Climate Change

How does it affect me?

Steve Wohlmuth wohlmus@gnspes.ca Central Kings Rural High School Canads

Climate Change

What Are Greenhouse Gases?

Some greenhouse gases occur naturally in the atmosphere, while others result from human activities (anthropogenic gases). Naturally occurring greenhouse gases include water vapor, carbon dioxide, methane, nitrous oxide, and ozone. Certain human activities, however, add to the levels of most of these naturally occurring gases:

Carbon dioxide is released to the atmosphere when solid waste, fossil fuels (oil, natural gas, and coal), and wood and wood products are burned.

Methane is emitted during the production and transport of coal, natural gas, and oil. Methane emissions also result from the decomposition of organic wastes in municipal solid waste landfills, and the raising of livestock.

Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of solid waste and fossil fuels.

Very powerful greenhouse gases that are not naturally occurring include *hydrofluorocarbons* (HFCs), *perfluorocarbons* (PFCs), and *sulfur hexafluoride* (SF6), which are generated in a variety of industrial processes.

Each greenhouse gas differs in its ability to absorb heat in the atmosphere. HFCs and PFCs are the most heat-absorbent. Methane traps over 21 times more heat per molecule than carbon dioxide, and nitrous oxide absorbs 270 times more heat per molecule than carbon dioxide. Often, estimates of greenhouse gas emissions are presented in units of millions of metric tons of carbon equivalents (MMTCE), which weights each gas by its GWP value, or Global Warming Potential. (USEPA 2005)

Section 1:
Climate Change: Carbon Dioxide

During the past 200 years, humans have caused a remarkable change in the levels of atmospheric greenhouse gases. Since the 1960's, direct measurements have been taken by scientific instruments to measure changes in the earth's atmosphere. Using these measurements, scientists have noticed changes in the greenhouse gases, particularly carbon dioxide. In recent years, scientists have used the deep ice cores from Antarctica to determine carbon dioxide measurements in the geologic past. This was done by examining bubbles containing the trapped atmosphere in the polar ice. Scientist have been able to examine ice that is 650 000 years old in Antarctic. These measurements were done by the *European Project for Ice Coring in Antarctica (EPICA)* and release to the scientific community in November 2005. (Edward J. Brooks 2005)

Steve Wohlmuth wohlmus@gnspes.ca Central Kings Rural High School Canads

Question 1a. Line Graph

Using the data provided, construct a line graph to illustrate the carbon dioxide levels measured by the European Project for Ice Coring in Antarctica Team (EPICA). (PPM = Parts per million) and CO2Now.org.
Put the time on the (X) axis and the carbon dioxide levels on the (Y) axis. Title and Label graph (10pts)

In thousand of years ago (tya)	Carbon Dioxide Level (ppm)
650	190
600	220
500	245
400	270
300	250
200	245
100	240
Today (0)	393

Question 1b.

Using the data above, determine the percentage change for the following time periods. (11pts) Global Carbon Dioxide Level (PPM) * Math to first decimal.

(TYA)	PPM	YEAR	PPM	% Change
650	190	600	220	
600	220	500	245	
500	245	400	270	
400	270	300	250	
300	250	200	245	
200	245	100	240	
100	240	Present	393	
YEAR	**PPM**	**YEAR**	**PPM**	**% Change**
1990	354	1995	360	
1995	360	2000	369	
2000	369	2005	379	
2005	379	2013	393	

Source: National Oceanic and Atmospheric Administration 2010 and CO2Now.org

Question 1 c.

Construct a list four (4) anthropogenic gas sources/locations admitted in your community or region? (4pts)

1. _____
2. _____
3. _____
4. _____

Question 1 d.

Detail a management strategy to reduce (1) one of the anthropogenic gas sources in your community. (2pts)

_____

Steve Wohlmuth wohlmus@gnspes.ca Central Kings Rural High School Canads

---

Section 2:
Climate Change: Temperature

Global sea level and the Earth's climate are closely linked. The Earth's climate has warmed about 1.5°F during the last 100 years. As the climate has warmed following the end of a recent cold period known as the "Little Ice Age" in the 19th century, sea level has been rising about 1 to 2 millimeters per year due to the reduction in volume of ice caps, ice fields, and mountain glaciers in addition to the thermal expansion of ocean water. If present trends continue, including an increase in global temperatures caused by increased greenhouse-gas emissions, many of the world's mountain glaciers will disappear. For example in Iceland, about 11 percent of the island is covered by glaciers (mostly ice caps). If warming continues, Iceland's glaciers will decrease by 40 percent by 2100 and virtually disappear by 2200. (USGS 2005)

Question 2 a. Line Graph

Construct a line graph to illustrate the annual global surface temperature anomalies (land and sea) from 1880 to 2010. Put the Years on the (X) axis and the temperature on the (Y) axis. Title and Label graph (10pts)

Year	Temperature in Celsius
1880	-0.23
1890	-0.33
1900	-0.11
1910	-0.45
1920	-0.25
1930	-0.10
1940	+0.03
1950	-0.23
1960	-0.08
1970	-0.03
1980	+0.11
1990	+0.28
2000	+0.28
2005	+0.52
2010	+0.58
2013	+0.64

National Climate: Data Center (NOAA) 2013

Questions 2 b.

What implications do increased temperatures globally have on natural disasters such as hurricanes, Floods and droughts? (Internet Research) (4pts)

Steve Wohlmuth wohlmus@gnspes.ca Central Kings Rural High School Canads

---

Section 3:
Climate Change:
Anthropogenic Sources

Question 3 a. Bar Graph

Using the following data below, construct a dual bar graph to illustrate the top ten carbon dioxide contributors globally. Title and Label graph (10pts)

The Top Ten Carbon Dioxide Emission Nations: 1999 and 2013
MMT = Million Metric Tons

Country	Emissions (MMT) Annually (1999)	Emissions (MMT) Annually (2011)	Percentage Change from 1999 to 2013
China	2992	7 031	
USA	5682	5461	
Russia	1560	1709	
India	971	1742	
Japan	1157	1208	
Germany	840	789	
Canada	567	544	
United Kingdom	559	522	
South Korea	432	509	
Iran	317	538	

International Energy Annual: 2013

Question 3 b.

Using the table above, calculate the percentage change between 1999 and 2013. (5pts) * Math to first decimal.

Question 3 c. *(think for yourself)

Which four countries had the largest increase in percent between 1999 to 2013? *Why have these countries emission level increased so much? (3pts)

Question 3d (think for yourself)

Why are most of the top 10 countries reluctant to participate in a major emission reduction agreement? (2pts)

Steve Wohlmuth wohlmus@gnspes.ca Central Kings Rural High School Canads

---

Taking Action

Question 3e.

What are (5) things that could be done by each person or household to reduce greenhouse gas emissions? (Online Research)
http://www.davidsuzuki.org/what-you-can-do/reduce-your-carbon-footprint/ (5pts)

1. _____
2. _____
3. _____
4. _____
5. _____

Section 4:
Climate Change: Disappearing Arctic Ice

For the ten consecutive year, scientists using satellite data have tracked a stunning reduction in arctic sea ice at the end of the northern summer. The persistence of near-record low extents leads the group to conclude that Arctic sea ice is likely on an accelerating, long-term decline.

Question 4 a.

Using the data table on the next page, determine in percent how much of the arctic ice cap has been lost from 1979 to 2012? (2pts)

Steve Wohlmuth wohlmus@gnspes.ca Central Kings Rural High School Canads

Question 4 b. Line Graph

Using the data below, construct a line graph of Arctic Ice cover (average for January) from 1979 – 2020. Title and Label graph (10pts)

IMPORTANT: When indicating time on the (X) axis, extent the year to 2020.

Year	Linear regression X values	Millions of square miles
1979	0	7.9
1980	1	8.3
1982	3	8.4
1983	4	7.9
1984	5	7.5
1985	6	8.0
1988	9	7.7
1989	10	7.9
1990	11	7.9
1992	13	6.8
1993	14	7.4
1994	15	7.4
1995	16	7.3
1996	17	7.3
1997	18	7.3
1998	19	7.5
1999	20	7.2
2000	21	7.5
2001	22	6.5
2002	23	6.9
2003	24	6.8
2004	25	6.3
2005	26	6.3
2006	27	6.5
2007	28	5.4
2008	29	6.0
2009	30	6.3
2010	31	6.0
2011	32	5.5
2012	33	4.7
2013	34	4.8

The National Snow and Ice Data Center (NSIDC)

Steve Wohlmuth wohlmus@gnspes.ca Central Kings Rural High School Canads

Question 4 c.

On the graph using a line of best fit, predict the Arctic ice cover to the year 2020. Use a dashed line of best fit from 2013 to 2020. (2 pts)

_____
_____

Question 4d. (Bonus)

Using linear regression, what would be the area of Arctic Ice cover in 2020?

_____

Question 4e. (Bonus)

Using linear regression, in what year (calendar year) will the Arctic Ice cover disappear or reach zero cover?

_____

Section 5:

Climate Change: Sea Level Rise and the Global Conveyer Belt

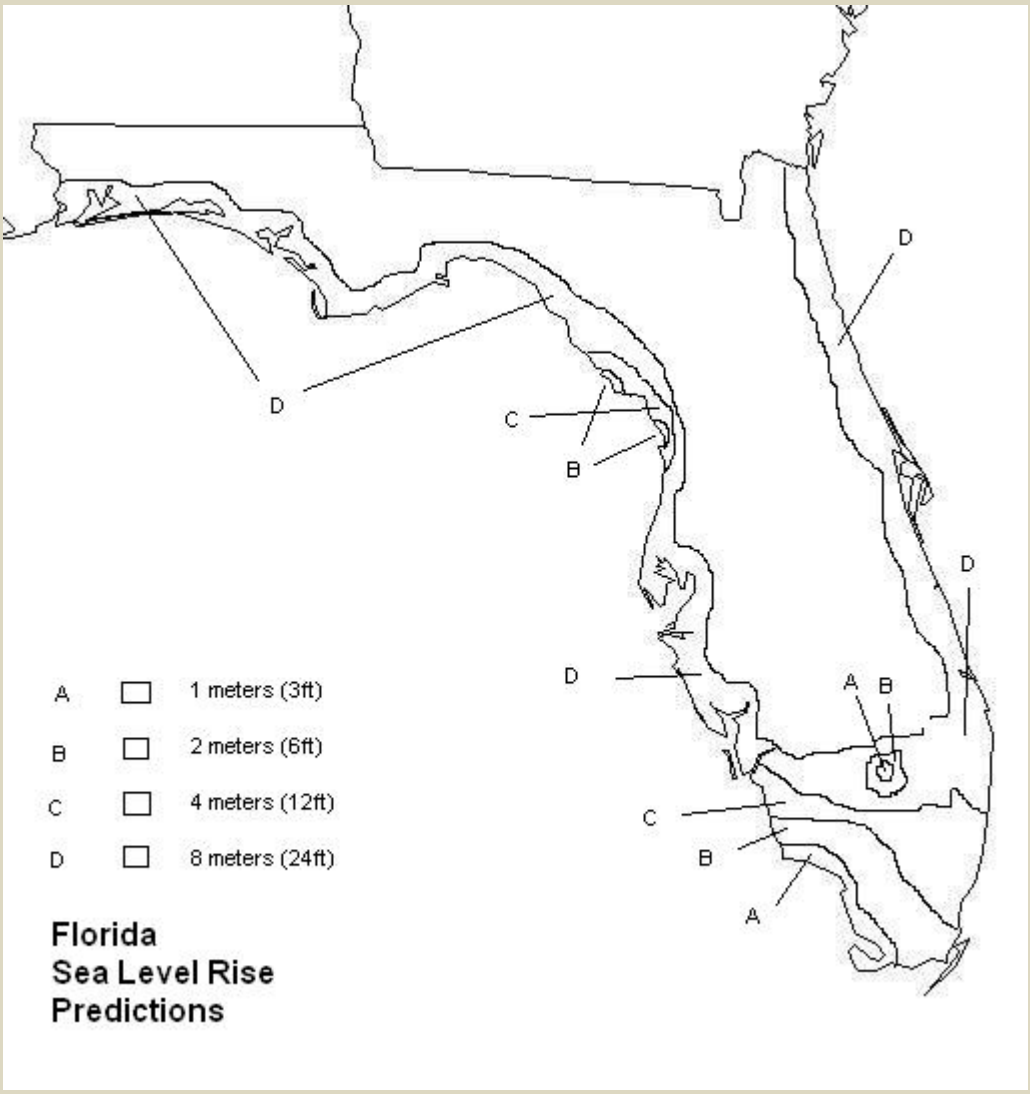
Over the last 100 years, the global sea level has risen by about 17.5 cm. Sea level change is difficult to measure. Relative sea level changes have been derived mainly from tide-gauge data. In the conventional tide-gauge system, the sea level is measured relative to a land-based tide-gauge benchmark. The major problem is that the land experiences vertical movements (e.g. from isostatic effects, neotectonism, and sedimentation), and these get incorporated into the measurements. (United Nations Environmental Programme 2006)

The major concern is what would happen if the Greenland and/or the Antarctic Ice Sheet melted? Experts predict if the Greenland Ice Sheet melts that global sea level will rise 7 meters.

This melting of the Greenland Ice Sheet also may have profound impacts on the Atlantic/Arctic Ocean water. The mixing of fresh water and salt water could affect the stability of the thermohaline in the Atlantic and Arctic and could also disrupt the “Global Conveyer Belt”.

Steve Wohlmuth wohlmus@gnspes.ca Central Kings Rural High School Canads

5a. Using the map of Florida provided, color code the areas affected by coastline sea level rise into the future. You will need four color pencils to complete this question. Use one color for each sea level change. Start at the current Florida coastline, determine the progression of sea level change overtime. (Source: NASA 2013)



Source: Geology.com and NASA

5b. Given the predicted change in the future, how would you advise or consult local authorities? Outline a mitigation plan for the Sate of Florida. Consider short and long term options. Use an atlas, highway map to predict which communities, towns and cities that could be potentially impacted by rising sea levels. (5pts)

Steve Wohlmuth wohlmus@gnspes.ca Central Kings Rural High School Canads

Section 6

The Impact of Sea Level Rise: Kentville, Nova Scotia CANADA

6a. Using the map of Kentville provided, colour code the areas affected by coastline sea level rise over the next 400 years. You will need two colour pencils to complete this question. Use one colour for each sea level change. Start at the banks of the Cornwallis River and using the contour lines determine the location of each 200/400 years of sea level change. Note: The mean average height of Cornwallis River is 5.7 meters. **(8pts)**

Coastline Predictions: Nova Scotia Department of Natural Resources (Utting and Finck 2010)

Year	Predicted Sea Level Change in Meters
2211	4 m + 5.7 m = 9.7m (10m)
2411	8 m + 5.7 m = 13.7m (14m)

6b. Given the predicted change over coming centuries in question 5b, how would you advise or consult local authorities? Outline a mitigation plan for the town of Kentville. Consider short and long term options. (5pts)

_____
_____
_____
_____
_____
_____
_____
_____

Steve Wohlmuth wohlmus@gnspes.ca Central Kings Rural High School Canads