



UNIVERSITY OF  
**REGINA**



**CLIMATE CHANGE EDUCATION SASKATCHEWAN**

# **Grade Ten to Twelve Mini Units**

## **Cross-Referenced to Saskatchewan Core Sciences**

Grade Ten  
Grade Eleven & Twelve  
Grade Twelve

November 2003

Canada



Government of  
Saskatchewan

**SaskEnergy**  **SaskPower**



Saskatchewan  
Watershed  
Authority

## Acknowledgements

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### **Climate Change Education Saskatchewan – Management, Advisory and Working Committee Members**

**Director:** Dan Beveridge, Saskatchewan Instructional Development and Research Unit (SIDRU), University of Regina (November 2001 – April 2004) succeeded by Lyle Benko, SIDRU, University of Regina (April – September 2004)

**Management Committee Members:** Dan Beveridge, SIDRU, University of Regina (November 2001-April 2004) succeeded by Lyle Benko, SIDRU, University of Regina (April-September 2004); Ed Dean, Saskatchewan Environment; Lynn Anderson succeeded by Dean Elliot, Saskatchewan Learning; Sharon Metz, Saskatchewan Watershed Authority; Leslie Gosselin, SaskEnergy; Sheila Harlos, SaskPower and Climate Change Action Fund represented by: Debby Corbin, Chief, Outreach Programs, and Annette Boudreau succeeded by Kathy Crate, Program Officer, Outreach and Communications Services Division, Office of Energy Efficiency, Natural Resources Canada, Government of Canada

**Advisory and Working Committee:**

**Chairperson:** Lizabeth Nicholls, Saskatchewan Watershed Authority (November 2001 – April 2004)

**Members:** Carmelle Sikma, Climate Change Saskatchewan; Barry Mitschke, Education Consultant; Linda Dodd and Deb Froh, Regina Public School Board; Louise Jones, Saskatchewan Environmental Society; Lynn Anderson and Dean Elliott, Saskatchewan Learning; Dan Beveridge, Lyle Benko and Paul Hart, Faculty of Education, University of Regina; and Sarah Longman, Saskatchewan Urban Native Teacher Education Program (SUNTEP), University of Regina.

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- Climate Change Action Fund
- Climate Change Saskatchewan
- Regina Public School Board
- Saskatchewan Environment
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Thank you to everyone who has supported or promoted Climate Change Education Saskatchewan.

# **The One Tonne Challenge And the Climate Change Education Saskatchewan Mini-Units**

The mini-units in this package relate to specific curriculum areas that already have a fit with climate change. All of the lessons relate to climate change and use activities, readings and /or outdoor trips to teach the concept. Including the One Tonne Challenge as part of this unit of study will help the students identify ways that they can reduce their greenhouse gas emissions at home and at school. They love to protect the environment and will be keen to do all that they can for our climate.

The One Tonne Challenge, established by the Government of Canada, asks that every Canadian set the goal of reducing their personal greenhouse gas emissions by ONE TONNE (1,000 kilograms). How much is one tonne of GHG emissions? Enough to fill a two-storey 3-bedroom house with greenhouse gas!

How can individuals reduce? Use less energy. Conserve water & resources. Reduce waste. Fewer emissions means protecting our climate and having cleaner air and healthier Canadian communities.

The One Tonne Challenge website ([www.climatechange.gc.ca/onetonne/english/](http://www.climatechange.gc.ca/onetonne/english/)) has all of the information you will need to calculate your personal greenhouse gas emissions with a special calculator. You will be asked to answer questions about your daily activities and will get a personalized report about your GHG emissions. The report will identify the sources and where they come from and will show you how you compare to Canadians in general.

Once you have uncovered where you are contributing the greenhouse gas emissions you will move on to step 2; where you will be asked to select activities that you are willing to do in order to reduce your level of emissions. Get ideas from the Tips Guide and the section on Actions Taken by Canadians. There are lots of very practical and useable ideas for individuals, families and groups.

All of this is as easy as visiting the website and signing up. It only takes a few minutes to see where you fit in and to begin to think of ways that you can reduce GHG emissions. Give it a try!

[www.climatechange.gc.ca/onetonne/english/](http://www.climatechange.gc.ca/onetonne/english/)

**Go ahead! Take the Challenge! Reduce greenhouse gas emission!**



UNIVERSITY OF  
**REGINA**



**CLIMATE CHANGE EDUCATION SASKATCHEWAN**

# **Grade Ten Mini Unit**

**Cross-Referenced to Saskatchewan  
Core Science 10**

Barry Charington

November 2003

Canada 



Government of  
Saskatchewan

**SaskEnergy**  **SaskPower**



Saskatchewan  
Watershed  
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# International Commission on Global Climate Change

## A Role Play Module for Grade 10 Science

### Objectives:

- To explain the role of the natural greenhouse effect in maintaining an environment able to support life on earth.
- To investigate how human activity has enhanced the greenhouse effect and altered global climate.
- To identify the scope and magnitude of climate change.
- To understand the varied scientific, social and political implications of climate change.
- To understand how climate change will impact different stakeholders, third world versus first world, consumers versus producers, and industry versus environment.
- To realize that there is no quick fix to complex environmental problems.
- To appreciate that mitigation of the enhanced greenhouse effect will have beneficial and negative effects and compromises must be made.
- To understand that global climate change is inevitable and we must adapt to changes in environment.

### Materials:

- Introductory video: Nova: “Gaia, Goddess of the Earth.” or “Is It Hot Enough For You?”  
NFB/CBC: The Nature of Things - “Turning Down the Heat-The New Energy Revolution” Included in the Pembina Institute Kit: Climate Change - Awareness and Action.
- Pembina Institute: Climate Change – Awareness and Action; Teacher Plan, Learning Activity 8 Politics, Power and Public Opinion. General procedure and set up, includes 10 possible additional roles.
- Roles for the role-play: Climate Change Saskatchewan
- Web Sites on Climate Change (check Climate Change Saskatchewan for a list)

### Activity Information:

- Grade Level 10 (could be adapted 8-12)
- Subject Science 10: Core Unit A, Option A-2. The Greenhouse Effect
- Time: 7 to 10 hours depending upon class size and how much independent study time is expected.
- Setting: Classroom, Resource Centre. The Commission could meet through an entire school day in a civic facility such as town or city hall, courthouse.

### Activity: (Lesson suggestions based on a one hour class period)

- Lesson 1. Introduction of Greenhouse Effect and the Enhanced Greenhouse Effect
- Lesson 2. Continuation of introduction of basic concepts, assignment of roles and description of activity.
- Lesson 3-5: Independent research time on the individual role assigned to each student.

- Lesson 6-9: Reports to the International Commission on Climate Change. (6-8 minute presentation for each student with an additional 2-3 minutes for questions, 6-8 student presentations per period.)
- Lesson 10: Commissioner's Report – In class essay. The question:  
Prepare a commissioner's report incorporating ideas presented during the last several days of class. In your report you should consider
- i) what is the greenhouse effect and how is this altered by human activities,
  - ii) what is the nature, scope and magnitude of climate change,
  - iii) what should be done to mitigate and or adapt to climate change,
  - iv) what are the costs of your suggestion actions/inactions,
  - v) who will pay and how will your changes be financed.

### **Evaluation:**

1. The role-play. Students are marked out of 5 in each of the following 6 categories:
  - i) Utilization of information given in class and in the role-play description.
  - ii) Utilization of additional information from independent research.
  - iii) Organization, clarity and content of the oral presentation including staying within the time limits.
  - iv) Ability to play the role including defining the correct information and presenting it in character.
  - v) Use of supporting materials – overheads, posters, video, web, PowerPoint etc.
  - vi) Impact upon the commissioners, a peer mark assessed by the class and averaged.
  - vii) A mark is assigned out of 25 and is calculated using the best 5 of the 6 category marks above.
  
2. The commissioner's report marked out of 25. Key points evaluated include
  - i) use of logical reasoning to develop and analyze arguments
  - ii) validity of information selected to make arguments
  - iii) arguments are supported by information
  - iv) both sides of any argument are considered
  - v) recommendations are made
  - vi) consequences of recommendations are considered
  - vii) the student comes to a defensible conclusion.

Both marks are averaged and used as 100% of the unit evaluation for Unit A. Additional questions related this topic may appear on the final exam.

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Unit Plan produced by Barry Charington, Saskatoon Public School Division for Climate Change Saskatchewan

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Postscript. Teachers are encouraged to design and add their own roles. Please send any that you develop to [charington@shaw.ca](mailto:charington@shaw.ca) or to Climate Change Saskatchewan so they can be added to the database of roles.

NAME: Stephen / Stephanie HALSTEIN

AGE: 34

OCCUPATION: meteorologist

REPRESENTING: National Centre for Atmospheric Research, Bolder Colorado, U.S.A.

You are to provide scientific information to the commission on the effects of global warming. The warmest year since instrumental records have been kept is 1998. 2002 and then 2001 were close behind. The ten warmest years since 1880 have occurred since 1987, 9 since 1990. This has been confirmed by NASA's Goddard Institute for Space Studies.

The warming effects are occurring at different rates at different levels of the atmosphere as many greenhouse models predict. The troposphere had the highest temperatures in 23 years of recording in 1988 and 1990, but these changes are small and may be unrepresentative of longer term trends.

There is a correlation between greenhouse gases, particularly carbon dioxide and average temperature. You are not yet positive that there is a true cause effect relationship and are hesitant to say that global warming is now happening, but you are led by the models of global warming to believe that it will happen.

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NAME: Irving / Jamie METZLER

AGE: 44

OCCUPATION: Climatologist

REPRESENTING: Climatewatch International, A Non-profit Lobby Group, Washington, U.S.A.

You believe that the greenhouse effect is alive and growing. You have three main points to make:

- 1) the earth is warmer now than at any other time in the history of instrumental measurements.
- 2) Global warming is now large enough that we can ascribe with a high degree of confidence a valid cause-effect relationship between warming and the greenhouse effect. In recent years global warming is between 0.4 and 1°C on average over a 30-year period. The probability of a chance warming of this magnitude is about 1%, so there is a 99% chance that the warming seen is due to the greenhouse effect. Furthermore, details of the warming are consistent with computer models, the stratosphere is cooling while surface temperatures rise, the effects are greater at higher latitudes than near the equator, more warming is occurring over land and sea ice than over open ocean, and more warming in the winter than in the summer.
- 3) Computer climate simulations indicate that the greenhouse effect is already large enough to begin to affect the probability of extreme events such as summer heat waves. In the last decade areas of the US have experienced prolonged periods of higher than normal temperatures with no rain, higher than would be expected based upon past climate records.

Global warming now seems unstoppable; you wish to encourage governments and industry to take steps to adjust to life with global warming.



NAME: Salvador / Maria ALVAREZ AGE: 55  
OCCUPATION: Professor of Atmospheric Studies  
REPRESENTING: University of Brazil, Brasilia, Brazil

Carbon dioxide is but one of many greenhouse gases. It accounts currently for about 50% of global warming; however, there are other trace gases that are present in lower amounts but are 10000 times more effective at absorbing infrared heat. These gases continue to appear at increasing rates in the atmosphere and shortly will account for more than half of global warming.

Among these other greenhouse gases are water vapour, followed by methane. Methane has been increasing but there is a lot of debate as to its origins. It is produced by natural decay in swamps, bogs and rice paddies and in the digestive tracts of some animals. Nitrous oxide and tropospheric ozone are two gases that can be directly attributed to industrialization, in particular automobile exhaust. Nitrous oxide is also produced from increased use of nitrogen fertilizers. Chlorofluorocarbons (CFC's) are recent significant players in the greenhouse effect, especially CFC-11 and CFC-12.

Carbon dioxide was the first gas to rise after the industrial revolution; however, these other gases have been rising more rapidly in this century. Any agreement on reduction of greenhouse gases must include all greenhouse gases, not just carbon dioxide.

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NAME: George / Georgina LAMBE           AGE: 47  
OCCUPATION: Climatologist  
REPRESENTING: World Climate Monitoring Institute, Berne, Switzerland

You are a recognized world authority on computer predictions of climate change. Although early models showed some gross oversimplifications, you are reasonably sure that more recent models are superior and good predictors. You have demonstrated this by entering data accumulated earlier this century and predicting current conditions. You found that you had an accuracy rate of 95%.

Your model breaks the atmosphere into 9 layers and into boxes that are several hundred miles on each side. Although each box is not homogeneous, it may contain differing amounts of water or land or different landforms (prairies and mountains). The model could be improved by using smaller areas in each box but this slows the computer down to the point where it is useless. This model is not good for examining local effects but is good at predicting global trends.

Your model has demonstrated that with the continued exponential production of carbon dioxide and other greenhouse gases there will be a 2°C to 5°C change in average global temperature in the next 50 years.

Your presentation to the conference will outline computer modeling and outline some of the assumptions made and the results obtained from computer modeling of the atmosphere.

NAME: Jordan / Jodi JACOBSEN

AGE: 52

OCCUPATION: Oceanographer

REPRESENTING: Woods Hole Oceanographic Institute, Woods Hole Massachusetts

You will supply the commission with information about global warming and sea levels.

There are three major reasons why ocean levels will rise as the earth warms. The first is the melting of the polar ice caps. A large volume of water is tied up in the polar ice caps and global warming will cause this to melt and increase sea level. Secondly warming will cause large frozen ice masses such as the West Antarctic Ice Sheet to break loose, fall into the sea and travel to warmer waters. The third effect would be due to thermal expansion of water. The oceans will act as a heat sink, absorbing much of the extra heat retained as the earth warms. This will help to moderate temperature rises, but as the waters warm they will expand, causing a rise in sea level.

This rise may be as dramatic as 1 to 2 meters in the next 50 years and continue at a rate of 2-3 cm. per year after that. These effects would be devastating.

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NAME: Joseph / Fiona van LIEROP

AGE: 33

OCCUPATION: Government Official, Vanuatu

REPRESENTING: The Coalition of Small Island Nations

You are head of a lobby group of 28 small island countries in the Pacific, Caribbean and the Mediterranean. Your group represents one of the biggest potential losers if the predictions about global warming are true. Most of the people in your nations are tied to the sea and many members of your group are low lying islands that would disappear like Atlantis should sea level rise 2-3 meters. Although your nations are not the poorest in the world they lack the resources to build dikes and seawalls that would be necessary to save land. Also the inhabitants of these lands depend upon the sea and would find it difficult to exist if cut off from the sea.

Your group does not want to get tied into reduction of energy use based on current levels that are biased toward the wealthy nations. Energy consumption must decrease dramatically in developed nations while being allowed to rise slowly in developing nations. In order to stave off disaster there must be technology transfers between nations, particularly from rich to poor. You also advocate giving funds to rainforest nations to preserve their rainforest. Finally you believe that some significant accords must be obtained from this summit. Your nations cannot tolerate being guinea pigs while we experiment with the only planet that we have.

NAME: Fenton / Faye HARDING                      AGE: 41  
OCCUPATION: Industrial Consultant  
REPRESENTING: Harding Global Consultants Ltd, Toronto, Ontario, Canada

Your firm has been advising numerous governments on way to reduce carbon dioxide emissions. You should stress to the commission that there are technologies available to at least curb the rise in carbon dioxide levels if not turn it around.

Some examples of methods to reduce carbon dioxide emissions are:

- Increase power generation efficiency, which will generate more power from existing resources, thereby eliminating the need to build more power plants to meet increased demand.
- Increase consumption efficiency, for example use low power fluorescent lighting and other alternatives that produce the same amount of light with lower wattages.
- Disposal of carbon dioxide from combustion by dissolving it in brine and precipitating it out as insoluble carbonates.
- Cogeneration. This allows waste heat from industrial process to be used elsewhere. Waste heat generated from a coal power plant could be used for space heating or coupled to a greenhouse. Methane produced by various plants, e.g. cattle barns or sewage treatment plants, could be burned off to supply heat for the plant, or for adjacent housing.

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Russell / Rosemary DOUGLAS                      AGE: 57  
OCCUPATION: Director; Environment Canada Office Coordinating Canadian  
Participation in Negotiations for the Reduction of Atmospheric Pollution  
REPRESENTING: the Government of Canada, Ottawa, Canada

You are representing the Government of Canada, and in particular the Minister of the Environment, the Honorable \_\_\_\_\_.

Canada is a world leader in environmental regulations. Canada has unilaterally decreased acid rain causing emissions of sulfur dioxide and nitrous oxides by 50% and has recently convinced the United States to start reduction in levels of these pollutants. Canada hosted a major conference on ozone depleting CFC's and signed the Montreal Accord. Canada is ahead of target on the reduction of usage of CFC's. Canada has pledged to maintain carbon dioxide levels at no greater than 1990 emissions. Canada is but one of over 100 countries signing the Kyoto Protocol. We want a comprehensive agreement that would include specific targets and schedules for reducing emissions of carbon dioxide and other greenhouse gases. These targets must be fair, obtainable and strictly adhered to by all involved in order to be effective.

NAME: Zullfigar / Ali QUERSHI            AGE: 29  
OCCUPATION: Government Scientist  
REPRESENTING: The Government of Bangladesh

The effects of global warming may already be facing your nation. Bangladeshis have been subjected to worse than normal typhoons causing large amounts of damage to the delta farmlands and tremendous loss of life. Your country is extremely poor and has no resources to limit the amount of suffering by those affected. Rich countries such as Holland can build massive dikes and seawalls with pumps to remove seawater from lowlands or Britain can build its gates at the mouth of the Thames. Your country cannot be tied down through reducing or maintaining current carbon dioxide emissions. These already are among the lowest in the world and must be allowed to increase so that your country can generate power to increase your capacity to produce wealth for your peoples. The heavy energy consuming nations must bear the brunt of any reductions as they are the major producers and they have the wealth and technical expertise to reduce emissions while maintaining current energy production.

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NAME: Brian / Fiona BOYLE            AGE: 18  
OCCUPATION: Sixth Form Student  
REPRESENTING: Clifton College, Bristol, U.K.

You are representing a group of English youth who have met for a week to discuss global warming. You are to prepare a position paper summarizing the hopes and aspiration of the next generation including your vision of a pollution free world. Just some ideas coming out of your week that you managed to record include:

- review of lifestyle: do industrialized nations require the current levels of energy?
- alternatives to transport: more local production would mean less energy used in transport of goods.
- reduce personal transport by living near your place of employment, then you can walk or bike to work rather than drive.
- use public transport more often.
- reduce heating demand by putting on a sweater rather than raising the thermostat.
- purchase only energy efficient appliances and ensure that they are serviced regularly to maximize efficiency. Also ensure that they are turned off when not in use.
- avoid consumer good containing CFC's, e.g. Halon 1211 containing fire extinguishers.
- insist that liquid refrigerants are drained into a closed container to be cleaned and recycled when servicing cooling appliances such as air conditioners at home or in the car or refrigerators
- plant trees and encourage green belts and parklands.  
Your presentation will stress cooperation between individuals and setting realistic goals and expectations.
- Switch to primary energy sources, gas driers, stoves etc.
- Use reusable goods rather than disposable goods – plastic cups, paper plates as these require less energy for manufacture.

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NAME: Paul / Paula GOLDBERG                      AGE: 26  
OCCUPATION: Journalist, Haifa, Israel

You have written an article on techno fixes to global warming.

Many prefer Techno fixes because they do not require any changes in the underlying cause of the problem; one can simply continue uninterrupted with one's current lifestyle.

The National Academy of Science and National Research Council of the United States have several proposals. These organizations recognize reengineering, but do not support any programs, not even pilots. These ideas are technically feasible in terms of cooling effects and costs and have the potential to affect greenhouse warming on a substantial scale. However, these involve 'back of envelope' calculations and costs and details are fuzzy.

A number of these ideas are outlined in your article in Newsweek, May 20, 1991 and include:

- a fleet of Boeing 747's crisscrossing the sky releasing dust into the lower stratosphere blocking sunlight.
- use naval guns to shoot dust high into the stratosphere; the amount of dust equivalent to that from volcanoes would be effective, e.g. Mt Pinatoba, 1991
- release billions of aluminized hydrogen filled balloons into the stratosphere to reflect sunlight.
- Orbit 50,000 mirrors, each 39 miles square.
- mount lasers on mountaintops to zap CFC's rising towards the ozone layer rendering them harmless and soluble in water.

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NAME: James / Lynne LOCKWOOD                      AGE: 66  
OCCUPATION: Freelance Scientist, Castle Coomb, U.K.

During your life you have developed a controversial theory that has been called the "GAIA Hypothesis" named after the Greek Goddess of the Earth. This theory proposes that life on earth is a self-regulating control system with a series of feedback loops just like an engineering control system. This notion was accepted first by two groups, engineers and theologians. Scientists still remain skeptical.

The essence of this system is that when the earth warms up, life on earth alters to cause the earth to cool and when it cools too much life changes to warm the earth. One of the major ways of regulating the system is through the use of carbon dioxide as a greenhouse gas. For example, during an ice age, life on the planet decreases, especially in terrestrial biomes. There are fewer plants to remove carbon dioxide and more decay to release carbon dioxide. This results in a natural greenhouse effect that warms the planet and melts the ice. As the planet 'greens' up plant growth is stimulated and carbon dioxide is drawn from the atmosphere causing the carbon dioxide levels to decrease and reduce the greenhouse effect.

There are some that will try to use this hypothesis as an excuse to do nothing. This concerns you greatly. Changes in this system take thousands or even hundreds of thousands of years; the carbon dioxide levels due to man have occurred over just one hundred years. This is too fast for the earth to react to changes of this magnitude. Also we are destroying the ability of the earth to respond by

polluting our oceans and cutting down our rainforests that would be the very organisms that would be required to use excess carbon dioxide.

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NAME: John /Joan HARTE                      AGE: 24  
OCCUPATION: Ecologist  
REPRESENTING: University of Colorado, Denver, Colorado, U.S.A.

In your short scientific career you have been studying the Vostok ice cores. By drilling down through the ice deposited through the ages one can get a peek at carbon dioxide levels over the last 160,000 years. The deeper the core sample, the older the ice. One can count layers in the core, much like tree rings, as there is a difference between the clean winter ice and the melted and dirty summer ice. The ice can be melted and the dissolved gas profile can be done to determine the amount of carbon dioxide. Some ideas of temperature can be determined by measuring the ratio of oxygen-16 and oxygen-18 in fossilized shells of marine animals. The information can also be correlated to geological evidence. Your research shows that during warm periods higher levels of carbon dioxide gas were found than in cold periods. However, it is impossible to determine which cause-effect relationship is valid because of the error in timing. Did periods of warm produce high amounts of carbon dioxide, or did high levels of carbon dioxide produce the periods of warmth. You urge caution in interpreting your results.

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NAME: Ronald / Rosalind GREEVA                      AGE: 47  
OCCUPATION: Climatologist  
REPRESENTING: World Climatology Institute, Geneva, Switzerland

Your role is to present information on long-term global climate. Although we do not have temperature readings from the intermediate and distant past, we can make hypothesis based upon the fossil record and known species of plants and animals. The earth's temperature seems to be remarkably well regulated and kept nearly constant within a 5-8°C temperature range. This occurs despite the fact that the sun's energy is gradually increasing over the 3-4 billion years since the earth's formation. For example, during the ice age when mile high sheets of ice covered much of North America, Europe and Asia, the temperature was only about 5°C colder than today. The ice ages appear to be a cyclic occurrence and are related to variations in the earth's orbit. The orbit of the earth changes from nearly circular to a wide ellipse. During the elliptical phase the earth is farther away from the sun and receives less energy and cools. We have passed through the circular portion and are moving towards the ellipse that would suggest that we are heading towards another ice age. Yet temperatures are the warmest in 10,000 years of human civilization (1.5°C warmer than last century). These are the fastest changes in history.

NAME: Andrew / Audrey SMYTHFIELD      AGE: 36  
OCCUPATION: Oceanographer  
REPRESENTING: Scripps Institute of Oceanography, La Jolla, California, U.S.A.

El Niño, a South Pacific Ocean current that has been particularly active over the last decade may be causing the increase in temperatures and storms in the United States that has been attributed by some to the greenhouse effect. El Niño tends to warm and cool in two-year cycles. Just as its warming cycle produced the 1987-88 droughts, in 1989 it cooled sharply, making the U.S. much cooler and wetter. In 1990-91 the warming cycle brought about drought and warmer temperatures.

In your research of El Niño you have found that the ocean surface temperature appears limited to 31°C. As the water warmed, evaporation increased causing water vapour content to rise. Water vapour enhances the greenhouse effect increasing atmospheric temperature even more (super greenhouse). But high cirrus clouds form as a result of increased evaporation and convection. This reflects the sun's energy back reducing the greenhouse effect and shuts down the super greenhouse.

These types of positive and negative feedback loops have not been widely studied and this and other cloud effects are often ignored in climate models, making them unreliable.

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NAME: Bartholomew / Barbara SMITH      AGE: 28  
OCCUPATION: Assistant Professor of Geography  
REPRESENTING: University of Guelph, Guelph, Ontario, Canada

You present carbon dioxide levels over time to the commission. The levels of carbon dioxide have increased steadily over the last four centuries at an accelerating rate. The levels are now the highest in 1600 centuries. You are pessimistic about the possibility of reaching an agreement to cut carbon dioxide levels significantly because of the negative trends in the world economy necessary to bring this about.

You see major disagreements arising between the industrialized wealthy nations and the third world. Third world countries reserve their right to exploit their natural resources including forests and petroleum reserves even if they contribute to global climate change. The peoples of these countries have a right to strive towards the same high standard of living of the northern nations, the standard of living obtained largely by energy production. Third world countries argue that reductions in carbon dioxide levels must, to be fair, come from the wealthy nations who have had the advantages of wealth and the third world be allowed to catch up.

Your concern is that any reductions in carbon dioxide emissions in the industrialized nations will be more than offset by increases in carbon dioxide production among poor nations.

NAME: Tuzu / Xaiping CHAN

AGE: 30

OCCUPATION: Biologist

REPRESENTING: Academic Sinica's Institute of Atmospheric Physics, Beijing, China

Your career centers on the study of methane, another major greenhouse gas. You have found that large amounts of methane come from rice fields, about 14% of the total. This is increasing as more marginal land is converted to the growing of rice. In China many grain-growing regions were flooded and the people told to grow rice. Your data in Chinese fields show that due to different and more primitive farming practices the amount of methane is 4 to 10 times higher in China than in the U.S. or Europe. This data would lead you to recommend that there be a shift away from rice cultivation back to cereal grains.

Methane is also produced by livestock. You suggest that it might be better to feed less livestock and use the grain that they would eat to feed the human population and thereby decrease methane production.

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NAME: Gabriel / Gabrielle CORTEZ-MENDES AGE: 41

OCCUPATION: Spokesperson, U.S. Environmental Protection Agency

REPRESENTING: The Government of the United State of America, Washington, D.C.

You are to put forward the American position at this conference. You note that information stating that there is a climate change problem is incomplete and inconclusive. You believe that voluntary limits on the growth of carbon dioxide and other greenhouse gases may be of use; however, you oppose any arbitrary limits or time lines.

You feel that there is plenty of time to react and before spending a large amount of money fixing problems that might not exist, or fixes that do not affect the problem, further research into global climate change and possible solutions would allow better deployment of limited resources to fight global climate change.

The United States is in the midst of a major economic recession and any measures that would hurt an already poor economy would be opposed by the United States. However, the Government of the United States is willing to fund research into technologies that could reduce the harmful effects of global climate change. President Clinton had announced that the United States will strive to keep year 2000 CO<sub>2</sub> levels below 1990 levels. President Bush has asked White House advisors to prepare a national action plan which is expected to emphasize regulatory flexibility, voluntary actions by industry, the development of cleaner technologies and emissions allowance trading.



NAME: Horo / Shioko KAMURA      AGE: 35  
OCCUPATION: Chief Executive Officer  
REPRESENTING: Nagachi Machine Works, Tokyo, Japan

You represent a group of far eastern business people who see the greenhouse effect as a threat to energy demanding industrial plants in the developing far east.

You will bring to the attention of the commission that global warming is primarily an American problem and therefore much of the solution should come from the United States. The United States appears to be the big losers in a warmer world while most other nations stand to gain. California, already subjected to multiple years of drought, will continue dry and this will move northward; the prairie and Midwestern states stand to become plagued by droughts and the eastern states will become hotter, more humid and be subjected to more violent storms.

Other nations such as Russia, Canada and the nations of Europe will see increased growing seasons and extensions of arable land northward. Increased evaporation over the Atlantic could restore the fringes of the Sahara and other areas of Africa could also receive greater rainfall.

You see the marketing of the greenhouse effect as a clever ploy by the United States to export an American problem and get the rest of the world to share in the cost of correction.

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NAME: Tomas / Thelma WEISENTHAL      AGE: 28  
OCCUPATION: atmospheric scientist  
REPRESENTING: Heidelberg University, Heidelberg, Germany

Your research has indicated that reducing greenhouse emissions may initially accelerate temperature rises. This is due to sulfur dioxide emissions that are coincident with carbon dioxide. Sulfur dioxide crystallizes out producing sulfate droplet crystals that reflect sunlight back. If emissions were reduced, the sulfate crystals would disappear first before carbon dioxide levels drop reducing the reflection but maintaining warming. There is a possible North South imbalance here because the northern hemisphere produces more sulfur dioxide.

This and other information that you present means that regulators must persist in their actions to get gains due to decreased levels of carbon dioxide. Do not expect instant fixes.

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NAME: Sepias / Mosarwa MAGWAMBA      AGE: 24  
OCCUPATION: farmer, Kanye, Botswana  
REPRESENTING: A Coalition of Third World Nations

You are person of modest means. You were fortunate to be born into one of the most stable of African nations where the government school gave you seven years of education. Your modest farm provides sorghum and cattle for export and brings you an income of about \$3600 per year, a good wage in Africa.

You are articulate and well read. You are concerned about the greenhouse effect, both for your farm

and for your nation. The region in which you farm is prone to drought and you can see that the greenhouse effect may cause changes in climate that you do not understand, nor can you control. For your nation, you can see changes that will be dictated to you by the wealthy countries of the Northern Hemisphere. Your country has only recently begun the task of building wealth for its inhabitants. Through luck, diamonds found at the edge of the Kalahari Desert, and good government, the people of Botswana have moved from being simple hunter-gathers or Bushmen towards citizens of the 21st Century. You eye with envy the wealth of the Northern Hemisphere as seen on your recently purchased television that receives signals of European and American shows broadcast from South Africa and hope that your children will be able to share some of that wealth. Your country has just started the process of industrialization. You fear that the wealthy countries will try to limit your energy production that will limit your countries economic growth, currently at about 13% per year. You feel that the industrialized countries that have created the problem and the wealth should bear the major responsibility for the problem and should bear the biggest share of the solution. If the Northern Hemisphere countries try to limit carbon dioxide emissions in the third world you see major conflict, perhaps leading to a major North-South war and destabilization of world order.

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**NAME:** Jacques / Jacqueline PHILLIPON

**AGE:** 63

**OCCUPATION:** Forester

**REPRESENTING:** Department of Lands and Forests, Government of France, Paris.

Man has caused great changes in land use. At one time Europe was covered by large forests. As late as 1600, forests covered the majority of Britain. The forests have been cleared first for agriculture, growing crops and grazing animals and more recently for human habitation. As Europe became overcrowded, people and deforestation was exported to the new world where large tracts of forests were converted to agricultural use from the 1700's to the modern era. Now we see deforestation at an even greater rate now in the tropical forests of the Amazon, Malaysia, Indonesia and elsewhere around the equator. As in the past these nations see deforestation as necessary to feed growing populations. The deforestation has two major negative effects. First, forests are responsible for large amounts of photosynthesis that consume great amounts of carbon dioxide and heat energy. The replacement with grasses or crops does not compensate for the moderation of temperature effect. Secondly, there are large amounts of carbon dioxide removed from the atmosphere in forests. This is released either by burning the trees or allowing them to decompose. So we have a double effect, large amounts of carbon dioxide are released and the earth's ability to remove it from the atmosphere is reduced.

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**NAME:** Marcel / Marianne LaPORTE

**AGE:** 53

**OCCUPATION:** Vice President (Communications)

**REPRESENTING:** Canadian Power Input Generators (CanPIG)

Your company has identified the need for further power generation early in the 21st Century. Demand side conservation will limit growth this decade; however, the major power conservation technologies will be implemented by the year 2005 and power demand will continue to grow. In order to meet this anticipated demand you need to build several major power stations across the country. You are not favouring one particular power generation method at this time. The decision to select a specific option is based upon a number of factors including environmental considerations, cost and meeting system reliability criteria. Most, if not all, electricity generation and transmission projects have some impact

upon the environment. Fossil fuel generating stations release chemicals into the atmosphere, dam and transmission line construction projects have an effect on local plant, animal and aquatic life. Nuclear power does not release harmful chemicals but generates nuclear waste that must be carefully managed over long periods of time. Wind and solar power currently are expensive and will involve large areas of land to generate significant power.

You will encourage the politicians to come to a rapid conclusion and set guidelines. You must start environmental impact studies now in order to meet project completion deadlines and have generating capacity on line to meet the anticipated demand.

NAME: That / Gracia NGO                      AGE: 26

OCCUPATION: staff scientist

REPRESENTING: Office of Technology Assessment (OTA)

Your role is primarily one of supplying information on technological development and energy consumption among the member nations

Your office has noted the US position to negotiate total greenhouse gases only. US can then promise to produce greenhouse gases at 1991 levels by the year 2010. However your office notes that this target can be met simply by phasing out CFC's according to the agreement at the Montreal Summit.

This does not represent any movement on carbon dioxide. The US could cut carbon dioxide by 35% using existing technology at a cost of \$150 billion annually (1.8% of GNP). Australia, Austria, Denmark and New Zealand have pledged a 20% drop in carbon dioxide in 10-15 years. Canada and Japan have agreed to stabilize production.

Refer to Scientific American Vol. 264 No. 4

**ENERGY CONSUMPTION PER CAPITA (million BTU per person)**

Canada	275	Japan	110
United States	260	France	108
Netherlands	205	Italy	100
USSR	190	Mexico	47
Czechoslovakia	175	Brazil	25
West Germany	155	China	25
United Kingdom	140	Indonesia	10
Poland	140	India	10

NAME: Carlos / Carlotta SARACHO-MENDEZ AGE: 36  
OCCUPATION: Entomologist  
REPRESENTING: World Beef Institute, Buenos Aries, Argentina

You feel your industry is being made a scapegoat in the global warming issue, especially around the issue of methane.

Methane is recognized as an important greenhouse gas and it is recognized that herbivores, especially ruminants are large producers of methane. However, you will argue that the number of ruminants in the world has not dramatically increased. For example the American plains were home to millions of bison, yet the American west was not subjected to a greenhouse effect. Now that these bison have been replaced by cattle (and by far fewer) the effect on global warming should be negative.

You have dedicated a large part of your life to the study of ants and your research has shown that ants, especially tropical species, produce large amounts of methane, in fact far more than cattle. There are considerably more head of ants on the planet than cattle; in fact there are more tonnes of ants than cattle. Perhaps we should eliminate these animals to curb global warming.

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NAME: Fakri / Fatima FAZZAD AGE: 48  
OCCUPATION: H. H. Timkin Professor of Science  
REPRESENTING: Harvard University, Massachusetts, U.S.A.

There are those that will argue that higher carbon dioxide levels will have a fertilizing effect on plants, stimulating plant growth and taking carbon dioxide out of the atmosphere. Your research has shown that this can happen but most often this effect is overestimated because of other factors limiting growth such as water or fertilization. In poorer countries the cost of fertilizer or irrigation is too high to take advantage of high carbon dioxide levels and therefore gains due to high carbon dioxide will only be felt in wealthy nations of the northern hemisphere.

Your research has examined two types of plants. There are C3 plants that are less efficient in high oxygen atmosphere and more efficient in high carbon dioxide. C4 plants are protected from high oxygen and therefore are not affected. At high levels of carbon dioxide, C3 plants will grow faster and compete more successfully against C4 plants. C3 plants include many major food crops such as rice, potatoes, wheat, beans and virtually all tree species. These plants will compete better against C4 weeds and reduce the need for herbicides. However these are mostly Northern Hemisphere crops. Equatorial food crops such as sugarcane, sorghum, maize and many tropical grasses are C4 plants and in a high carbon dioxide environment will be less able to compete with C3 weeds, resulting in reduced yields in nations which can least afford it

REFERENCE: BAZZAZ, Fakhri and Eric D FAJER, "Plant Life in a CO<sub>2</sub> Rich World." Scientific American, January, 1992; Vol 226, No. 1, p68-

NAME: Forbes / Charlotte CHIN

AGE: 27

OCCUPATION: Freelance Journalist

REPRESENTING: American Press Society, New York, New York

You are to point out that press coverage of disasters such as the greenhouse effect may involve biases by world media. Reports which give catastrophic consequences are more likely to get press attention than reports that would say that the effects are more moderate or are benign, simply because the dramatic gives the best copy. As a consequence stories that present a cautious approach to global climate change are often downplayed, moved to the middle of the newspaper or newscast or are simply edited out in favour of more exciting stories.

This type of biased news reporting may be getting the wrong message out to the public who may become more demanding of politicians to act. Politicians frequently are more motivated by public opinion, or perceived public opinion, rather than by scientific fact or theory. Consequently news biases are amplified.

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NAME: Michael / Michelle GARRISON

AGE: 25

OCCUPATION: Ecologist

REPRESENTING: NOAA (National Oceanic and Atmospheric Administration), Bay Saint Louis, Mississippi, U.S.A

Your Ph.D. Thesis investigated the effect of rising sea levels on the intertidal zone.

Your research has identified a large number of ecological disasters that will be caused by a rapid rise of sea levels by as much as 2 meters in as little as 50 years. There have been changes much greater than this in history, but they have occurred over the space of millions of years that allows for living organisms to adjust or move with the sea level. Never before in evolutionary history have the changes been so rapid and so universal. Aquatic life of the intertidal zone will be adversely affected. As sea levels rise, sandy or gravel beaches important to the life and breeding of many invertebrate species of the intertidal zone will be destroyed. As the sea moves inland there will be a surge of nutrients and or toxins released that will upset the delicate balance of the intertidal zone.

Another biome that will be largely destroyed will be the saltwater marshes and the delta regions.

These are very delicately balanced ecosystems that have a moderate level of salt. As the sea level increases the salt level will increase destroying the vegetation. Much of this vegetation such as the mangroves require hundreds of years to establish and will be wiped out in the space of one generation, because they cannot reestablish quickly enough.

NAME: Robert / Rachel LIVERMORE

AGE: 32

OCCUPATION: Atmospheric Scientist

REPRESENTING: Kangaroo Refrigerants Pty., Brisbane, Australia

You are representing a group of refrigerant consumers. Your major concern is over the hazards of banning Freon and related compounds prematurely before all information is available.

You intend to address inadequacies with current computer models. The models currently in use break the surface of the earth into very large squares or rectangles that are treated uniformly by the computer. This is despite the fact that each quadrant may contain areas of vastly different topography, for example mountains and prairie or plains and ocean. Also each square contains different amount of fresh and salt water that will have a moderating effect on temperature change.

You will also point out to the commission that the effects of clouds are not currently accounted for in computer models. The formation of clouds will take large amounts of energy for the vapourization of the water, thereby moderating temperature increases and the clouds, when formed, will reflect much of the sun's radiation back into space, thereby decreasing the temperature in the atmosphere.

Since we do not understand these effects and since these effects of clouds will counteract the greenhouse effect, we do not need to take immediate action.

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NAME: John / June COMINICI

AGE: 58

OCCUPATION: Chemist

REPRESENTING: Integrated Chemicals Ltd, Fenton, New Jersey, U.S.A.

You represent a group of chemical manufactures, primarily those producing Freons and other refrigerants. You are to discuss the chemistry of these compounds and to point out that there are currently no suitable replacements.

Refrigerants are very important in today's food economy. Vast amounts of food spoil daily in countries that can least afford it including Russia, China and nations of Africa because of the lack of refrigeration. Billions run the risk of food poisoning because of poor refrigeration. Many of the poorer nations are just getting refrigeration and to ban Freon and related compounds would prolong the misery.

Freons are well suited to the purpose of refrigeration. They are long lasting, stable, non-combustible, non-corrosive compounds that have the right properties for refrigeration.

Currently there are no superior compounds, or even adequate substitutes. The industry is researching alternatives with little success to date. You will request that the commission does not act rapidly on the banning of CFC's as refrigerants at least until suitable substitutes can be found and equipment modified to use them.

NAME: Ken/Kendra MILLER      AGE: 47  
OCCUPATION: geologist  
REPRESENTING: Cornell University, Ithaca, New York, U.S.A.

You have recently been associated with a group of scientists studying mud drilled from three onshore sites and one offshore site along the coast of New Jersey. The Jersey shore was chosen because it is a natural laboratory of Earth's own systems. Mud has been drilled from as deep as 4300 feet below the ocean floor. Breaks in the mud show change in sea level also reveal past episodes of global warming when ice sheets melted causing oceans to rise. If the sediments can tell us how sea levels have changed naturally over the millennia, we'll be better able to understand future changes, both natural and man-made. We will be able to more intelligently deal with the complex range of effects that global warming may have on shorelines around the world.

Offshore drilling is done on the high-tech JOIDES Resolution (Joint Oceanographic Institute for Deep Earth Sampling, an advisory board of scientists from 19 member nations). This modified oil drilling platform has drilled holes in many coastal locations around the world. The ship has 12 sophisticated laboratories on seven levels for the study of sedimentology, paleontology, petrology, geochemistry, geophysics, paleomagnetism and physical properties.

Your work shows that there have been great shift in sea level over the last 50 million years, likely coupled to general periods of warm and cool climates. These changes likely occurred over thousands of years and had a dramatic effect on the amount of life and the type of lifeforms as indicated by fossils found in the mud of both offshore and onshore drilling samples.

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NAME: Richard / Belinda Lindzen      AGE: 58  
OCCUPATION: Atmospheric Scientist  
REPRESENTING: United Kingdom Meteorological Office, Greenwich, U.K.

Your role is to present the weakness in the models of global warming that predict current behavior. Although it appears that surface stations show increases since the 1970's, National Oceanic and Atmospheric Administration (NOAA) satellites have not shown an increase in average temperatures for the bottom 4 miles of the atmosphere. NOAA's Comprehensive Ocean Atmosphere Data Set says the oceans cooled during the 1980's, while data collected by your office show warming in the same decade.

Skeptics by profession, scientists such as yourself, accessing the evidence of climate change talk soberly of possibilities and uncertainties but tend to shun flat predictions. Many activists, meanwhile, are convinced that global warming is a major threat to humanity. You are to urge caution in taking action, believing that we still have lots of time to study the problem and make wise, informed decisions. After all the temperature has risen less than 1°C in the last century with no apparent ill effects.

**NAME:** John / Jane Shot-Both-Sides      **AGE:** 60  
**OCCUPATION:** Geneticist, Elder  
**REPRESENTING:** Aboriginals

Your role is to represent the aboriginal perspective. You will use traditional Aboriginal story and understanding of prophesy to relate to the conference how Aboriginal peoples have seen the problems of changes to the climate due to lack of respect for the concept of Sacred Balance in the World. These prophesies, in metaphoric form also offer potential solutions to reduce the negative impact of climate change.





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Climate Change Saskatchewan

**CLIMATE CHANGE EDUCATION SASKATCHEWAN**

# **Grade Eleven & Twelve Biology Mini Unit**

**Cross-Referenced to Saskatchewan Core  
Agricultural Biology 20 & 30**

Jane Wilson

Editor:  
Barry Charington

November 2003

Canada



Government of  
Saskatchewan

**SaskEnergy**  **SaskPower**



Saskatchewan  
Watershed  
Authority

# Carbon and Climate Change

## Objectives

To understand how the carbon cycle works and how plants and animals contribute to the cycle.

To describe how humankind has affected the amount of carbon in the atmosphere with different activities.

To understand how the amount of carbon in the atmosphere relates to the greenhouse effect and climate change.

To understand how agriculture affects the carbon levels in the atmosphere and thereby affects and is affected by the greenhouse effect, inevitably affecting climate change.

To investigate how we can change agricultural practices to adapt to climate changes.

To investigate how changing agricultural practices may affect climate.

## Activity Information

**Grade Level:** 11-12

**Subject:** Biology, Agricultural Studies

**Curriculum**

**Correlation:** Biology 20: Ecological Organization; Agricultural Botany of Saskatchewan

**Skills:**

**Duration:** 8-10 class periods

**Group Size:** will fit any class size

**Setting:** classroom, library, computer room- internet access

**Vocabulary:** carbon dioxide, carbon sinks, carbon sources, carbon sequestering, natural greenhouse effect, enhanced greenhouse effect

## Materials

Resource-Based Learning Approaches

See References

## Background Information

Carbon dioxide is one of the greenhouse gases. It is emitted by the burning of fossil fuels, normal respiration, and agriculture among others. The added carbon dioxide contributes to enhance the greenhouse effect and trap more heat on the surface of the earth. This phenomena contributes to global warming.

Plants remove carbon dioxide from the air and it is used in the process of photosynthesis to produce oxygen and food. As the climate changes on the Earth and conditions on the Prairies become more arid, the biodiversity and numbers of plants decrease. This reduces the amount of carbon dioxide is placed in “carbon sinks” and increases the amount of carbon dioxide in the atmosphere, all contributing to the greenhouse effect.

### **Activity 1**

See Resource: Climate Change: Pembina “The Carbon Connection: (pp 21-39)

To learn the different parts of the carbon cycle.

#### **Summary:**

Introduce the students to the carbon cycle using Transparency 2 – “The Natural Carbon Cycle” Define the terms: carbon source, carbon sink, carbon sequestering giving the few example as listed on the Student Activity 2A of sources and sinks. This activity should take about 5 to 10 minutes for a quick overview. Brainstorm with students for other sources and sinks in nature. Spend about 10 minutes on this activity and have students make a 2 column list of these examples.

Hand out the story “The Great Carbon Caper and have students read and determine the changes that carbon undergoes throughout the story. Have students use highlighter, one for sources and one for sinks and underline the changes in the appropriate colours. Then hand out the activity sheet for students to fill in.

**Assessment:** Take up in class or take in for marks.

### **Activity 2**

See Resource: Climate Change: Pembina “The Carbon Connection: (pp 21-39)

The objective of this activity is to determine how humans have affected the Natural Carbon Cycle.

#### **Summary:**

Use Transparency 3 – “Tipping the Balance” to give students an idea of how humans are affecting the Natural Carbon Cycle and have the class discuss other ways humans have affected the cycle. Have them fill in the Student Activity 2B

**Assessment:** Have students write a sequel to “The Great Carbon Caper” to demonstrate what would happen to carbon atoms in future with human influence in mind.

### **Activity 3**

See Resource: Climate Change: Pembina “The Carbon Connection: (pp 21-39)  
Climate Saskatchewan Website

What is the Greenhouse effect; natural and enhanced, and how does the level of CO<sub>2</sub> affect the greenhouse effect?

**Summary:**

Use Transparency 1 – “The Natural Greenhouse Effect” and handout Fact Sheet 2 – “Greenhouse Gases” to review with students what the Greenhouse effect is.

**Student Research:**

Using resources determine the predicted future climate change in Canada and/or Saskatchewan.

*See list of references below*

**Activity 4**

Brainstorm with students how agriculture might affect the greenhouse effect and climate.

Divide Students into groups to research any/all the following topics:

- a. What farming practices increase stored carbon?  
(could divide into plant crops/livestock)
- b. What farming practices decrease stored carbon?  
(could divide into plant crops/livestock)
- c. How do farming practices affect weather/climate conditions?

This activity will take several classes – give up to 2 classes for students to research and then give an oral report back to the rest of the students.

**Assessment:** Group work and oral reports. Give students outlines of how they will be marked for group work and standards for their oral reports.

**Activity 5**

Pick one of the situations explain how you can adapt your current farming practices to have success.

1. Situation where a farmer is wheat farming, the weather has changed and the conditions are now \_\_\_\_\_, where growing wheat is not a viable project. Because the conditions are not conducive to wheat growing the farmer must research and determine what type of “agriculture” solution will be appropriate for him/her.
2. The climate is now like \_\_\_\_\_ but the farmer wants to do \_\_\_\_\_. What does he/she need to do to help their plan be a success?

**Assessment:** Written report to be handed in at the end of the allotted time.

## Text References

Climate Change, Pembina Organization  
SEEDS,  
Green Teacher  
EcoRegions of Saskatchewan CD and book

## Website Resources

Government of Canada, Climate Change Teacher Resources:

[http://www.climatechange.gc.ca/english/workroom/teachers\\_resources/index.shtml](http://www.climatechange.gc.ca/english/workroom/teachers_resources/index.shtml)

- Climate Change information sheet – Environment Canada
- Environment Canada – Climate Change website: [www.climatechange.gc.ca](http://www.climatechange.gc.ca)
- Climate Change Saskatchewan Website: [www.climatechangesask.ca](http://www.climatechangesask.ca)
- Climate Change – Government of Alberta: <http://www3.gov.ab.ca/env/climate.html>
- Climate Change Central: <http://www.climatechangecentral.com/>
- Government of British Columbia: <http://wlapwww.gov.bc.ca/air/climate/>
- Natural Resources Canada: [http://adaptation.nrcan.gc.ca/posters/cc\\_en.asp](http://adaptation.nrcan.gc.ca/posters/cc_en.asp)
- United Nations Environment Programme's Information Unit for Conventions: <http://unfccc.int/resource/iuckit/>
- United Nations Environment Programme: <http://climatechange.unep.net/>
- 2002 Golden Hills School Division and Galileo Educational Network Association™: <http://www.galileo.org/schools/crowther/science/blueplanet/climate.html>
- David Suzuki Foundation - Climate Change: [http://www.davidsuzuki.org/Climate\\_Change/](http://www.davidsuzuki.org/Climate_Change/)
- Center of International Earth Science Information Network: <http://www.gcrio.org/ipcc/qa/cover.shtml>
- U.S. Environmental Protection Agency: <http://yosemite.epa.gov/oar/globalwarming.nsf/content/index.html>
- The Pacific Institute for Studies in Development, Environment, and Security: <http://www.globalchange.org/>
- Manchester Metropolitan University, Joe Buchdahl: <http://www.doc.mmu.ac.uk/aric/gccsg/>
- Climate Change Calculator: [http://www.climcalc.net/eng/Intro\\_1.html#changing](http://www.climcalc.net/eng/Intro_1.html#changing)
- Potential Impacts of Climate Change and Impact on Agriculture and Food Supply: <http://www.gcrio.org/CONSEQUENCES/summer95/agriculture.html>
- Food and Agriculture Organization of The United Nations: <http://www.fao.org/NEWS/1997/971201-e.htm>
- CIESIN Thematic Guides \* Provisional Release \*: <http://www.ciesin.org/TG/AG/AG-home.html>
- Agriculture and Agri-Food Canada: [http://www.agr.gc.ca/policy/environment/eb/public\\_html/ebe/climate.html](http://www.agr.gc.ca/policy/environment/eb/public_html/ebe/climate.html)
- Saskatchewan Environment: <http://www.serm.gov.sk.ca/environment/climatechange/>
- Climate Change Solutions: <http://www.climatechangesolutions.com/english/default.htm>
- University of Reading: <http://www.ecifm.rdg.ac.uk/home.htm>

- How are Climates Changing in the Prairies?, Natural Resources Canada:  
[http://adaptation.nrcan.gc.ca/posters/articles/pr\\_03\\_en.asp?Region=pr&Language=en](http://adaptation.nrcan.gc.ca/posters/articles/pr_03_en.asp?Region=pr&Language=en)
- Saskatchewan Soil Conservation Association: <http://ssca.usask.ca/links.html>
- Climate Change Connections 2002; Climate Change and Agriculture:  
<http://www.web.net/~climate/pages/agriculture1.html>
- Saskatchewan Agriculture: <http://www.agr.gov.sk.ca/>
- Agriculture and Climate Change - A Prairie Perspective:  
[http://www.iisd.org/pdf/agriculture\\_climate.pdf](http://www.iisd.org/pdf/agriculture_climate.pdf).
- Agriculture and Agri-Food Canada; "Pulse Crop Production On The Canadian Semi-Arid Prairies": [http://res2.agr.ca/swiftcurrent/lre-tre/millrpulse2\\_e.htm](http://res2.agr.ca/swiftcurrent/lre-tre/millrpulse2_e.htm)
- Specialized Crop Production Area Spoke Program: <http://paridss.usask.ca/cgi-bin/specialcrop/pari.pl?function=activities&type=4>
- Challenges and Opportunities of Including Agricultural Soil Sinks in the Kyoto Protocol: <http://ssca.usask.ca/2001proceedings/Lindwall1.htm>
- References and publications containing useful information on crop production and soil conservation: [http://www.wetland.sk.ca/pdfs/landowner/mgn\\_sk\\_wetlns\\_BIB.pdf](http://www.wetland.sk.ca/pdfs/landowner/mgn_sk_wetlns_BIB.pdf).



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**CLIMATE CHANGE EDUCATION SASKATCHEWAN**

## **Grade Twelve Mini Unit**

### **Cross-Referenced to Saskatchewan Core Physics 30**

Barry Mitschke  
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Editor:  
Barry Charington

November 2003

Canada



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## **Climate Change Writing Workshop 25-10-02**

### **“ELECTRICITY, A PRIMARY ENERGY SERVANT”**

The demand for electrical energy has increased dramatically in recent years. Conserving electrical energy is very important.

**Note:** Pages refer to the Physics 30 Curriculum Guide.

#### **Foundational Objectives**

To appreciate the value and limitations of technology within society. (P.193)

To promote awareness, understanding, concern and commitment, and action related to climate change.

#### **Learning Objectives**

To identify the main methods that are used to produce electricity in Canada (P.207).

To research the major methods that are used for generating electrical energy in Saskatchewan, and elsewhere in Canada. Create a major report.

To identify the advantages and disadvantages of each method noting the impact each has on the environment. (p.195)

To use the SaskPower website to complete an “energycheck”.

<http://www.saskpower.com/services/energycheck/energycheck.shtml>

To conserve electricity, hence taking action to slow Climate Change.

#### **Module Information**

Grade: 12. Subject: Physics 30, SK Core Curriculum. Correlation: Electricity. Skills: [add from WILD and DSLs]. Duration: 5+ hours Group Size: regular class. Setting: classroom; library; computer lab or station(s); community library; home. Vocabulary: biomass, geothermal, fuel cell; see the activities for other words.

**Materials:** Resource-based Learning materials. See the References.

#### **Background Information**

Electricity is a household word. It is a business/industry word. It is indispensable to modern life. Electricity allows us to use all types of appliances, devices, machines, and tools that each act as an extension of self, in actuality creating multiple “energy servants” for us to use.

We generate much electricity by using three main fossil fuels ---- coal, natural gas, and oil. This



generation releases CO<sub>2</sub>, a prime greenhouse gas that is contributing to climate change.

**Saskatchewan generates electricity from many sources --- coal (60%), hydro (25%), natural gas and cogeneration (14%), wind (~1%). This electricity is distributed around the province to homes, businesses and industry to sustain our ways of living.**

Saskatchewan, Canada and the world are being challenged by the Kyoto Agreement to reduce GHG emissions, to adapt to climate change and meet increasing demand with new electrical generation capacity. The blackout in Eastern North America in summer of 2003 and the continued energy crisis in California attest to the severity of the problem. Conserving electricity, and other forms of energy, can help slow climate change. All citizens are asked to help!

## **ACTIVITIES**

Feel free to vary the following sequence.

### **Activity #1**

See the Physics 30, Core Curriculum Guide, and Activity #7, p. 195.

The main energy sources for the generation of electricity include coal (lignite in SK), hydroelectricity, nuclear fission, natural gas, wind, biomass, geothermal. Newer methods may include: fuel cells (including phosphoric acid fuel cells), molten carbonate fuel cells (and solid oxide fuels), magnetohydrodynamics, stored energy systems (stored energy in CO<sub>2</sub> and electric batteries), nuclear batteries, hydrogen utilization, and possibly nuclear fusion.

Using some method, assign each student to research one energy source; for example, lignite coal. Using a resource-based learning approach --- print, AV, the Internet, expert people, etc. --- the student creates an in-depth, illustrated report of several thousand (5-10 000) words on their assigned topic.

The advantages and disadvantages of generating electricity from each source should be clearly identified. (This could be summarized in a table.) How does each method impact the environment? How does Kyoto influence this generation choice? What Aboriginal communities will be impacted and how will their cultural lifestyles be affected?

Once these reports are completed, they should be shared. Use brief oral reports or a poster display that may use a “show and tell”, a “walk-about”, or a jigsaw (become an “expert”) method.

Decide on the worth of the report and the sharing in terms of the class evaluation scheme.

## Activity #2

Access a computer lab or a computer station set-up at school. If this is not possible use a home computer or the computer access at the local library. Parental permission will be necessary since the SaskPower account information will have to be provided.

Go to [www.saskpower.com](http://www.saskpower.com) to access “energycheck”, an online tool that helps to evaluate the electricity (and natural gas) use in one’s home. Focus on the electricity part, but you may have to deal with both electricity and natural gas.

As the SaskPower brochure says: “When you enter the major electrical and natural gas appliances you use in your home, energycheck gives you a general indication of your home’s energy use. It also calculates the greenhouse gas emissions associated with these appliances and equipment, and provides you with tips on how to save money and conserve energy.”

Compare the energy use in various homes.

Discuss electricity use as a class. What are the best ways to conserve electricity? Each student must make a commitment to do something to conserve electricity, and then to deliberately practice conservation consistently. Involve the whole family.

## Assessment and Evaluation

Assessment and evaluation methods may focus on:

Writing a research report.

An oral presentation to peers using a display or presentation, if possible.

Completing the “energycheck”.

Participating in classroom discussions.

## References

Saskatchewan Education. (1992). Physics 20/30. A Curriculum Guide for the Secondary Level.

SaskPower. (1991). Saskatchewan Electrical Energy Options. Final Report (November).

Society, Environment & Energy Development Studies (SEEDS) Foundation. (2002) Creating a Climate of Change. Resources for Teachers. Section 7-1 to 7-5.

[www.saskpower.com](http://www.saskpower.com). The “energycheck” tool.

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<http://www.saskpower.com/environment/rpp/enviroreview03.pdf>