The Arctic Tundra Biome

Lesson Overview:

The lesson explores the characteristics of the Arctic Tundra biome and analyzes the factors influencing the climate, soils, natural vegetation and fauna of the region.

Grade Level:
Grades 9-12

Time Required: 60-90 minutes

Curriculum Connection:
British Columbia, Geography 12

Links to Canadian National Standards for Geography:

Essential Element #1: The World in Spatial Terms
• Map, globe, and atlas use (e.g. observing and analyzing relationships)

Essential Element #2: Places and Regions
• Physical and human processes shape places and regions
• Regional analysis of geographic issues and questions

Essential Element #3: Physical Systems
• World climate regions
• World patterns of biodiversity
• Inter-annual climate variation

Geographic Skill #2: Acquiring Geographic Information
1. Systematically locate and gather geographic information from a variety of primary and secondary sources.
2. Systematically assess the value and use of geographic information.

Geographic Skill #3: Organizing Geographic Information
1. Select and design appropriate forms of maps to organize geographic information.
2. Select and design appropriate forms of graphs, tables and charts to organize geographic information.
3. Use a variety of media to develop and organize integrated summaries of geographic information
Geographic Skill #4: Analyzing Geographic Information
1. Use quantitative methods of analysis to interpret geographic information.
2. Make inferences and draw conclusions from maps and other geographic representations.
3. Use the processes of analysis, synthesis, evaluation and explanation to interpret geographic information from a variety of sources.

Geography Skill #5: Answering Geographic Questions
1. Formulate valid generalizations from the results of various kinds of geographic inquiry.
2. Evaluate the answers to geographic questions.
3. Apply geographic models, generalizations and theories to the analysis, interpretation and presentation of geographic information.

Link to the Canadian Atlas Online (CAOL)
www.canadiangeographic.ca/atlas/
"The Power of Permafrost"
http://www.canadiangeographic.ca/atlas/themes.aspx?id=artic&sub=artic_features_permafrost&lang=En

Additional Resources, Materials, and Equipment Required:
- Computer lab and LCD projector
- Canadian Atlas Online “Canada’s Many Faces” - Video clip “Arctic Lands”
- The Arctic Tundra Biome Student Worksheet
- Climate Controls Handout
- Pencils, blue and red pencil crayons
- Calculator

Main Objective:
The primary goal of the lesson is to describe and account for the location and characteristics of the Arctic Tundra biome.

Learning Outcomes: By the end of the lesson, students will be able to:
- Define the term “biome”
- Locate the Arctic tundra biome on a world map
- Draw a climate graph from a table of climate data for a specific climate station
- Describe the characteristics of the Arctic tundra climate region
- Calculate the:
  - Annual temperature range
  - Mean annual temperature
  - Total annual precipitation for the specific climate station
- Explain how climate affects human activity
• Outline the soils and natural vegetation characteristics of the Arctic tundra biome
• Describe how vegetation adapts to environmental conditions
• Relate the Arctic soil type to the Arctic biome
The Lesson:

<table>
<thead>
<tr>
<th>Teacher Activity</th>
<th>Student Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td></td>
</tr>
<tr>
<td>• Show students the Canadian Atlas Online “Canada’s Many Faces” - Video clip “Arctic Lands”.</td>
<td>• Students watch the video clip and write down key descriptive words of their observations of the Arctic landscape from the video clip.</td>
</tr>
<tr>
<td>• Ask students to write down key descriptive words of their observations of the Arctic landscape from the video clip.</td>
<td>• Students share their observations with the class.</td>
</tr>
<tr>
<td>Lesson Development</td>
<td></td>
</tr>
<tr>
<td>• Introduce the theme of the Arctic biome.</td>
<td>• Students share their definitions of biome.</td>
</tr>
<tr>
<td>• Ask students to share what aspects of biome they observed in the video clip.</td>
<td>• Students work through the worksheet and complete it by the end of the lesson.</td>
</tr>
<tr>
<td>• Hand out the worksheet entitled “The Arctic Tundra Biome Student Worksheet” and the handout “Climate Controls”.</td>
<td>• In the event that there is insufficient time, instruct students to complete the web-based sections of the worksheet in the lab and conclude the assignment for homework.</td>
</tr>
<tr>
<td>• Assign students the worksheet to be completed in the computer lab by the end of the lesson.</td>
<td></td>
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<tr>
<td>Conclusion</td>
<td></td>
</tr>
<tr>
<td>If students have completed the worksheet during the lesson, collect the assignment and assess the three components: climate, soils, flora &amp; fauna.</td>
<td>Hand in assignment for assessment.</td>
</tr>
</tbody>
</table>

Lesson Extension:
Students can create their own graphic organizer of the Arctic Tundra biome by making a copy of the climate graph and soil profile with a photograph of the natural vegetation of the biome.
Students can add summary notes on the graphic organizer explaining the factors influencing the biome.
Students can apply the template of the Arctic Tundra biome lesson to their study of the other biomes outlined in the Geography 12 curriculum.
Assessment of Student Learning:

Assessment of the climate graph (following instructions) – marks are given for accuracy, neatness and correct title.

Grade the climate calculations for accuracy.

Assess the analysis of the climate, soils and natural vegetation of the Arctic Tundra biome. Students should demonstrate an understanding of the relationships between climate, soils and natural vegetation (e.g.: permafrost does not allow plant root penetration – therefore the dominant plant life consists of stunted shrubs, mosses and lichen. Low rainfall does not support the growth of trees. Low temperatures result in permafrost.)
Student Worksheets

The Arctic Tundra Biome

A biome is defined as “a broad, regional type of ecosystem characterized by distinctive climate and soil conditions and a distinctive biological community adapted to those conditions.”
(http://www.environment.nelson.com/0176169040/glossary.html)

The aim of this lesson is to discover the characteristics of the Arctic biome by studying the features of its
• climate
• soils
• natural vegetation
• animal life

Where is the Arctic Tundra biome?

Refer to the following website to locate the Arctic Tundra region on a world map.
http://www.blueplanetbiomes.org/world_biomes.htm

1. Shade in the extent of the Arctic Tundra region on the map outline below.

2. Describe the location of the Arctic Tundra biome.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
The Arctic/Polar/Tundra Climate

The Arctic climate is also referred to as a Polar or Tundra climate. We will use a climate graph to illustrate the characteristics of a typical Arctic climate. Use an atlas to find the location of Iqaluit and plot its location on the world map above.

Iqaluit, Nunavut

<table>
<thead>
<tr>
<th></th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temperature (°C)</strong></td>
<td>-26.6</td>
<td>-28</td>
<td>-23.7</td>
<td>-14.8</td>
<td>-4.4</td>
<td>3.6</td>
<td>7.7</td>
<td>6.8</td>
<td>2.2</td>
<td>-4.9</td>
<td>-12.8</td>
<td>-22.7</td>
<td></td>
</tr>
<tr>
<td><strong>Precipitation (mm)</strong></td>
<td>21.1</td>
<td>15</td>
<td>21.8</td>
<td>28.2</td>
<td>26.9</td>
<td>35</td>
<td>59.4</td>
<td>65.7</td>
<td>55</td>
<td>36.7</td>
<td>29.1</td>
<td>18.2</td>
<td></td>
</tr>
</tbody>
</table>

Data Source: [http://climate.weatheroffice.ec.gc.ca/climate_normals](http://climate.weatheroffice.ec.gc.ca/climate_normals)

**Instructions for drawing a climate graph:**
- Plot the temperature for each month with a dot in the middle of the column for the month at the appropriate temperature. Join the dots with a smooth line. The line is usually drawn in red pencil.
- Plot the precipitation for each month with a bar in the column for the month at the appropriate precipitation level. The columns (bars) are usually coloured in blue pencil.
- Give the graph an appropriate title.
Climate Questions

1) Calculate the following values for the climate station of Iqaluit, Nunavut: 
   A. annual temperature range (maximum subtract minimum temperature). 
      Write this number in the box below.

      | annual temperature range |
      |---------------------------|

   B. mean annual temperature (sum of mean monthly temperatures divided by 12). 
      Write this number in the box left blank in the climate data table for 
      Temperature – Year.

   C. total annual precipitation (sum of mean monthly precipitation). 
      Write this number in the box left blank in the climate data table for 
      Precipitation – Year.

2) For the climate station of Iqaluit:
   A. Describe and account for the annual range in temperature (HINT: the 
      gradient of the line graph illustrating temperature is a graphic indication 
      of how small or large the temperature range is.)

   B. Describe and account for the pattern of precipitation (when does the 
      precipitation occur and in what amounts?)

(HINT: refer to the handout “Climate Controls" to remind you of the factors 
influencing climate.)

<table>
<thead>
<tr>
<th>Summarize the characteristics of the Arctic climate.</th>
<th>Summarize the main climate controls influencing the Arctic climate</th>
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</thead>
<tbody>
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</tbody>
</table>

Food for Thought
Which climate control is largely responsible for the Arctic's “long dark winters and short, bright summers”?
## Soils of the Arctic/Tundra

<table>
<thead>
<tr>
<th>Gelisol Soil Profile</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Describe the colour and the texture of the soil as illustrated in the soil profile.</em></td>
<td></td>
</tr>
<tr>
<td><em>Read “The Power of Permafrost” Information from the Canadian Atlas Online to complete the next 3 soil activities:</em></td>
<td></td>
</tr>
<tr>
<td>Gelisols are described as those soils that have permafrost within 200 cm (2 metres) of the soil surface. What is meant by “permafrost”?</td>
<td></td>
</tr>
<tr>
<td><em>Describe a gelisol and its permafrost qualities in terms of its drainage and human activities such as road construction and mineral extraction.</em></td>
<td></td>
</tr>
<tr>
<td>How is the thawing permafrost beneficial to the Canadian North?</td>
<td></td>
</tr>
</tbody>
</table>

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“The Power of Permafrost” Information:
**Flora and Fauna of the Arctic Tundra Biome**

The natural vegetation (flora) and the animal life (fauna) of the Arctic Tundra biome are adapted to the climate of the region.

Refer to the following website to learn more about the flora and fauna of the Arctic Tundra biome.

http://www.ucmp.berkeley.edu/exhibits/biomes/tundra.php

Explain how the following characteristics of the flora and fauna are influenced by the climate and soils of the Arctic Tundra biome.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Influence of climate and/or soils</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low biotic diversity</td>
<td></td>
</tr>
<tr>
<td>Shallow root systems</td>
<td></td>
</tr>
<tr>
<td>Low shrubs grouped together</td>
<td></td>
</tr>
<tr>
<td>Plants budding</td>
<td></td>
</tr>
<tr>
<td>Short reproductive cycle</td>
<td></td>
</tr>
<tr>
<td>Mammal and bird fat</td>
<td></td>
</tr>
<tr>
<td>Animal hibernation</td>
<td></td>
</tr>
<tr>
<td>Animal and bird migration</td>
<td></td>
</tr>
<tr>
<td>Absence of reptiles and amphibians</td>
<td></td>
</tr>
</tbody>
</table>
## CLIMATE CONTROL

<table>
<thead>
<tr>
<th>Climate Control</th>
<th>Effect on Temperature (T) and Precipitation (P)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Latitude</strong></td>
<td>T The further from the Equator (north or south) the cooler the temperatures</td>
</tr>
<tr>
<td></td>
<td>P The closer to the Poles, the lower the precipitation, since cooler air holds less moisture</td>
</tr>
<tr>
<td><strong>Ocean Currents</strong></td>
<td>T Warm ocean currents, raise temperatures along the coast (esp. in winter); cold ocean currents lower temperatures</td>
</tr>
<tr>
<td></td>
<td>P Warm ocean currents create wet coastal climates; cold ocean currents help create drier coastal climates</td>
</tr>
<tr>
<td><strong>Wind and Air Masses</strong></td>
<td>T Onshore winds moderate temperatures; offshore winds result in extreme temperatures. Polar air masses are cold whilst tropical air masses are warm</td>
</tr>
<tr>
<td></td>
<td>P Onshore winds carry moisture inland; offshore winds bring drier conditions. Canada experiences prevailing westerlies. Continental air masses are dry whilst maritime air masses are moist</td>
</tr>
<tr>
<td><strong>Elevation</strong></td>
<td>T The higher the elevation, the cooler the temperature</td>
</tr>
<tr>
<td></td>
<td>P The higher the elevation, the higher the precipitation possible</td>
</tr>
<tr>
<td><strong>Relief</strong></td>
<td>T Mountains block winds; temperatures on the windward side can be moderate and on the leeward side, they can be extreme; south facing slopes in the NH are warmer</td>
</tr>
<tr>
<td></td>
<td>P Windward regions are wet and leeward regions are dry (rain shadow effect); south facing slopes in the NH are drier</td>
</tr>
<tr>
<td><strong>Near Water</strong></td>
<td>T Temperatures are moderated (warmer winters; cooler summers) when winds move inland; continental areas far from oceans experience extreme temperatures</td>
</tr>
<tr>
<td></td>
<td>P Coastal areas with mountains receive higher precipitation continental areas receive less precipitation especially when blocked by mountains</td>
</tr>
</tbody>
</table>