Section 2:
Suggested Learning Activities

SUGGESTED LEARNING ACTIVITIES

Introduction

This section provides suggested learning activities related to the video *Sila Alangotok—Inuit Observations on Climate Change*. The activities require students to gather information from the video (activating and acquiring knowledge) and to apply and extend their learning. Students are not expected to complete all the learning activities—teachers will select learning activities that are most appropriate for their students. It is recommended that students watch the video more than once, looking for different things each time.

A. Activating Prior Knowledge

This learning activity will help students explore the importance of incorporating local observations on climate change with the work of scientists. Students will begin with an exploration of the concept of traditional ecological knowledge (TEK). The questions from BLM 2 may be used after the video has been viewed or in conjunction with a cooperative learning activity. Suggestions for cooperative learning strategies are provided in this teacher's guide, as well as in the *Senior Years Science Teachers' Handbook* (Manitoba Education and Training, 1997, Chapter 3)—hereafter referred to as *SYSTH*.

Objectives

The students will

- describe why TEK is becoming increasingly important
- activate their thinking related to why observations made by community members may be important to an understanding of climate change
- identify individual actions that may reduce climate change

Senior 2 Learning Outcomes

Knowledge:

S2-4-08 Discuss potential consequences of climate change.

Examples: changes in ocean temperature may affect aquatic populations, higher frequency of severe weather events influencing social and economic activities, scientific debate over nature and degree of change...

Skills and Attitudes:*

S2-0-2a

S2-0-3f

S2-0-8e

S2-0-9f

***Note:** Refer to Appendix 1 for a complete listing of the skills and attitudes outcomes.

Materials

Video: *Sila Alangotok—Inuit Observations on Climate Change*

BLM 2: Video-Related Questions

Appendix 2: Aboriginal Traditional Knowledge and Environmental Management (page 57 only)

Procedure

Opening Question: How can local people's observations be important to scientists as they try to understand climate change?

Part 1: Introduction to Traditional Ecological Knowledge (TEK)

1. Provide students with an intentionally provocative statement such as the following to generate discussion.

   "Aboriginal people's traditional knowledge of the local environment is of great value to scientists today."

   Have students decide whether they personally agree or disagree with the statement and share their views with a partner. The partners discuss their views until they are able to reach consensus. Each pair then joins another pair, repeating the process of sharing and discussing views until they reach consensus.

2. Provide students with the first page of the article "Aboriginal Traditional Knowledge and Environmental Management" (Appendix 2, page 57). After students have read this page, have them complete the following reflection:

   "What surprised me about the article was . . ."

   "What I found particularly interesting about the article was . . ."

Part 2: Video-Related Questions

Have students answer the questions on BLM 2. Suggested responses are provided below for teacher reference.

1. What were some of the observations of climate change made by the community members of Sachs Harbour?

   Some of the changes noted in the video are:

   - *change in temperature*
   - *flies everywhere*
   - *delayed freeze-up*
   - *thunderstorms*
   - *shorter fall and slower freeze-up*
   - *boating in November*
   - *no icebergs in summer*
   - *geese stay for a shorter length of time in spring*
   - *melting faster each spring*
   - *warmer summer*
   - *warmer water*
   - *different insects*
   - *severe storms*
   - *deformed muskox*
   - *erosion*
   - *damage to buildings*

2. Why may the observations of Inuit Elders and community members be important in a discussion of climate change?

   The Elders and community members make observations on a day-to-day basis; therefore, they may observe subtle changes in the local environment. The observations of Elders and community members are based upon their activities related to subsistence living and therefore may not be apparent to a scientist. Scientists usually study a local area for a short period of time (although satellites may change some of these studies and may help with longer-term observations). The observations of community members have been passed down from generation to generation, and have helped community members plan for the arrival of animal and plant species they rely upon for their subsistence. The observed changes in these events are indicators of climate change.

3. How do the observations of Inuit Elders and community members contribute to the understanding of natural climate change and climate change associated with human activities?

   The observations of Elders and community members have been collected over a long period of time, well before the Canadian government began recording and documenting the local weather. These observations are passed down through oral tradition and have resulted in a lifestyle that is dependent upon the timing of environmental occurrences that are in turn dependent upon a predictable climate. The observations of Elders can provide baseline information to compare to current observations.

4. What are some actions you might take (as an individual or as part of a group) to reduce climate change?

   - ***Individual***
     - *reduce gas emissions: reduce recreational snowmobiling*
     - *reduce energy use: turn lights off when leaving a room, set thermostats to lower levels when leaving home*
     - *recycle*
   - ***Group***
     - *reduce gas emissions: reduce recreational snowmobiling, carpool, use public transportation, walk, cycle*
     - *reduce consumption of non-renewable resources: install programmable thermostats and adjust temperature as required*
     - *set up a recycling program*

The final question can serve as a starting point for student research in this area. The results can take a variety of forms, such as posters, oral presentations, newspaper articles, and drama, which can be shared with the class, the school, and the community.

B. Concept Map and Debate

Concept maps help students actively create a visual representation of the relationships between and among concepts in a piece of information. An explanation of the concept map and its uses is available in *SYSTH* (Manitoba Education and Training, 1997, Chapter 11). In this learning activity, groups of students will create a concept map of the key concepts introduced in the video. Once each group has created a concept map, students will apply the information by participating in a debate. Strategies for debating in the classroom can be found in *SYSTH* (4.19).

Objectives

The students will

- identify the relationship between climate- and community-based resources
- define climate
- synthesize information from a media source
- apply information gathered from a resource in the form of a debate

Senior 2 Learning Outcomes

Knowledge:

S2-4-08 Discuss potential consequences of climate change.

Examples: changes in ocean temperature may affect aquatic populations, higher frequency of severe weather events influencing social and economic activities, scientific debate over nature and degree of change...

Skills and Attitudes:*

S2-0-2a, S2-0-2b, S2-0-2c

S2-0-3d, S2-0-3e , S2-0-3f

S2-0-4f, S2-0-4g

S2-0-7c, S2-0-7e, S2-0-7f

***Note:** Refer to Appendix 1 for a complete listing of the skills and attitudes outcomes.

Materials

Video: *Sila Alangotok—Inuit Observations on Climate Change*

BLM 1b: Decision-Making Chart

Procedure

Opening Question: Based on your knowledge of the factors that contribute to climate, how do you think climate change will affect northern Canada?

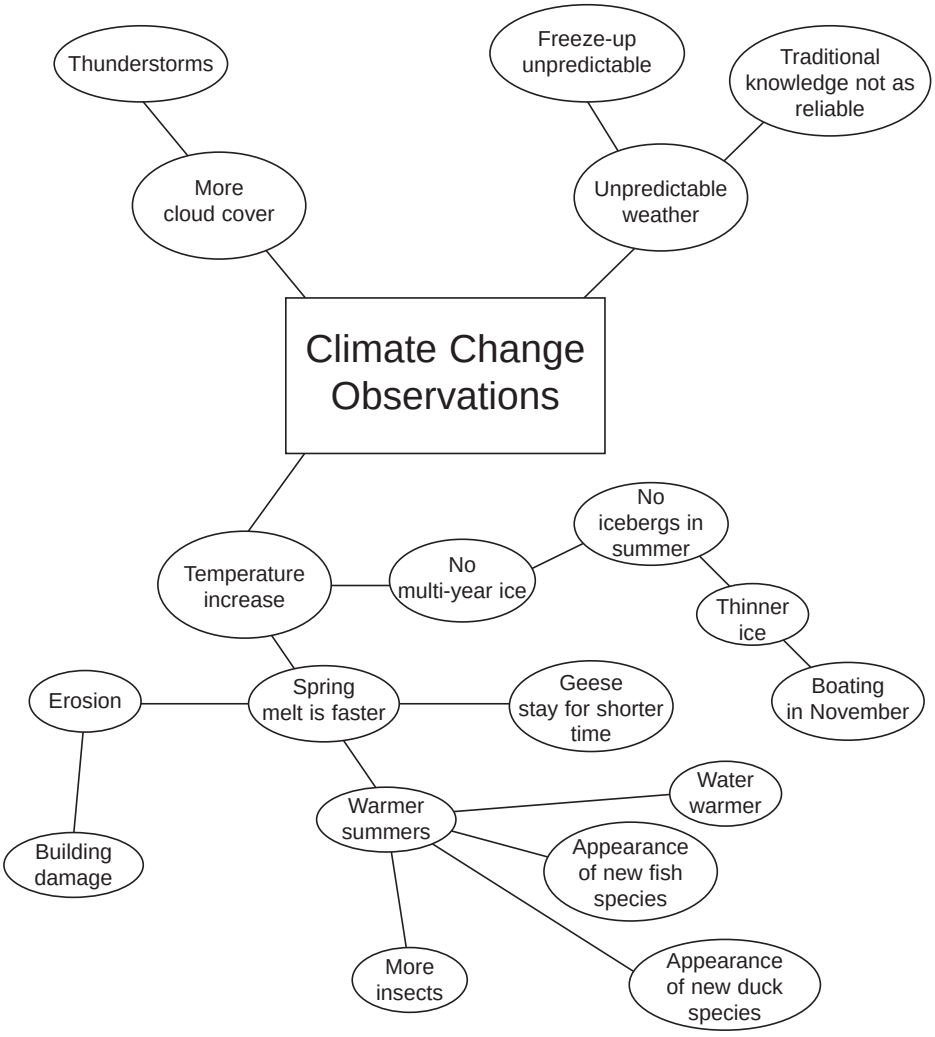
Concept Map

1. Before showing the video, divide students into groups (groups of four work well). Let students know that each group will be required to create a concept map that summarizes the key concepts related to how climate change will affect northern Canada. Have the groups assign roles such as recorder of group discussion and key concepts, concept map recorder, lead debater (for the next part of the activity), and moderator. Give the groups a few minutes to assign roles and decide how they will record the information while viewing the video.

2. Show the video.

3. Provide each group with chart paper and markers. Allow 15 to 20 minutes for groups to share their individual notes and create a flip chart summary.

Sample Concept Map



Note: The concept maps are used as sources of information for the debate that follows.

Debate

1. Divide the class into two groups by combining the concept map groups to create two sides for the upcoming debate.
2. Write the following statement on the board/overhead:

> **The observations of one community member complement and add to the understanding of climate change.**

3. Each group appoints a lead debater. The rest of the group members support their team's lead debater. One group must be in favour of the statement; the other must argue against the statement. Students might use the Decision-Making Chart (BLM 1b) to help them organize their thoughts.
4. Conduct the debate as follows:
   a. Each lead debater delivers a two-minute introductory argument for his or her team's position.
   b. Allow five minutes for teams to prepare a one-minute response.
   c. Each lead debater delivers the final one-minute response.

   Note: Refer to *SYSTH* (Manitoba Education and Training, 1997, 4.19) for more information on holding a debate in a science classroom.

Assessment

Have students write a reflective piece on their perceptions of the video and on their participation in the concept mapping and debating activities.

Sample Reflective Questions: How did the observations of the community members in Sachs Harbour enhance the research team's understanding of climate change?

Sample Self-Assessment: How did you contribute to the debate? What could you improve for the next time? What strengths in debating do you have? What will you retain for the future?

C. Trip Reports Jigsaw

Trip reports were developed to help document the process used to gather observations made by the people of Sachs Harbour related to climate change. (Trip reports are found on the International Institute for Sustainable Development website at <http://www.iisd.org/casl/projects/inuitobs.htm>).

Typical information for each report included the following:

- purpose of the trip and a comment on the trip's success
- team members
- schedule of activities (broken down into video group activities and science group activities for trips 2 to 5)
- specifics related to the tasks and success of each trip
- next steps
- budget commentary

The trip reports include a wealth of information on the process used by the project team, as well as the specific findings.

In this learning activity students will use a cooperative learning strategy called a Jigsaw to identify and analyze the methods used by the project team to gather information in the community of Sachs Harbour. For more details on the Jigsaw strategy or other cooperative learning strategies, refer to *SYSTH* (Manitoba Education and Training, 1997, Chapter 3).

Objectives

The students will

- evaluate information drawn from a variety of sources
- synthesize information on climate change obtained from a report
- identify and evaluate methods used by scientists to obtain information

Senior 2 Learning Outcomes

Knowledge:

S2-4-08 Discuss potential consequences of climate change.

Examples: changes in ocean temperature may affect aquatic populations, higher frequency of severe weather events influencing social and economic activities, scientific debate over nature and degree of change...

Skills and Attitudes:*

S2-0-2a, S2-0-2c

S2-0-4f, S2-0-4g

S2-0-7f

S2-0-8e

S2-0-9c

***Note:** Refer to Appendix 1 for a complete listing of the skills and attitudes outcomes.

Materials

Video: *Sila Alangotok—Inuit Observations on Climate Change*

Trip Reports (obtained as PDF files from <http://www.iisd.org/casl/projects/inuitobs.htm>): Enough for each group

BLM 2: Video-Related Questions

BLM 3: Trip Report Summary

BLM 4: Trip Report: Reflection Questions

Appendix 2: Aboriginal Traditional Knowledge and Environmental Management (page 58 only)

Procedure

Part 1: Research

Prior to this learning activity, ensure that students have viewed the video and answered questions 1 to 3 from BLM 2.

1. Have students, in groups of four, share their responses to questions from BLM 2. These groups are the "home" groups.

2. Have students in each home group number themselves from 1 to 4. Students then rearrange into "expert" groups (all "1" members together, all "2" members together, etc.). Each expert group is assigned a trip report and is responsible for summarizing and describing the purpose, objectives, methods, and findings for their trip report, using BLM 3.

3. Students return to their home groups to present the information gathered in their expert groups.

Part 2: Trip Report: Reflection Questions

Have each home group complete the questions from BLM 4. Suggested responses are provided below for teacher reference.

1. List the methods used to gather information in the Sachs Harbour community.
   - *Group discussion/brainstorming*
   - *Interviews (both short and general in nature and longer and more specific in nature)*
   - *Scientific measurements*
   - *Videotaping on-the-land activities*

2. The science group found that interviews were a valuable method of gathering information. Summarize the benefits of this methodology.
   - *Gave the initial observations more detail*
   - *Allowed for the separation of climate-related observations from non-climate-related observations*
   - *Placed observations in time and space*
   - *Identified the context of the observations*
   - *Allowed for identification of which community members were observing which phenomena*
   - *Identified which community members were most knowledgeable about climate change*
   - *Helped secure species identifications*
   - *Generally, interviews provided the most detailed information*

3. Using the information from the video and the trip reports, discuss with your group whether the scientists gained valuable information about climate change through this project. Develop a statement that justifies, to funding groups, the use of this costly and time-consuming method of gathering information about climate change from other communities.
   - *Responses should refer to the fact that interviews generate the most detailed and accurate information.*

Part 3: Application

Have each group imagine they are responsible for organizing a "trip 5." Using the information from trips 1 to 4 and lessons learned, each group will outline the purpose and objectives for the trip and the methods to be used. A set of interview questions should also be developed.

Responses will vary. The purpose and objectives can target a particular area of students' interest, or a perceived gap in the project to date. For example, information related to the fall season has not been gathered. Methods should include interviews and on-the-land observations/video recording.

Extension

Have students read the second page of the article "Aboriginal Traditional Knowledge and Environmental Management" (Appendix 2, page 58). Have them identify specific examples of how traditional knowledge gathered through interviews has been used.

Sample Summaries of Each Trip

Detailed reports of the four trips that the project team made to Sachs Harbour are available on the International Institute for Sustainable Development website at <http://www.iisd.org/casl/projects/inuitobs.htm>. Summaries of these trips are provided on the following pages for teacher reference.

Trip Report Summary
(For Teacher Reference)

Trip Report Number: 1

Purpose and Objectives:

- Describe the project to the Inuit community.
- Hold planning workshops so that local people can describe their livelihood system.
- Videotape the planning workshop.
- Videotape location shots of the community.
- Plan an article on the contribution of local observation and traditional knowledge to climate change research.

Methods:

The project team met to discuss the trip objectives and the details of the scheduled activities. Prior to holding the workshop, the team was introduced to community Elders by a community member, Rosemarie. The majority of adults in Sachs Harbour attended the workshop—over 30 people in all.

During the workshop, six different activities took place:

- **Issue identification:** Issues were identified by the community.
- **Cause-effect analysis:** Issues were arranged into "trees" or priority areas.
- **Timeline:** Community members and Elders charted the changes in the environment back through time.
- **Ranking:** Participants used coloured dots to prioritize the climate change effects.
- **Annual calendar:** Participants created a circular representation of yearly events and traditional activities.
- **Trip planning:** Participants selected the best time for videotaping and interviews.

Findings:

Observations recorded during the first trip:

- **Changes in birds:** The community provided observations of bird species that had not been present in the past.
- **Changes in marine animals:** Community members observed new species such as salmon and herring and an increase in deformed fish; rock cod was observed to be on the decline.
- **Changes in land animals:** The caribou population was smaller and contained fewer large males; the muskox population had increased, but with higher incidences of deformities than in the past; polar bears left their dens earlier and moved further away from the community; the wolf population had increased; the rabbit population had decreased; a new type of black/red fox was observed.
- **Changes in insects:** Increased number and diversity of insects, increased number of mosquitoes, and longer mosquito season were observed.
- **Changes in weather patterns:** Milder winters, warmer summers, shorter fall, and slower freeze-up were observed; increased rain, summer hail, and occurrence of thunder and lightening were observed; fluctuations in the seasons were noted, particularly an earlier arrival of spring.

Trip Report Summary

Trip Report Number: 2

Purpose and Objectives:

- Videotape Inuit as they perform traditional activities such as sealing and fishing during the short Arctic summer, when the coastline is free of ice.
- Videotape changes to the environment such as shoreline slumping caused by melting permafrost, and appearance of new animal and insect species.
- Videotape interviews with community members about changes in their environment due to climate change and effects of these changes on their livelihood and their ability to adapt to these changes.
- Audiotape longer interviews with selected community members to gather data for the project's journal article.

Methods:

- The videotaping group recorded the seal hunt, the melting permafrost, net fishing, interviews with Elders and the science group, and wildlife shots.
- The science group conducted interviews with community Elders and hunters. The interviews focused on observing the effects of climate change on the summer season, and were structured using the initial workshop as a guide. This group focused on three areas: the traditional knowledge, the relevance of the knowledge to research on climate change, and the development of a process for better communication of Inuit traditional knowledge.

Findings:

By following up on the initial observations from the first trip, the science group found that the interviews

- gave initial observations more detail
- allowed for the separation of climate-related observations from non-climate-related observations
- placed the observations in time and space
- identified the context of the observations
- allowed for the stratification of observations and identification of community members observing phenomena
- identified which community members were most knowledgeable about climate-related change and traditional activities
- gave insight on indicators of change, as used by community members
- helped to secure unclear bird and fish identifications

Trip Report Summary

Trip Report Number: 3

Purpose and Objectives:

- Videotape Inuit as they perform traditional activities during the winter.
- Videotape the environment in the winter.
- Videotape short interviews with community members about changes to their environment that may be caused by increased climate variability, about effects of these changes on their livelihood, and about their ability to adapt.
- Record longer, more in-depth interviews with selected community members.

Methods:

- The group videotaped several sequences, including: wildlife, interviews with community members at winter camp, a traditional muskox harvest, polar bear fleshing, and ice gathering.
- The science team conducted 13 interviews, which built upon enhanced observations and knowledge of climate-related change.

Findings:

Points made after the interviews:

- There is an abundance of knowledge in the community relating to historical and current wildlife populations, their behaviour and health, and the relationship between weather and wildlife.
- Climate-related change is complicated by factors such as harvesting patterns.
- Knowledge of active harvesters contributes to current science-based knowledge of wildlife and climate change.
- While the specific impacts of climate change on wildlife populations may be difficult to assess, it is clear that any wildlife-related changes will also affect the community.

Trip Report Summary

Trip Report Number: 4

Purpose and Objectives:

- Videotape Inuit as they perform traditional activities during the spring and videotape the environment in the spring.
- Videotape short interviews with community members about changes to their environment that may be caused by increased climate variability.
- Record longer, more in-depth interviews with selected community members.

Methods:

- The team videorecorded interviews with community members, taped members running a dogsled team across the frozen ocean, and taped interviews with
  – Rosemarie and Sarah Kuptana
  – Roger Kuptana on observed climate change
  – Stephen Robinson, a geoscientist, on the increased melting of the permafrost
  – other community members on the changes in the shoreline
- The science team interviewed nine community members. The interviews were informal and flexible. All the interviews emphasized permafrost and springtime changes. The interviews also looked at spring seasonal activities such as goose hunting and ice fishing. The science team had community members bring them to places on the land where changes were occurring.

Findings:

The science team drew the following conclusions:

- There is an abundance of knowledge in the community related to historical and current landforms, erosion activity, and permafrost conditions. The knowledge is closely tied to the activities of community members. The community members were able to tell the difference between natural and abnormal climate and erosion processes; the melting permafrost has had less impact on community activities than the rapid spring melt and delayed winter freeze-up have had; the community members discussed the permafrost and its changes using additional variables such as wind, precipitation, temperature, and human activity.

D. The Impact of Climate Change on the Arctic

There are similarities between the observations the Elders and community members made regarding climate change and the projections suggested by Western scientists. The "Executive Summary" in *Responding to Global Climate Change in Canada's Arctic* (Maxwell, 1997, xiv–xvii), summarizes the possible impacts. In this learning activity students will examine climatic change and the projections of Western scientists, along with the observations made in the video.

The next step is to have students think about how they could design a questionnaire or survey to find out the climate change observations of their own community. In Senior 2 English language arts, students are expected to design questionnaires or survey instruments. Some strategies to assist students in developing these instruments can be found in *Senior 2 English Language Arts: A Foundation for Implementation* (Manitoba Education and Training, 1998, Senior 2–220).

Objectives

The students will

- compare and contrast the predictions made by scientists with observations made by Inuit Elders and community members
- design an instrument that will summarize observations on climate change in their own community

Senior 2 Learning Outcomes

Knowledge:

S2-4-07 Investigate and evaluate evidence that climate change occurs naturally and can be influenced by human activities.

Include: the use of technology in gathering and interpreting current and historical data.

S2-4-08 Discuss potential consequences of climate change.

Examples: changes in ocean temperature may affect aquatic populations, higher frequency of severe weather events influencing social and economic activities, scientific debate over nature and degree of change...

Skills and Attitudes:*

S2-0-2a, S2-0-2c

S2-0-4f, S2-0-4g

S2-0-7f

S2-0-8e

S2-0-9a

***Note:** Refer to Appendix 1 for a complete listing of the skills and attitudes outcomes.

Materials

Video: *Sila Alangotok—Inuit Observations on Climate Change*

Appendix 3: Responding to Global Climate Change in Canada's Arctic (Executive Summary)

BLM 5: Impact of Climate Change on the Arctic

Procedure

Opening Question: Based on your knowledge of the factors that contribute to climate, how do you think climate change will affect northern Canada?

1. As students view the video, have them record (in the first column of BLM 5) all comments made by community members and Elders regarding their observations on climate change in the Sachs Harbour community.

2. Before students read the "Executive Summary" report, discuss the concepts of "direct" and "indirect" impacts of climate change.

3. Have each student then examine the "Executive Summary" report and identify the direct and indirect impacts of climate change by underlining direct impacts once and double underlining indirect impacts. Using this information, students then complete the remaining columns of BLM 5. Student responses will vary.

4. Have students pair up and share their tables with one another, filling in any missing information.

5. Have students complete questions 1 to 3 on BLM 5.

   Note: Sample answers are provided on the following pages for teacher reference.

Sample Answers (for Teacher Reference)

The Impact of Climate Change on the Arctic*

Video—Community Information	Report—Scientists' Information	
	Direct Impacts	Indirect Impacts
Temperature		
– permafrost changes, landslides depicted in the video, discussion of the disappearance of sea ice when collecting fresh water – the open water season – increased change in temperature – later freeze-up – thunderstorms – shorter fall and slower freeze-up – boating in November; no icebergs in summer – geese stay shorter time in spring – melting faster each spring – warmer summer – warmer water	– winter temperature will increase 5 to 7ºC over the mainland and up to 10ºC over Hudson Bay – summer temperature will increase up to 5ºC over the mainland and 1 to 2ºC over Hudson Bay	– increased evaporation, may affect vegetative cover – reduction in flows of rivers – over half the discontinuous permafrost will disappear eventually and boundary will shift northward – increase in shallow landslides – sea ice occurrence will decline – open water season will increase – river ice season will be reduced
Precipitation		
– increase in appearance of insects and greater diversity of insects – deformed muskox – erosion	– increases in precipitation of up to 25% will be spread throughout the year over most of the Arctic	– biome distribution will change – ecosystem composition will change and species diversity will decrease – increase in forest fires, more insects, and longer growing season – populations of caribou may decline due to increase in pests and decrease in availability of forage – shift in distribution of species northward

(continued)

* Climate change data is based on Environment Canada's reports of the Canada Country Study, which assessed the impacts of climate change on the different regions of Canada.

Sample Answers *(continued)*

Video—Community Information	Report—Scientists' Information	
	Direct Impacts	Indirect Impacts
Infrastructure		
	– increased cost in general operations in the Arctic – expansion of roadways – longer shipping season – increased maintenance costs of roadways – reduced power demand for heating and insulation – increased length of construction season – increased length of tourism season	
Society		
	– traditional knowledge and local adaptations of people may no longer be applicable – health of northerners may be affected	– the weather is no longer predictable based upon traditional ecological knowledge
Animal and Plant Populations		
	– decline in age and girth of trees – increase in harvests of most fish species	– greater diversity of fish species – catching salmon where salmon were never found before

Sample Answers—BLM 5

1. Note similarities and differences between observations of community members and information from scientists.

   a. Summary of Similarities:
      – *Both information sources provide details related to the landscape and plant and animal species.*
      – *The actual observations reported by the community members relate directly to the predictions made by scientists.*

   b. Summary of Differences:
      – *Not all the scientists' predictions have been observed at this time.*
      – *Community members have observed additional changes that were not included in the scientists' predictions (e.g., deformed species on the rise, greater diversity of species now found).*
      – *The community members did not talk about infrastructure changes.*

Note: Not all the changes observed by community members are necessarily attributable to climate change.

2. Do you think it is important to include information from both scientists and community members when trying to understand something as complex as climate change? Why or why not?

   Answers will vary. Students should recognize the importance of both types of information.

3. Brainstorm two other situations where it would be important to gather information from both scientists and local community members (e.g., To see the impacts of...).

   Answers will vary. Possibilities include:

   – *To see the impacts of a hydro dam development, forestry project, oil pipeline, etc.*

E. Examining the Environmental, Economic, and Social Consequences of Climate Change in the North

Climate change is not only an environmental issue—it also has economic and social implications. Social factors include physical, psychological, spiritual, and social health. In this learning activity students will explore possible social, economic, and environmental consequences of climate change on the community members of Sachs Harbour.

Objectives

The students will

- brainstorm the possible consequences of climate change on northern communities by looking at environmental, economic, and social factors
- use a variety of sources to investigate the consequences of climate change on northern communities

Senior 2 Learning Outcomes

Knowledge:

S2-4-07 Investigate and evaluate evidence that climate change occurs naturally and can be influenced by human activities.

Include: the use of technology in gathering and interpreting current and historical data.

S2-4-08 Discuss potential consequences of climate change.

Examples: changes in ocean temperature may affect aquatic populations, higher frequency of severe weather events influencing social and economic activities, scientific debate over nature and degree of change...

Skills and Attitudes:*

S2-0-1d

S2-0-2a, S2-0-2c

S2-0-5d

S2-0-7f

***Note:** Refer to Appendix 1 for a complete listing of the skills and attitudes outcomes.

Materials

Video: *Sila Alangotok—Inuit Observations on Climate Change*

Materials for presentations, as required

Procedure

Opening Question: Based on your knowledge of the factors that contribute to climate, how do you think climate change will affect northern Canada?

1. Place students in pairs. Have each pair brainstorm and record possible consequences of climate change in northern communities by looking at environmental, economic, and social factors.
2. Introduce the video. Have students watch the video and record, on a separate piece of paper, any additional consequences.
3. Have each pair choose a format for presenting the information they have gathered. Possible formats include a poster, rap, poem, illustration, and newspaper article.
4. Have each group present their findings to the class.

Sample Brainstorming Record of Possible Consequences of Climate Change in Northern Communities*

Environmental	Economic	Social
Temperature – winter temperature will increase 5 to 7ºC over the mainland and up to 10ºC over Hudson Bay – summer temperature will increase up to 5ºC over the mainland and 1 to 2ºC over Hudson Bay **Precipitation** – increases in precipitation of up to 25% will be spread throughout the year over most of the Arctic – increased evaporation may affect vegetative cover – reduction in river flows – over half the discontinuous permafrost will disappear eventually and boundary will shift northward – increase in shallow landslides – sea ice occurrence will decline – open water season will increase – river ice season will be reduced – biome distribution will change – ecosystem composition will change and species diversity will decrease – increase in forest fires – more insects – longer growing season – populations of caribou may decline due to increase in pests and decrease in availability of forage – shift in distribution of species northward	– increased cost in general operations in the Arctic – decreased accessibility of ice roads (a major infrastructure in the North in the winter) – expansion of roadways – increased maintenance costs of roadways – longer shipping season – loss of equipment due to weakened ice roads (a major problem for oil and gas companies) – in the past, ice roads did not need to be flooded as there was enough natural ice formation; now the ice roads need to be flooded to get them thick enough to travel on – reduced power demand for heating and insulation – increased length of construction season – increased length of tourism season – decline in age and girth of trees – increase in harvests of most fish species	– traditional knowledge and local adaptations of people may no longer be applicable – disruption of traditional knowledge systems – disruption of traditional lifestyles/livelihoods – health of northerners might be affected – relocation of communities due to permafrost erosion, especially along the coasts – loss of life (increasingly dangerous to travel on the ice) – more frequent and intense storms increase danger for people in boats along the Beaufort Sea, etc.

* Climate change data is based on Environment Canada's reports of the Canada Country Study, which assessed the impacts of climate change on the different regions of Canada.

F. The Arctic Ecosystem and Climate Change Observations

In the video, members of the Sachs Harbour community speak of several animal and plant species that are specifically being affected by the change in climate. In this learning activity, students will explore the habitats of a variety of Arctic species by using information available on Environment Canada's website and by predicting some possible impacts of climate change on animals. If desired, the exploration can be adapted to suit the geographic area of the students. In First Nations communities an additional interview component can be incorporated into this exploration by encouraging students to document and record the observations of Elders and hunters on climate change in their own research. Suggestions for a town meeting like the one shown in the video are included at the end of this exploration.

Note: One of Manitoba's recommended resources *Science 10* (Ritter, et al., 2001, 637-638) includes an introduction to issues involving global warming in Canada.

Objectives

The students will

- explore the habitat of species in the Arctic ecosystem and identify the requirements for these species to survive
- predict the possible impacts of climate change on the habitats of Arctic species
- research observations on the impacts of climate change on the habitats of Arctic species

Senior 2 Learning Outcomes

Knowledge:

S2-1-10 Investigate how human activities affect an ecosystem and use the decision-making process to propose a course of action to enhance its sustainability.

Include: biogeochemical cycling, population dynamics, and biodiversity.

Skills and Attitudes:*

S2-0-2a, S2-0-2b, S2-0-2c

S2-0-7e

S2-0-9c

***Note:** Refer to Appendix 1 for a complete listing of the skills and attitudes outcomes.

Materials

Video: *Sila Alangotok—Inuit Observations on Climate Change*

Hinterland Who's Who information sheets of various Arctic species, available from Environment Canada, Canadian Wildlife Service website at <http://www.cws-scf.ec.gc.ca/hww-fap/index_e.cfm>. Suggested species: Canada goose, common eider, greater and lesser snow goose, ptarmigans, whooping crane, Arctic fox, caribou, moose, muskox, polar bear, snowshoe hare, and wolf.

Procedure

Opening Question: Based on your knowledge of the factors that contribute to climate, how do you think climate change will affect the animal populations in northern Canada?

1. Assign each student to a group of four to six students. Each group member will select an Arctic species to research. Have the class decide which features of the habitat each group must examine for their species.
2. Allow students time to research.
3. Have each group member present and discuss his or her research with the rest of the group. Have each group compile a summary of information about their group's species.
4. Have the group predict the possible impacts of climate change on their species. These will be conjectures or hypotheses about how climate change may affect their species.
5. Have students view the video and identify all the species that the Inuit Elders and community members mention as being affected by the observed climate changes in Sachs Harbour.
6. Have students record the observations that scientists, Inuit Elders, and community members made about their selected species and add this information to their research.
7. Have each group create a food web composed of the species studied in their group and create a poster of the food chain that includes explanations of the impact of climate change.
8. Conduct a Gallery Walk of the posters, with peer-assessment sheets for each group. Place a pad of self-adhesive paper at each site so that students can write immediate comments and feedback for their peers and then attach the notes to the poster.

Incorporating Local Knowledge

Some schools may be in a community where students have the opportunity to interview local hunters, trappers, and Elders to help them comprehend the knowledge held within their own community about animal species and climate change. If this is the case, extend this lesson by incorporating an interview component. Have students brainstorm the questions they would ask a hunter or Elder about the changes observed in the local environment. With the students, create an interview protocol they could follow for this investigation and include a discussion of appropriate ways to approach an Elder and ask for information.

Have students include this information on their posters and invite the community members who participated to view the posters. Have students record all the comments made by the community members about their poster and reflect on these comments.

G. Development Project: A Decision-Making Activity

The decision-making process encourages students to evaluate science and technology issues in the context of society and the environment. In the following learning activity, student groups make decisions related to a specific role they will play in a mock open house moderated by the teacher. The objective of the open house is to complete the decision-making process with the input of all the stakeholders. This will be a challenge for the students and the teacher.

Objectives

The students will

- identify the impact of a proposed economic development project on an Arctic community and on climate change
- use the decision-making process to develop a plan regarding a proposed economic development project in an Arctic community

Senior 2 Learning Outcomes

Knowledge:

S2-1-10 Investigate how human activities affect an ecosystem and use the decision-making process to propose a course of action to enhance its sustainability.

Include: biogeochemical cycling, populations dynamics, and biodiversity.

Skills and Attitudes:*

S2-0-1d

S2-0-2a, S2-0-2b, S2-0-2c

S2-0-3d, S2-0-3e, S2-0-3f

S2-0-4f, S2-0-4g

S2-0-5d

S2-0-6d

S2-0-7c, S2-0-7e, S2-0-7f

***Note:** Refer to Appendix 1 for a complete listing of the skills and attitudes outcomes.

Materials

BLM 6: Role Cards for Conference Members

BLMs 1a and 1b: Decision-Making Process and Decision-Making Chart

Access to the Internet

Role-Playing

Scenario

A large oil and gas exploration company named Ready Gas, in partnership with Inuit Oil and Gas, has recently applied to drill for oil close to an Inuit community. This type of partnership is now required for southern-based companies before proceeding to oil exploration and extraction in Canada's North. The oil that is extracted will be sold to the United States, where there is an oil shortage. In the application, Ready Gas agrees to employ community members for the construction of buildings and train community members for the maintenance of the drill. To determine whether the exploration application should be approved, the federal government is holding an open house to give the stakeholders a chance to present their opinions and suggest outcomes regarding the impact the oil project will have on the community and the environment.

1. Have students brainstorm and identify the possible stakeholders that may be involved in the open house.
2. Divide the class into pairs or groups of three. Give one role card (see BLM 6) to each group (or develop role cards as a group). Each group will evaluate the impact of climate change from the perspectives of different stakeholders in the debate by using the decision-making process.
   a. Have students use the Decision-Making Chart (BLM 1b) to identify as many alternatives as they can from their own perspective (based on their role).
   b. Have each group try to predict alternatives that may be proposed by other groups. These should be added to the chart.
   c. Each group should then complete the risk/benefit analysis, logic check, values identification and prioritizing, and action recommended.

   Note: Students will need to research the various perspectives and courses of action they might propose.
3. The objective of the open house will be to generate a possible course of action that will include the action guidelines and an implementation timeline.
4. Hold a mock open house of delegates. The person presiding over the discussions will play the role of the Prime Minister of Canada.
5. Have students reflect on the process involved in the conversations and debates that may have occurred during the open house.

H. Creating a Community Plan to Reduce Greenhouse Gas Emissions

Many cities and towns across Canada have developed their own plans to reduce greenhouse gas emissions. The Federation of Canadian Municipalities (FCM) has actively encouraged the reduction of greenhouse gases of municipal governments. In 1995, the FCM established its "20% Club," which challenged communities to reduce their greenhouse gas emissions by 20% below 1990 levels by 2005. The cites of Ottawa, Toronto, Regina, Edmonton, and Vancouver were the founding members of the 20% Club. The Club has now evolved into the Partners for Climate Protection Program, a joint initiative with the International Council for Local Environmental Initiatives.

For more information see:

- The International Council for Local Environmental Initiatives <http://www.iclei.org/>
- The Federation of Canadian Municipalities <http://www.fcm.ca/newfcm/>

Some local governments have developed community plans that address the reduction of greenhouse gas emissions. The FCM website presents case studies of small northern communities committed to designing community plans that reduce greenhouse gas emissions (e.g., the Oujé-Bougoumou community, Québec; the village of Fort McPherson, Northwest Territories; and the town of Fort Smith, Northwest Territories).

The following learning activity will ask students to explore the initiatives of their local municipal government and design an action plan for their community to reduce greenhouse gas emissions. This activity can be adapted by having students design an action plan for their school rather than their community. The principal or a board member could present information on ways in which the school reduces greenhouse gas emissions.

Note: It is assumed that students have completed a study of weather and climate, specifically greenhouse gases, prior to conducting this learning activity.

If students conducted the previous learning activity, they will have had some exposure to the decision-making process. If not, review the decision-making process prior to this exploration.

Objectives

The students will

- explore the initiatives of their local community to reduce greenhouse gas emissions
- identify possible initiatives that could be taken to reduce greenhouse gas emissions in their local community
- design an action plan to implement initiatives to reduce greenhouse gas emissions
- design a method to evaluate an action plan
- present the action plan to the class

Senior 2 Learning Outcomes

Knowledge:

S2-1-10 Investigate how human activities affect an ecosystem and use the decision-making process to propose a course of action to enhance its sustainability.

Include: impact of biogeochemical cycling, population dynamics, and biodiversity.

S2-4-07 Investigate and evaluate evidence that climate change occurs naturally and can be influenced by human activities.

Include: the use of technology in gathering and interpreting current and historical data.

Skills and Attitudes:*

S2-0-2a

S2-0-3d, S2-0-3e, S2-0-3f

S2-0-4e, S2-0-4f, S2-0-4g

S2-0-5d

S2-0-6d

S2-0-7c, S2-0-7d, S2-0-7e, S2-0-7f

***Note:** Refer to Appendix 1 for a complete listing of the skills and attitudes outcomes.

Materials

Internet access for exploration of local community initiatives to reduce greenhouse gas emissions and the initiatives taken by other communities

Presentation by a local community government member(s) on the initiatives taken to reduce greenhouse gas emissions

Video: *Sila Alangotok—Inuit Observations on Climate Change*

BLMs 1a and 1b: Decision-Making Process and Decision-Making Chart

Procedure

Opening Question: How do you think you can contribute to reducing your community's greenhouse gas emissions?

1. Have students watch the video *Sila Alangotok—Inuit Observations on Climate Change*. During the video presentation, have students identify the impacts of climate change on Sachs Harbour.

2. Have students review what they have learned in previous science lessons about greenhouse gases and brainstorm some of the initiatives their community could be taking to reduce greenhouse gas emissions.

3. Have a local government representative present to the class the community's plan to reduce greenhouse gas emissions. If the community does not have a plan, the representative might present some activities related to greenhouse gas reduction (e.g., recycling programs, heating and lighting of government buildings).

4. Divide students into groups of four. Brainstorm with the class to identify the components of a presentation. Ensure that each group member has a responsibility in the presentation.
5. Have each group of students use the decision-making process to decide on some action to take regarding the community's response to global climate change. (Students may use BLM 1b; however, they will need to provide more details in the Action Recommended portion than space allows.) Have each group design an action plan for their community to reduce greenhouse gas emissions, incorporating the information already obtained from the video and the community presentation. Have students propose possible actions for both greenhouse gas emission reduction and emission credits.
6. Have each student group present the information to the rest of the class.

Assessment

Use the criteria below or student-generated criteria to assess students' presentation skills.

Criteria for Assessing Presentation Skills

Criteria	Exemplary	Accomplished	Beginning
Content	– Presentation is logically or creatively organized. – Main points of action plan are presented in a clear and convincing manner. – Information from video and community presentation is effectively incorporated. – Visuals are used effectively.	– Presentation is organized. – Main points of action plan are presented. – Information from video and community presentation is incorporated. – Visuals are used appropriately and add to presentation.	– Presentation lacks clear organization and structure. – Action plan is not clearly described. – Information from video and community presentation is not incorporated. – Visuals are used ineffectively.
Delivery	– Words are spoken clearly and rate of speech is well paced. – Volume is loud enough to be heard easily. – Keeps the audience's attention.	– Some words are not spoken clearly and rate of speech is at times too slow or too fast. – Volume is loud enough most of the time. – Generally keeps the audience's attention.	– Many words are not spoken clearly and rate of speech is generally too slow or too fast. – Volume is difficult to hear most of the time. – Does not hold the audience's attention.

I. Extension: TEK and Environmental Management

The video *Sila Alangotok—Inuit Observations on Climate Change* highlights one example of how scientists have acknowledged the importance of TEK and are incorporating information gathered from local people into their work. Across Canada there are many examples of the incorporation of TEK into decision-making processes. The following learning activity will allow students to explore some of these examples.

Objectives

The students will

- identify examples where TEK has been used in decision making
- explore one case study

Senior 2 Student Learning Outcomes

This learning activity goes beyond the student learning outcomes identified for Senior 2 Science.

Materials

Appendix 2: Aboriginal Traditional Knowledge and Environmental Management (pages 59 to 61)

Procedure

Opening Question: How can TEK be used in decision making?

1. Have students read the final three pages of the article "Aboriginal Traditional Knowledge and Environmental Management" (Appendix 2, pages 59 to 61).
2. Have students make notes on the types of examples the article contains.
   a. Ask students to select one of the examples cited in the article and use the Internet to gather more information on the project to prepare a summary report containing information that answers questions such as the following:
      - Who was involved?
      - How did it happen?
      - What was the result?
      - Why was this important?

   OR

   b. Have students investigate an example of how local TEK/community members have been involved in a decision-making process. Students can use the questions outlined above to guide the creation of a summary report.