Socially-based Curriculum Unit: The Cost of Global Warming

Unit Title: The Cost of Global Warming

Time Frame: 4 lessons

Unit Developer(s): James Armstrong

Developed for Course Name and Course Code: Science, Grade 10, Academic (SNC2D)

Strand(s) and Curriculum Learning Expectations Addressed:

Earth and Space Science: Weather Dynamics Strand

ESWV.0- demonstrate an understanding of the factors affecting the fundamental processes of weather systems;
ESWV.01- investigate and analyse trends in local and global weather conditions to forecast local and global weather patterns;
ESW1.04- describe and explain the effects of heat transfer within the hydrosphere and atmosphere on the development, severity, and movement of weather systems (e.g., effects such as pressure gradients, cloud formation, winds);
ESW1.07- describe cyclones, hurricanes, tornadoes, and monsoons in terms of the meeting of air masses, atmospheric humidity, and the jet stream.
ESW2.01a- formulate scientific questions about weather-related phenomena, problems, and issues (e.g., "What is the effect of heat energy transfer within the hydrosphere?");
ESW2.01b- demonstrate the skills required to plan and conduct a weather-related inquiry, using a broad range of tools and techniques safely and accurately, and adapting or extending procedures where required (e.g., determine how the accuracy of weather predictions can be maintained when data from several places and people are combined);
ESW2.01c- select and integrate information from various sources, including electronic and print resources, to answer the questions chosen;
ESW2.01d- analyse data and information and evaluate evidence and sources of information, identifying flaws such as errors and bias (e.g., explain possible sources of error when interpreting a satellite picture used for predicting weather);
ESW2.02- investigate factors which affect the development, severity, and movement of global and local weather systems (e.g., the ozone layer, El Niño, bodies of water, glaciers, smog, rain forests).
ESW3.01- explain the role of weather dynamics in environmental phenomena and consider the consequences to humans of changes in weather (e.g., the role of weather in air pollution, acid rain, global warming, and smog; the fact that smog aggravates asthma);

Desired Results

Unit Description:

This unit will have students investigate the link between humanity's impact on the environment and economy. The unit will start with students analysing data showing an increase in global atmospheric carbon dioxide emissions and the corresponding increase in mean global temperature. To build on this concept students will then be presented with data showing trends in the number and severity of hurricanes. As students look at these concepts, they will investigate the possible link between human activities and the changes we are seeing in our environment. Finally, students will examine information outlining the economic and environmental cost to taxpayers and individuals resulting from global warming and the problems it causes.

Enduring Understandings / Learning:

- Humans are responsible at least in part for global climate change.
- Hurricanes are the result of numerous interrelated factors.
- Humans have had a large impact on the environment, and that has lead to a corresponding increase in the impact of environmental weather phenomena on humans.
- Everyday choices made by humans do have large and long lasting consequences.
- Students will learn to use data to draw conclusions about an environmental issue.

Assessment Tasks

Performance Tasks and Other Evidence That Will Demonstrate the Knowledge and Skills Acquired:

Lesson 1: Global atmospheric carbon dioxide emissions, and the link to the global warming.

- Analyse global carbon dioxide concentrations from monitoring stations around the world (1958 - 2005).
- Analyse Global distribution of carbon dioxide concentrations based on latitude, season, and year.
- Plot carbon dioxide levels on a graph for the Mauna Loa research station for 1958 – 2005.
- Plot changes in average global temperature on the graph for 1958 – 2005.
- Answer questions associated with the graph.

Lesson 2: Global warming and hurricanes.

- Plot the number of major hurricanes and average global temperature for the past 125 years.
- Analyse the number and relative strength of hurricanes over the last 125 years.
- Answer questions associated with the information presented.

Lesson 3: The cost of Global Warming (part 1)

- Plot hurricane damage costs for the United States for the 20 most costly hurricanes both in absolute dollars and those adjusted for inflation.
- Answer questions associated with the graph.
- Analyse images of hurricane Katrina.

Lesson 4: The cost of Global Warming (part 2)

- Research a topic associated with humanities effect on global warming.
- Write a short report on the chosen topic.

Assessment Criteria:

Lesson 1: Global atmospheric carbon dioxide emissions, and the link to the global warming.

- Teacher assessment of student's CO_2 and Temperature graph demonstrates that the student has a sound grasp of the mechanics of the graphing process. (Assessment for Inquiry)
- Teacher assessment of student responses to the CO_2 and Temperature question sheet shows that the student has a good understanding of the cause and effect relationship between increasing global atmospheric CO_2 levels and global warming. (Assessment for Making Connections)

Lesson 2: Global warming and hurricanes.

- Teacher assessment of student's Hurricane and Temperature graph demonstrates that the student has a sound grasp of the mechanics of the graphing process. (Assessment for Inquiry)
- Teacher assessment of student responses to the Hurricane and Temperature question sheet shows that the student has a good understanding of the mechanics of hurricane development and the resulting increase in number and severity of hurricanes based on increasing global temperature. (Assessment for Making Connections)

Lesson 3: The cost of Global Warming (part 1)

- Teacher assessment of student's Cost of Hurricanes graph demonstrates that the student has a sound grasp of the mechanics of the graphing process. (Assessment for Inquiry)
- Teacher assessment of student responses to the Cost of Hurricanes question sheet shows that the student has a good understanding of the impact of increased hurricane severity (based on global warming) on the economic and emotional well being of people in hurricane regions. In addition, student should demonstrate a link between the choices that individuals make and the resulting impact of those choices on other members of the global community.(Assessment for Making Connections)

Lesson 4: The cost of Global Warming (part 2)

Rubric assessment of the student's report demonstrates:

- The report addresses the audience and situation, and uses correct spelling and conventions. (Assessment for Communication)
- The student has a knowledge and understanding of the global warming issue. (Assessment for Knowledge)
- The student has an understanding of the cause and effect mechanism for the global warming issue, focusing on the link of human activities to the problem. (Assessment for Making Connections)

Unit Planning Notes

Prior Learning Necessary:

Most of the prior knowledge and skills required for this unit are topics that would normally be covered by the weather unit (ex. hurricane formation, greenhouse effect, etc.) or are relatively basic mathematical or scientific procedures (ex. construction of a scatter plot, researching a topic, etc.). The specific prior knowledge and skills are as follows:

Lesson 1: Global atmospheric carbon dioxide emissions, and the link to the global warming.

- Carbon cycle
- Combustion of a hydrocarbon reaction
- Humanities effect on the equilibrium of the carbon cycle
- Greenhouse effect
- Greenhouse gases (esp. carbon dioxide)
- Constructing a line graph
- Constructing a line of best fit
- Interpreting graphs

Lesson 2: Global warming and hurricanes.

- High and low pressure systems
- Causes of wind
- Coriolis effect
- How hurricanes are formed
- Factors effecting hurricane formation
- Constructing a combination bar and line graph
- Interpreting graphs

Lesson 3: The cost of Global Warming (part 1)

- Constructing a scatter plot
- Interpreting graphs

Lesson 4: The cost of Global Warming (part 2)

- How to research a topic
- How to write a report

Preparation Notes:

Very little preparation is required for this unit other than teaching the normal material contained within the weather unit (ex. hurricane formation, greenhouse effect, etc.). For this reason it is suggested that these lessons are done at or near the end of the weather unit as the knowledge the students obtain during the course of the unit will be beneficial to their understanding of the topics in these lessons. The specific preparation notes are as follows:

Lesson 1: Global atmospheric carbon dioxide emissions, and the link to the global warming.

- Locate and insert required images and data
- Photocopy worksheets

Lesson 2: Global warming and hurricanes.

- Photocopy worksheets

Lesson 3: The cost of Global Warming (part 1)

- Locate and insert required images
- Photocopy worksheets

Lesson 4: The cost of Global Warming (part 2)

- Book a Television and VCR/DVD *player (optional)*
- Book a computer lab
- Photocopy worksheets

Learning Plan

Lesson 1: 150 minutes

Global atmospheric carbon dioxide emissions, and the link to the global warming.

- Review the concepts of humanities effect on the carbon cycle, the greenhouse effect and global warming.
- Have students analyse the graphs (answer graph provided) and answer the questions in the worksheet for the following topics:
    1. Global distribution of carbon dioxide concentrations based on latitude, season, and year.
    2. Global carbon dioxide concentrations from monitoring stations around the world (1958 - 2005).
    3. Carbon dioxide concentrations and global temperature (1958 – 2005).

Lesson 2: 75 minutes

Global warming and hurricanes.

- Review the concepts of how hurricanes are formed and the factors effecting that formation, and the Saffir-Simpson Hurricane Scale.
- Have students analyse the graph (answer graph provided) and answer the questions in the worksheet for the following topics:
    1. Occurrence of major hurricanes and average global temperature for the last 125 years.
    2. Occurrence and relative strength of hurricanes over the past 125 years.

Lesson 3: 75 minutes

The cost of Global Warming (part 1)

- Based on the results students have discovered from the first two lessons have a class discussion about the link between human activities that produce carbon dioxide and the impact it is having on people through hurricane damage and other environmental problems. Pose to the class the question "What are the costs of global warming?"
- Have students analyse the graph (answer graph provided), view the images, and answer the questions in the worksheet for the following questions:
    1. Are hurricanes become more sever and costly?
    2. What impact do hurricanes (specifically Hurricane Katrina) have on people?

Lesson 4: (variable time depending the amount of time given for in class work on the report and if the optional movie is shown)

The cost of Global Warming (part 2)

- As students have now had the chance to see not only the impact of carbon dioxide on hurricane occurrence and severity, but also the impact that is having on damage costs this lesson will have them investigate additional effects of global warming.
- An option to facilitate ideas and discussion at this point is to watch the video "An Inconvenient Truth".
- Following the movie (if viewed) use the information from the movie and/or the fact sheet enclosed (The Impact of Global Warming in North America) in the project package to start a class discussion on the real cost of global warming (and indirectly of carbon dioxide emissions).
- Have students research a topic on carbon dioxide emissions or global warming and have them write a short report using the Global Warming Instruction Sheet and Rubric.

The flexibility of this report format allows for it to be as small or large as the teacher sees fit. **For this reason the student worksheet outline is vague, so that it may be tailored to the individual needs of the teacher.** The topics could be as simple as a particular event (ex. record temperatures, or precipitation, etc.) or it could be a large topic (global warming causes, effects, treaties, taxes and programs, etc.). The flexibility also allows this report to be assessed as a culminating task or major project, or simply a short report. Regardless, be sure to review with them the format for the report.

Attachments

Appendix A: **Lesson 1 Worksheet Package:** Carbon Dioxide and Global Warming (answer graph included)
Appendix B: **Lesson 2 Worksheet Package:** Hurricanes and Global Warming (answer graph included)
Appendix C: **Lesson 3 Worksheet Package**: The Cost of Hurricanes (answer graph included)
Appendix D: **Lesson 4 Worksheet Package:** The Cost of Global Warming (report rubric included)

Other Possible Course Applications

Course	Modification
CGC1D Geography of Canada, Grade 9 Academic	In this course a focus should be on Human/Environmental interactions such as: the impact of global climate change on occupations in Canada, and the role of Canada's government in environmental agreements such as the Kyoto Protocol.
CHC 2D Canadian History Since World War I, Grade 10 Academic	In this course the focus should be on how Canada's role in environmental agreements such as the Kyoto Protocol has changed Canada's global identity.
CGF 3M Physical Geography: Patterns, Processes and Interactions, Grade 11 University/College Preparation	In this course the focus should be on the investigation of the potential effects of long-term climate change on weather patterns and the resultant impact on humans.
CGT3E Geographics: The Geographer's Toolkit, Grade 11 Workplace Preparation	In this course the focus should be on the role of geotechnologies in the identification and monitoring of global climate change.
CGO4M Geomatics: Geotechnologies in Action, Grade 12 University/College Preparation	In this course the focus should be on the role of geotechnologies in the identification and monitoring of global climate change.
CGW4U Canadian and World Issues: A Geographic Analysis, Grade 12 University Preparation	In this course the focus should be on the identification and investigation of global climate change and it social, economic and environmental impacts.