overview

By Harold E. "Buster" Welch

Northern Perspectives: Volume 23, Number 1, Spring 1995

Marine Conservation - Keeping the Arctic Ocean on the Agenda

By Leslie Beckmann

Northern Perspectives: Volume 23, Number 1, Spring 1995  
The Coldest Coast - Marine Issue in the North  
By Leslie Beckmann

Northern Perspectives: Volume 23, Number 1, Spring 1995  
The Nunavut Final Agreement and Marine Management in the North  
By Bruce Gillies, Nunavut Tunngavik Inc.

[http://www.inac.gc.ca/pr/pub/indigen/ipsdca\\_e.html](http://www.inac.gc.ca/pr/pub/indigen/ipsdca_e.html)

This Indian and Northern Affairs Canada website contains the following document:  
*Indigenous Peoples and Sustainable Development in the Canadian Arctic*  
*A Canadian contribution to the land use dialogue at the Eight Session of the United Nations*  
*Commission on Sustainable Development, April 24 to May 5, 2000*

<http://www.tapirisat.ca>

Inuit Taparisat is committed to policies and programmes for strengthening the cultural, political, and economic position of all the regions.

*Yukon North Slope - the Land and the Legacy*  
*Yukon North Slope Wildlife Conservation and Management Plan*  
Volume 1: Environmental Overview 1996  
Published by the Wildlife Management Advisory Council (North Slope)  
Box 5928, Whitehorse, Yukon, Y1A 5L6

## **E**    Check For Understanding

The Northwest Passage is still a long way from being a reliable open-water route today. There is no sign yet that a ship not strengthened against the ice could get through, but it has to be considered as a future possibility.

Assess the potential risks and benefits of increased use of the Northwest Passage by examining the implications for the economy, society, and the environment. (*Students should identify the economic benefit related to providing support for ships travelling through the Northwest Passage, the environmental risks posed by oil spills and the effects of increased traffic on the migrations and movement of marine life; and the mixed social benefits - more money but reduced access to traditional foods.*)

**Identifying Shipping Routes**

Have students use a map of the Arctic Ocean to identify the following:

- Traditional kayaking routes
- Historic shipping routes
- Modern day shipping routes

Maps should include all three types of routes and a key that clearly identifies them.

**Stakeholder Sorting**

There are many different ways to view the stakeholders that are a part of the management of Arctic marine resources. Brainstorm, with students, some of the categories that might be used. Create a list, such as the one below, and ask students to use some of the terms from the list to create their own classification method for the different groups/organizations that they have been learning about. This activity will help to emphasize the very different (and sometimes competing) interests that may exist.

Sample headings for categorization

- Governmental Organizations
- Non-governmental Organizations
- Cultural Organizations
- Environmental Groups
- Academic Institutions
- Industry
- Communities
- Regulatory Agencies
- Consumer Groups
- Consumptive Groups
- Non-consumptive Groups
- Advisory Groups
- Aboriginal and Non-aboriginal Residents of the Arctic

## 1.6 POTENTIAL IMPACTS OF OIL AND GAS DEVELOPMENT

- SLO 5-20: Assess the potential implications of an oil spill in the Arctic.
- SLO 5-21: Identify and discuss the environmental, social, and economic implications of oil and gas exploration and production in the Arctic.
- SLO 5-22: Analyze issues/decisions in terms of implications for the economy, the environment, and society, considering a variety of perspectives.
- SLO 5-23: Examine and discuss subsistence fishing, sport fishing, and commercial harvesting of fish stocks.
- SLO 5-24: Examine the historical and modern day importance of fishing to inhabitants of the Arctic.
- SLO 5-25: Examine and discuss sustainability of Arctic fisheries and issues related to regulation and monitoring of fish stocks.
- SLO 5-26: Discuss and define tourism and ecotourism.
- SLO 5-27: Research and identify areas of the Arctic that are frequented by tourists.
- SLO 5-28: Examine and discuss environmental, social, and economic implications of ecotourism.

Essential Question: ***What are the environmental, social and economic implications of resource development and economic activity in Arctic waters?***

Recommended Time: Dependent on approach taken.

This section investigates three areas of resource use – oil and gas development, Arctic fisheries, tourism – and their implications related to the economy, the environment, and society. Information related to oil and gas development is included in the student guide. Fisheries and tourism information will be gathered by students.

The societal analysis will consider, particularly, impact on traditional lifestyles and foodstuffs. The following activities can be approached in a number of ways. For example, classes may choose to limit their study to one type of resource use that is particularly relevant to them, or different groups of students may be assigned to one of the three areas with a general reporting opportunity for them to share their findings.

### **Arctic Fisheries Activity Outline**

Have students complete the following activities to gather information related to the fishing industry:

- Complete a survey to determine the number of fish that are harvested locally. Estimate the amount of fish taken from the local area for subsistence fishing, sport fishing and commercial harvesting.

- Identify and discuss changes in fish stocks with local authorities and Elders.
- Discuss historical trends in fishing with elders to determine any change in fish stock locations and quantities.
- Determine which sections of the *Fisheries Act* and associated regulations are relevant.

Once students have compiled this information (it should be recorded in the Community Profile and kept as a classroom and community resource), have them carry out the following tasks (students may select one):

1. Decide if there is any problem with local fish stocks, and if so, what can be done to ensure their sustainability. Additional research may be needed.
2. Investigate the possibility of sport fishing as a viable means of promoting economic growth in their territory, also identifying the social and environmental implications of increased sport fishing.

### **Tourism Activity Outline**

Have students carry out the following activities (all of the information should be collected prior to moving on to the next task):

1. Use a concept frame to define and describe ecotourism (see *Appendix 3*).
2. Use data from territorial as well as federal tourism bureaus to identify the major tourist areas in terms of Arctic Marine environments and the type of visitor who is attracted (create a visitor profile).
3. Identify ecotourism opportunities within the area (create an inventory of potential locations and ideas).
4. Investigate the economic, environmental, and social implications of increased ecotourism in Arctic communities (conduct a case study, if possible).

Once this information has been collected, determine if there are local opportunities to develop a new ecotourism opportunity or promote an existing one, create a plan, and perform a cost-benefit assessment of the idea.

*Assessment Suggestion:* Have students create a presentation promoting their tourism idea to a local funding agency. Provide guidelines ensuring that the presentation includes facts gathered during the research phase and also addresses the environmental and social implications of the project, in addition to economic factors.

## PART 2 - INFLUENCE OF HUMAN ACTIVITIES

### 1.7 CLIMATE CHANGE

SLO 5-29:	Research and discuss evidence and theories of climate change.
SLO 5-30:	Explain the role of greenhouse gases in climate change.
SLO 5-31:	Identify causes of ozone depletion and its effects on Arctic marine ecosystems.
SLO 5-32:	Describe the effects of ozone depletion on phytoplankton.
SLO 5-33:	Explain the roles of evidence, theories, and paradigms in the development of scientific knowledge.
SLO 5-34:	Recognize both the power and limitations of science as a way of answering questions about the world and explaining phenomena.
SLO 5-35:	Confidently evaluate evidence and consider alternative perspectives, ideas, and explanations.
SLO 5-36:	Identify and evaluate the applications and limitations of science and technology in society.
SLO 5-37:	Analyze issues/decisions in terms of advantages and disadvantages for sustainability, considering a variety of perspectives.

Essential Question: *Is global warming taking place, and if so, what impact will it have?*

Recommended Time: 6 classes

#### Anticipation Guide

PRIOR to having students read the section in the student guide on climate change, have them complete an "Anticipation Guide" (see *Appendix 4*). Students will be provided with some statements to which they have to provide an initial response, and then a response after they have read the text, providing reasons for their change in thinking. These statements address some of the misconceptions related to both Global Warming and Climate Change and how science works and also provides a purpose for reading.

#### Inuit Observations on Climate Change

##### The Video

A video titled: "Sila Alangotok: Inuit Observations on Climate Change" was released in association with the project described in the student guide and is available through the International Institute for Sustainable Development (Phone: 204-958-7700, website <http://iisd.org>) The website describes this project and contains extensive trip reports and

additional information such as Inuit Timelines and Seasonal Calendars (good models for local development). This video is highly recommended as not only does it contain Inuit observations on climate change, it presents an excellent model for how scientists and community members can work together.

Have students watch the video at the beginning of this section and discuss the process used by scientists to gather information from the people of Sachs Harbour. They should watch it again at the end of this section and discuss which of the observations made by scientists (or predicted by scientists) were contained in the video.

Students should also be revisiting their own information, collected in conjunction with the weather section in module 1. Additional information related specifically to changing climate may also be gathered. It is important for a record of changes observed to be maintained within the Community Profile book the class is compiling.

### **The Science of Climate Change**

The focus of this section is to provide students with a basic level of understanding about the climate, the greenhouse effect and climate change, but more importantly, it also provides an excellent opportunity for students to investigate how science works. The debate among scientists over this issue and their ultimate lack of agreement will illustrate the following aspects of the nature of science:

- Science cannot answer all questions
- A variety of scientific approaches can be used to study an issue
- Debate is an important part of developing new scientific understandings
- Economic and societal factors play an important role in how an issue is addressed

There are numerous sources of information on climate change that students can access:

Alliance to Save Energy (ASE) (background information as well as student activities)

<http://www.ase.org/educators/lessons/hs/airpolloverview.htm>

Environment Canada's Green Lane

[www.ec.gc.ca/climate](http://www.ec.gc.ca/climate)

Government of Canada's main climate change site

[www.climatechange.gc.ca](http://www.climatechange.gc.ca) (1-800-959-9606)

Health Canada (click on "Healthy Living")

[www.hc-sc.gc.ca](http://www.hc-sc.gc.ca)

### **Lab 1 - The Greenhouse Effect (see Lab Manual)**

Have students carry out the Lab 1.

#### **Answers to student Questions:**

1. The dirt represents the surface of the Earth. The plastic wrap represents Earth's atmosphere.

2. Predictions may vary slightly. Pay careful attention to what students predict – it will provide clues for what misconceptions exist in your class and give guidance about whether to extend the inquiry.
3. The temperature in both cups should have increased, but at different rates. As the dirt in each cup gives off heat, the temperature of each increased. In the covered cup, however, the heat does not escape so the temperature rises more rapidly.
4. The students should see a graphical representation of the answer to question #2.
5. Answers will vary

### **Lab 2 - Greenhouse Gases (see Lab Manual)**

Have students carry out Lab 2.

Hints: Using two separate lamps achieves the best results in a 25 minute time period. If a group is near a draft or in direct sunlight, relocate them to another place. Outside factors such as these may interfere with the results of the experiment.

### **Optional**

Have students use the web to research how scientists collect data on carbon in the atmosphere and calculate things like average global temperature. A web search on "carbon dioxide and Mauna Loa" should lead to information on the world's longest running data set on atmospheric carbon dioxide, in Hawaii.

*IMPORTANT NOTE:* The greenhouse effect is a tricky concept mainly because the actual processes are more complex than the common "greenhouse" analogy would imply. In reality, the sun's rays coming in (ultraviolet light) pass through the atmosphere without a problem. However, the longwave radiation (infrared light) that radiates off the surface and has a much harder time passing through the atmosphere. Gas molecules in the atmosphere absorb this infrared radiation, creating an additional heat for the planet. By contrast, greenhouses and the insides of cars heat up mainly because the heated air that is let in cannot escape. But unlike the atmosphere, the glass in a greenhouse or car does not absorb the energy and act as a continuing heat source as the atmosphere does for Earth.

### **Alien Activity**

Provide students with the following information:

#### **Situation**

An alien from another planet has just arrived and is perplexed by the controversy surrounding the greenhouse effect and global warming. Here's how you can help:

**Task 1:** Draw a diagram illustrating the greenhouse effect. Label it carefully.

**Task 2:** Below your diagram write a concise paragraph that explains the diagram.

Write neatly and use correct English! Use the back of the page if necessary.

*Assessment Suggestion:*

### RUBRIC

POINTS	DESCRIPTIONS
4	Diagram contains all components of greenhouse effect, clearly illustrates the effect, and contains clear labels. Paragraph explains greenhouse effect, uses clear language, is concise, creatively reflects the audience
3	Diagram contains all major components of greenhouse effect, clearly illustrates the effect, and contains clear labels. Paragraph explains greenhouse effect, uses clear language, is concise.
2	Diagram contains most components of greenhouse effect, contains labels. Paragraph explains greenhouse effect, language may be unclear and/or rambling.
1	Diagram missing major components of the greenhouse effect, illustration may not be clear, no labels. Paragraph does not accurately reflect greenhouse effect.

### **Lab 3 - An Introduction to Field Data Collection**

(Refer to Lab Manual)

#### **Background Information**

This lab was obtained from TEA Classroom activities website. Visit this website for a variety of activities related to the Antarctic and Arctic ( <http://tea.rice.edu> )

The author has provided a preamble to the context for this activity. An excerpt is as follows:

#### **Context for the Development of the Lab**

##### **Bringing Real Research to the Classroom**

*Some of the questions that need to be answered by a research team studying the tundra environment include: How do you measure the changes over an area that includes all the main landforms? How do you incorporate changes in latitude, altitude, angle of slope, direction faced, soil types, and type of vegetation into your study? Will there be a direct relationship to the thaw depth of the active layer and the climate? How can the researcher represent that data on a map of the region?*

*My research group attempted to answer the questions by a sampling method which selected sites of one square kilometre that were located in representative locations through a region that went from the foot hills of the Brooks Range north to Deadhorse and west to Barrow, Alaska. At each site the thaw depth was probed at 100 m intervals in the selected square kilometre and at 10 metre intervals within a randomly selected*

*hectare within the site. In addition, each site had a set of temperature probes mounted on a mast that would record temperature in the soil, at the surface of the soil and in the air above the round.*

*This lab was a way for me to show my students what it is like to do research. I asked my students how the temperature changes as we go from the athletic fields at the school into the nearby woods. I set up lines for a series of line transects going down the hill from the athletic fields, across the region of succession created when the farm field that became the school grounds was abandoned, and into the woods. On each of the lines, I had the students make measurements of temperature and counts of the plant numbers at 10 metre intervals over a line that was 100 metres long.*

*The students were divided into teams and each member had a job (recording data, measuring temperature, counting plants). The groups compiled their data and I added data from other classes so that by the end of the day we had data that ran from early morning until late afternoon.*

*Students graphed the temperature data, analyzed the results, and drew a temperature map and analyzed the results. Our data surprised the students because it was possible to tell where there was a shadow and how the shadow moved during the day as we had done our transects from east to west down a hill into the trees.*

*For more information or additional activities, or to contact the author of this activity, visit the TEA website.*

*Author: John Nevins*

### **Analyzing Greenhouse**

Have student complete the analyzing greenhouse data activity found in *Appendix 5*. This activity requires students to create and analyze graphs.

#### **Task 1:**

- a.) The obvious trend is the increase in CO<sub>2</sub> concentrations. The greatest increase has taken place during the past 50 years.
- b.) The primary reason is the burning of fossil fuels that has resulted from increased industrial activity.

#### **Task 2:**

- a.) The greatest temperature increase was prior to 1940.
- b.) The greatest decrease in temperature was from 1940 to 1970.
- c.) The data show that, in a *rough* sense, the temperature increase during the past century has occurred as CO<sub>2</sub> levels have increased. However, the actual increase in temperature occurred *before* the greatest increase in CO<sub>2</sub> concentrations! This indicates that some other factors are probably involved. In a 1981 article in *Science*, several scientists made this interesting comment:

*Another conclusion is that global surface air temperature raised approximately 0.04 °C in the past century, roughly consistent with calculated CO<sub>2</sub> warming. The*

*time history of the warming does not follow the course of the CO<sub>2</sub> increase, indicating that other factors must affect global mean temperature.*

d.) Several possibilities which have been given for a delayed greenhouse effect are:

- The cooling effects of increased atmospheric pollution,
- The delayed warming of the oceans,
- The cooling effect of an increasing cloud cover caused by the greenhouse effect. Students may want to research these topics. The most mentioned phenomena is the effect of solar activity. According to the Marshall Institute, "The very close correlation between the solar changes and the changes in temperature suggests that the sun has been the controlling influence the last 100 years, with the greenhouse effect playing a smaller role."

*Assessment Suggestion:* Have students complete the following self-assessment.

	<b>SELF-ASSESSMENT</b>
THINGS I DID WELL	
THINGS I HAD DIFFICULTY WITH	
I LEARNED ...	
I WONDER ...	

**Predicted Changes in Canada's Arctic – Research Activity**

The information in the student guide provides a brief overview of some of the potential changes that could result from global climate change and the resulting impacts on the Arctic environment. Environment Canada's report *"Responding to Global Climate Change in Canada's Arctic - Volume II of Canada's Country Study: Climate Impacts and Adaptation"* contains extensive information on potential impacts of global change and can be used as the basis for student research projects. This document is located at:

[http://www2.ec.gc.ca/climate/ccs/ccs\\_e.htm](http://www2.ec.gc.ca/climate/ccs/ccs_e.htm)

In particular, it is recommended that students study potential socio-economic impacts related to:

- Oil and gas
- Transportation
- Building and construction
- Recreation and tourism
- Settlements, country food and human health
- Agriculture and forestry
- Fisheries
- Defence

## E Check For Understanding

Have students read the section and answer the questions provided.

1. Why is it important to distinguish between climate and weather when talking about climate change? (*Climate represents long term trends, weather represents what happens day to day, unusual weather does not necessarily indicate climate change*)
2. How does the burning of fossil fuels affect climate? (*The carbon dioxide that results affect the ability of the atmosphere to trap heat, intensifying the greenhouse effect*)
3. Which greenhouse gas does NOT occur naturally? (*Halocarbons*)
4. What economic aspects of global climate change make this issue highly political? (*The costs associated with reducing the emission of greenhouse gases can be prohibitive. Could include job losses, increased cost of consumer goods.*)
5. Summarize the main aspects of climate changes and indicate where uncertainties still lie (what don't people agree on).(*Refer to Understanding Climate Change and The role of science in the student guide*).
6. So you think a warmer climate would be a bad thing? Justify your answer. (*Many answers are possible, but students should demonstrate logical thought and ability to justify their answers*)
7. What do Elders in your community say about global warming? Can they identify differences in weather and climate in their lifetime (remember to differentiate between weather and climate)?
8. Why is ozone depletion an important issue for the Arctic Marine Environment? (*Plankton are affected by UV radiation and a reduction in their numbers would have a major impact on Arctic marine food webs*).

*Assessment Suggestion:* Have students answer the following questions:

1. Explain why the following statement is a misconception (contains flawed thinking): "Humans have caused the greenhouse effect." (*The greenhouse effect is a natural occurrence and is an important reason why we are able to support life as we know it today.*)
2. Explain what the global warming debate tells us about how science works and its strengths and weaknesses.

## 1.8 CONTAMINANTS

SLO 5-38:	Identify the contaminants and pathways found in the Arctic Ocean.
SLO 5-39:	Determine the effects of migration patterns on the spread of contaminants through Arctic ecosystems.
SLO 5-40:	Determine the effects of ocean currents on the spread of contaminants.
SLO 5-41:	Determine the effects of atmospheric currents on the spread of contaminants.
SLO 5-42:	Explain how the Arctic is a sink for organic chloride.

Essential Question: *How do contaminants get to the Arctic and what effects do they have on flora and fauna?*

Recommended Time: 1 class

Teachers may need to review information with students from earlier modules, related to bioaccumulation. The emphasis in this section is on the transport of these contaminants to the Arctic marine environment and its effects.

Detailed information on contaminants in the Arctic can be obtain from the following website: [www.tapirisat.ca](http://www.tapirisat.ca) This site contains information on monitoring programs that are currently underway.

### **Mapping the Flow**

Have students use the maps provided in *Appendix 6* as a basis to make some inferences related to what they see on the maps (why is the Arctic a "sink" for contaminants?).

**Mapping the Movement**

On the same maps, or an overlay, if possible, have students record the migration routes of marine mammals such as bowhead whales. Next have students infer what impact the overlap of contaminant flow and migration patterns might have on the spread of contaminants.

**Monitoring the Air**

Participate in a joint research project with another school or schools in a different territory to monitor pH levels of precipitation during the school year and hypothesize the cause of any differences between the locations and any fluctuations throughout the year.

## **APPENDICES**

APPENDIX 1: CONCEPT OVERVIEW

APPENDIX 2: ASSESSING ACTIVE LISTENING: OBSERVATION CHECKLIST

APPENDIX 3: CONCEPT FRAME

APPENDIX 4: ANTICIPATION GUIDE - GLOBAL WARMING

APPENDIX 5: ANALYZING GREENHOUSE DATA

APPENDIX 6: CONTAMINANT TRANSPORT

**APPENDIX 1: CONCEPT OVERVIEW****Key Concept:****Sustainability** (sustainable development)**Write a definition of the concept in your own words.****List 5 facts related to the concept:**

- 1.
- 2.
- 3.
- 4.
- 5.

**List your questions about the concept (at least two).****Complete this statement:*****Sustainability is NOT....*****Examples of sustainability:****Relevance today: This is an important concept today because...**



**APPENDIX 3: CONCEPT FRAME**

**Concept:**

**Examples:**

**Characteristics:**

**What is it like?**

**What is it unlike?**

**Can you illustrate it?**

**Definition:**

**APPENDIX 4: ANTICIPATION GUIDE - GLOBAL WARMING**

1. Prior to reading the assigned section in the student guide, provide an initial response to the statements provided below.
2. Following the reading, provide a second response (After) and explain why (or why not) your response changed.

STATEMENT	YOUR RESPONSE
<p>Global Warming is an accepted fact.</p>	<p>Initial:</p>   <p>After:</p>   <p>Why:</p>
<p>We'd all be better off with a warmer climate.</p>	<p>Initial:</p>   <p>After:</p>   <p>Why:</p>
<p>Economic factors need to be considered when deciding on a course of action related to climate change.</p>	<p>Initial:</p>   <p>After:</p>   <p>Why:</p>

**APPENDIX 5: ANALYZING GREENHOUSE DATA****Directions:**

In this activity, you will analyze and graph data on observed global temperatures and CO<sub>2</sub> concentrations. Then you will answer questions about this data.

**Task 1:** On a sheet of graph paper, graph the data in Table 4-2. Label the horizontal axis "Year" and label the vertical axis "CO<sub>2</sub> concentrations."

***Table 1: Atmosphere Concentrations of CO<sub>2</sub> During the Last 230 Years***

<b>YEAR</b>	<b>CO<sub>2</sub> CONCENTRATION (PARTS PER MILLION-PPM)</b>
1750	282 ppm
1800	283 ppm
1850	290 ppm
1900	297 ppm
1950	312 ppm
1980	335 ppm
1990	350 ppm

**Question:**

a) What pattern or trend do you notice in CO<sub>2</sub> concentrations?

b) During what years was the trend most pronounced?

**Task 2:** Table 2 gives actual average global temperature changes during the past 110 years, using 1890 as a base year. Below Table 2 is a graph showing CO<sub>2</sub> concentrations during this same time period. Graph the data in Table 2 on a sheet of graph paper. Then answer the questions that follow in your notebook.

**Table 2: Observed (Actual) Global Average Temperature Change**  
Based on data in "Climate Impact of Increasing Atmospheric Carbon Dioxide,"  
Science, August 28, 1991

YEAR	GLOBAL AVERAGE TEMPERATURE (OBSERVED CHANGE - DEGREES C)
1890	0.00
1900	0.18
1910	0.20
1920	0.22
1930	0.43
1940	0.54
1950	0.48
1960	0.43
1970	0.40
1980	0.55
1990	0.56

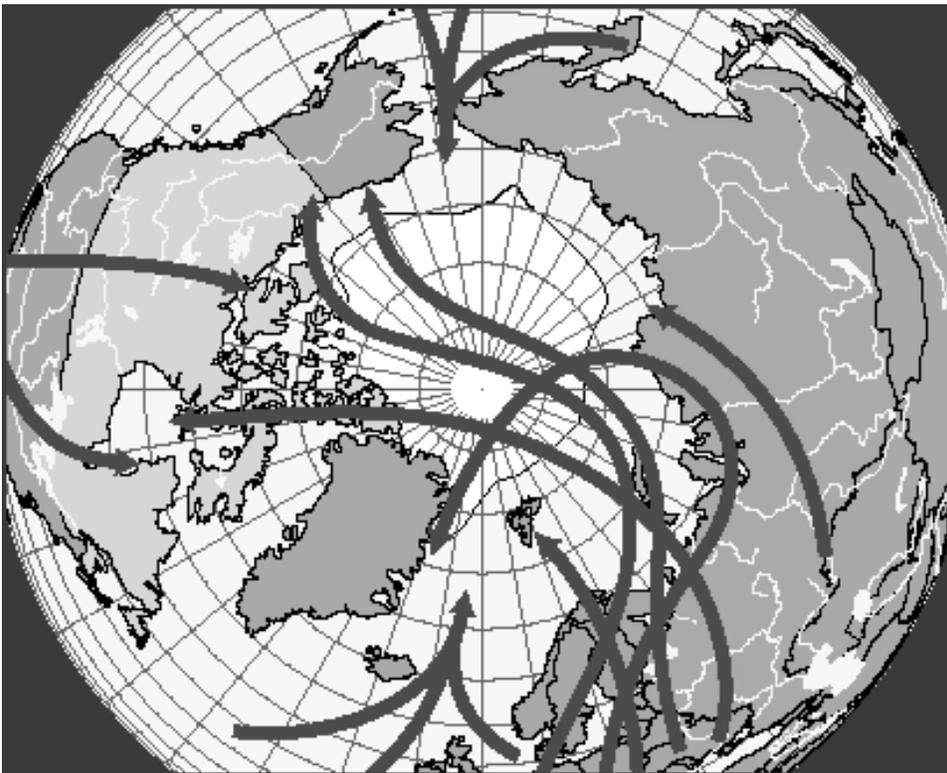
**Questions:**

- During what time period was the observed temperature increase the greatest?
- What period of time shows a decrease in observed temperature?

- c) What time period shows the greatest increase in CO<sub>2</sub> concentrations?
- d) Examine the data carefully. Does the data support the conclusion that increasing greenhouse emissions are responsible for the 0.5 degree Celsius increase in observed temperature during the past 110 years? Explain your reasoning below.
- e) Discuss your conclusions with your teacher and your classmates.
- f) What are some other natural phenomena that possibly could explain increases in temperature?

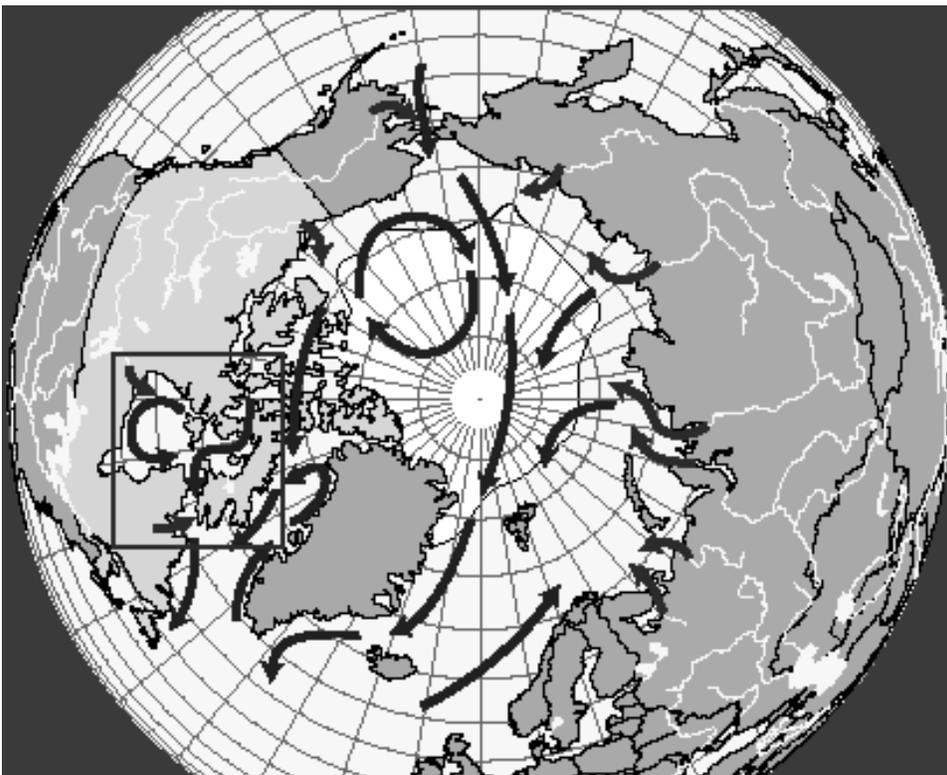
**APPENDIX 6 - CONTAMINANT TRANSPORT**

Wind Currents for the Transport of Contaminants



*Source:*  
[www.tapirisat.ca](http://www.tapirisat.ca)

Ocean Currents for the Transport of Contaminants



*Source:*  
[www.tapirisat.ca](http://www.tapirisat.ca)