



**CGF3M**

**PHYSICAL GEOGRAPHY: PATTERNS, PROCESSES, AND INTERACTIONS, GRADE 11, UNIVERSITY/COLLEGE PREPARATION**

**Overview**

Using geological and atmospheric data, students will analyse historical and current patterns of climate and predict future climate trends and weather patterns. Physical, economic and social impacts of climate change in different regions of the world will be examined.



**SYSTEMS THINKING**

The world can be viewed as networks of relationships among natural systems (as well as between human systems and natural systems) that constantly feed back to alter these dynamic relationships.

***How do past and current climate patterns have an impact on the physical environment of the Earth?***

**Curriculum Expectations**

Please see page 21 for a list of the course curriculum expectations that can be linked to the Guiding Questions below.

**GUIDING QUESTIONS**

QUESTIONS	LEARNING CONCEPTS
<p><i>What physical factors contribute to global climate patterns? How is energy change in the atmosphere related to climate change? How has climate changed over time?</i></p>	<p>The physical nature of the Earth can be explained in terms of how energy interacts with natural systems (such as the atmosphere, the hydrosphere, the lithosphere and the biosphere) to produce global climate patterns.</p> <p>Understanding how energy change in the atmosphere relates to climate change demands a review of geologic time scales as compared to human time scales. The historical understanding of changing climate patterns encompasses longer periods of time than is evident in the timescale in which we measure the current imbalance in the carbon cycle and the hydrological cycle.</p>

QUESTIONS	LEARNING CONCEPTS
<p><i>How are the familiar climate patterns of today linked to a region's economic prosperity and productivity? How could changes to prevailing winds and ocean currents change the productivity and prosperity of different regions?</i></p>	<p>Social systems interact with natural systems and begin to affect local environmental conditions. These interactions can eventually have a greater impact, changing systems beyond the local environment where they began. These changes affect wind and ocean current patterns that will result in dramatic changes for both developed and developing nations.</p> <p>The economic feasibility of certain activities (forestry, agriculture, fishing) in present-day locations will decline, but predictions are not clear. An analysis of the impact of different activities (e.g., resource industries) and the impact of local behaviour on global change can provide case studies of how human activity can increase or decrease the magnitude and rate of climate change.</p>

## INVESTIGATION

### UNDERSTANDING CO<sub>2</sub> TRENDS TO IDENTIFY POSSIBLE FUTURE OUTCOMES

Both local weather and global climate patterns are largely the result of the interactions of the atmosphere and hydrosphere. Prevailing winds and ocean currents result in specific weather patterns (too hot, severe weather) that contribute to changing demographic patterns and economic development. These changing patterns affect the productivity of different regions, which in turn is linked to people's prosperity.

Understanding the interactions of the many factors that contribute to climate is difficult. Data that provides evidence of historical climate patterns and changes can help people today understand and predict the effect of changing the level of CO<sub>2</sub> in the atmosphere. Using data

that show trends of change, students can identify possible future outcomes.

Current use of monitoring technology allows people to track *sources* of CO<sub>2</sub> emissions and identify carbon sinks — areas where carbon is being sequestered. This type of technology is useful for refining and altering models of climate change over time. Such technology could also be used as part of a system to monitor the effectiveness of action and to ensure compliance with CO<sub>2</sub> production limits. (Having such technical capacity raises other questions: e.g., “Would society allow an ‘environmental police service’ to detect the source of emitted gases?”)

## Teaching Suggestions

- **Visual Representation of Data:** There are many opportunities throughout this course where students could take data in different forms and create a visual representation. For example, students can take numbers from charts to form line graphs or bar charts, or to indicate variation on a map with several colours. Students may also be encouraged to gather their own data through field studies.
- **Prediction:** As different topics are approached within the course, students can predict how climate change will affect a specific region, then make larger global connections. An obvious opportunity comes in examining volcanic eruptions and linking them to different ice ages. Prediction can also be done at a very local level by examining micro-climates. For example, how does the construction/destruction of a hill make a difference to wind pattern, run-off, temperature, etc? How does the creation of a parking lot on a former agricultural field make a difference? (Joni Mitchell’s “Pave Paradise and Put Up a Parking Lot” may be used as an introduction. “Concrete Jungle” is another possibility.)
- **Specific Study of Climate Change:** Within this course, it would be very appropriate to incorporate the issue of climate change as a part of the climate systems unit. As the basics of climate systems are covered (ocean currents, wind patterns, temperature fluctuations, etc.) the different components and their relationship to climate change could be assigned to individuals or students working in small groups. Assign each group of students a particular region of the world: have them research the impact of climate on their region, and then predict the changes to that region if climate change (e.g., overall temperature increases) continues at its present pace. Results of the physical changes could then be linked to the consequent impact on the people (human systems) in the region. A comparison chart such as the following could be set up to synthesize the details found within the groups:

NATION/ ECOZONE	CURRENT CLIMATE (TEMP. RANGE)/ VEG/ WILDLIFE PATTERNS	CURRENT ENVIRONMENT- RELATED INDUSTRY AND SETTLEMENT PATTERN	PREDICTED PHYSICAL CHANGES IN THE ENVIRONMENT RELATED TO CLIMATE CHANGE	PREDICTED IMPACTS AND SETTLEMENT
Canada/prairie grasslands	Research according to the subheadings above; annotated maps would be appropriate here	Rich prairie soils have allowed the development of agriculture; people live in communities along rivers	Hot dry conditions eventually inhibit the soil’s ability to absorb rainfall and reduce grain yields; severe weather patterns include storms that produce heavy rainfall that is not absorbed by the soil, causing flooding.	Farmers change types of crops and soil mendments to accommodate the growing conditions; human communities will have to pay for municipal infrastructure that can accommodate the effects of severe weather. In extreme cases, the population may be forced to migrate if the land ceases to be productive.

## RESOURCES

### EL NIÑO AND LA NIÑA

*Explanations of El Niño and La Niña and effects*  
[www.pmel.noaa.gov/tao/elnino/nino-home.html](http://www.pmel.noaa.gov/tao/elnino/nino-home.html)

### OCEAN CURRENTS AND CLIMATE CHANGE

*Woods Hole Oceanographic Institute – oceans and climate change*  
[www.whoi.edu](http://www.whoi.edu)

### GLACIATION AND CLIMATE CHANGE

*An assignment which addresses how climate change affects glaciation and vice versa (links for answers)*  
[www.sln.org.uk/geography/enquiry/we35a.htm](http://www.sln.org.uk/geography/enquiry/we35a.htm)

## CURRICULUM EXPECTATIONS

STRAND/OVERALL EXPECTATIONS	SPECIFIC EXPECTATIONS
<p><b>Geographic Foundations: Space and Systems</b></p> <ul style="list-style-type: none"> <li>analyse the sources and nature of energy flows through the lithosphere, atmosphere, hydrosphere, and biosphere</li> <li>explain the physical processes that create landforms, climate, soils, and vegetation.</li> </ul>	<p><i>Building Knowledge and Understanding</i></p> <ul style="list-style-type: none"> <li>explain how the earth's orbit and tilt relate to the seasons and annual variations in climate</li> <li>identify the principal features of the lithosphere, atmosphere, hydrosphere, and biosphere</li> <li>identify the interconnections among natural systems within selected ecosystems</li> <li>describe the origins, distribution, and frequency of different kinds of storms</li> </ul> <p><i>Developing and Practising Skills</i></p> <ul style="list-style-type: none"> <li>describe the flow of matter and energy through ecosystems and explain the relationship of these flows to landforms, climate, soils, and vegetation</li> <li>explain how climatic controls act upon the elements of the atmosphere to produce the climatic zones of the earth</li> </ul> <p><i>Learning Through Application</i></p> <ul style="list-style-type: none"> <li>explain the concepts of heat balance and air circulation, using local examples</li> <li>analyse the effects of natural variations in climate on the structure and composition of the soils and vegetation of selected regions</li> </ul>
<p><b>Human-Environment Interactions</b></p> <ul style="list-style-type: none"> <li>evaluate the impact of natural systems on people and their activities</li> <li>evaluate the impact of human life on the environment</li> <li>explain the importance of stewardship and sustainability as guiding principles for human use of the physical environment</li> </ul>	<p><i>Building Knowledge and Understanding</i></p> <ul style="list-style-type: none"> <li>describe the trade-offs for humans living in areas that are subject to natural disruptions</li> <li>describe the effects of human activities</li> <li>describe the importance of using sustainable practices in resource-based industries</li> </ul> <p><i>Developing and Practising Skills</i></p> <ul style="list-style-type: none"> <li>analyse how natural hazards affect human activities</li> <li>analyse ways in which human activities may increase or decrease the risks from natural hazards</li> <li>evaluate the impact on a selected region of human-caused changes in atmospheric conditions</li> </ul> <p><i>Learning Through Application</i></p> <ul style="list-style-type: none"> <li>evaluate the impact of human activities on natural cycles</li> <li>analyse how selected human activities affect a local environment</li> <li>illustrate how the concept of sustainability is applied in a local environment</li> </ul>

<b>STRAND/OVERALL EXPECTATIONS</b>	<b>SPECIFIC EXPECTATIONS</b>
<p><b>Global Connections</b></p> <ul style="list-style-type: none"> <li>• explain the reasons for the global patterns of continents and oceans, landforms, climate, soils, and vegetation</li> <li>• explain the importance of water to global systems</li> <li>• analyse local, regional, and global issues related to physical geography</li> </ul>	<p><i>Building Knowledge and Understanding</i></p> <ul style="list-style-type: none"> <li>• explain the role that oceans and ocean currents play in moderating climate</li> </ul> <p><i>Developing and Practising Skills</i></p> <ul style="list-style-type: none"> <li>• explain the relationships that link global patterns of landforms, climate, soils, and vegetation to each other</li> <li>• describe the distribution of significant ocean currents and prevailing winds and their relationships to world vegetation and soil patterns</li> </ul> <p><i>Learning Through Application</i></p> <ul style="list-style-type: none"> <li>• compare global distribution patterns of climate, soils, and vegetation with patterns in a local bioregion</li> <li>• analyse the effects of human activities on water resources</li> <li>• summarize the geopolitical issues facing nations that share various physical regions</li> <li>• analyse the effects that human activities and/or natural events in a region or country can have on another part of the world</li> </ul>
<p><b>Understanding and Managing Change</b></p> <ul style="list-style-type: none"> <li>• analyse the causes and consequences of climate change</li> <li>• explain how human uses of the earth, especially uses involving technology, cause changes over time in natural systems</li> </ul>	<p><i>Building Knowledge and Understanding</i></p> <ul style="list-style-type: none"> <li>• describe the potential effects of climate change on the sustainability of resource based industries</li> <li>• explain the relationship between natural variations in global climate and glacial movements</li> <li>• identify the mechanisms of change within the lithosphere, atmosphere, hydrosphere, and biosphere</li> </ul> <p><i>Developing and Practising Skills</i></p> <ul style="list-style-type: none"> <li>• distinguish natural short-term variability from long-term trends in historical climate data</li> <li>• explain the potential effects of long-term climate change on different parts of the world, including their local community</li> <li>• explain the correlation between changes in population density, changes in human activities, and changes in the “ecological footprint” of our species</li> </ul> <p><i>Learning Through Application</i></p> <ul style="list-style-type: none"> <li>• describe the difficulties involved in predicting climate change</li> <li>• analyse changes in the physical geography and land use in their local area over time to determine how these changes have affected the population and the environment</li> <li>• evaluate the role of technology in changing relationships between humans and the environment</li> </ul>

STRAND/OVERALL EXPECTATIONS	SPECIFIC EXPECTATIONS
<p><b>Methods of Geographic Inquiry and Communication</b></p> <ul style="list-style-type: none"> <li>• use the methods and tools of geographic investigation and inquiry to locate, gather, evaluate, and organize information</li> <li>• analyse and interpret data gathered through research and investigation, using a variety of methods and geotechnologies</li> <li>• communicate the results of geographic inquiries and investigations, using appropriate terms and concepts and a variety of forms and techniques</li> </ul>	<p><i>Research and Investigation</i></p> <ul style="list-style-type: none"> <li>• develop and use appropriate questions to focus a geographic inquiry or investigation</li> <li>• gather geographic information from primary sources and secondary sources to research a geographic topic or issue</li> <li>• use remote-sensing imagery, maps, the global positioning system, and geographic information systems to measure natural conditions</li> </ul> <p><i>Interpretation and Analysis</i></p> <ul style="list-style-type: none"> <li>• use a variety of geotechnologies to interpret, analyse, and synthesize information in connection with a geographic inquiry</li> <li>• use different types of maps to interpret geographic relationships</li> <li>• use appropriate statistical methods in geographic analysis, observing accepted conventions</li> <li>• develop possible solutions to geographic problems or issues, using appropriate forecasting, decision-making, and/or problem solving strategies</li> <li>• explain the limitations on our ability to make accurate predictions about physical phenomena</li> <li>• explain the different points of view on a geographic issue that are, or might be, held by various stakeholders (e.g., individuals, business organizations, governments, special interest groups)</li> <li>• produce a variety of maps, diagrams, and charts, following accepted conventions, to illustrate geographic patterns and relationships</li> <li>• provide appropriate and sufficient geographic evidence and well-reasoned arguments to support opinions and conclusions</li> </ul> <p><i>Communication</i></p> <ul style="list-style-type: none"> <li>• communicate the results of geographic inquiries and investigations, for different audiences and purposes, using a variety of forms and including geographic visual supports, both conventional and geotechnological</li> <li>• use an accepted form of academic documentation to acknowledge all information sources, including electronic sources</li> <li>• use appropriate terminology when communicating results of geographic inquiries and investigations.</li> </ul>

This resource is an adaptation of the EcoSchools *Climate Change in Grade 11 and 12 Geography* produced by the Toronto District School Board (TDSB). The TDSB has donated this resource to the Ontario EcoSchools Program as part of its in-kind contribution to the project.



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