

The Winds of Change:
Climate Change in the Prairie Provinces

Group Members: _____

Trivia Challenge: Search the entire poster to find answers for the following: (bonus)

1. When was most of Canada covered with ice?
At the peak of the last ice age ~16 000 years ago
2. What is the current land cover around Uranium City?
Evergreen needleleaf forest
3. What landmark is seen in the picture of a city?
Calgary tower

Did You Know? Use the pieces of information under this heading (“Did You Know?”) on the poster to answer the following true/false (T or F) questions. If the statement is false, cross out the incorrect word or number value, and write in the correct version. (10)

- ___ Nearly 40% of Albertans live in either Calgary or Edmonton. **F, 60%**
- ___ Almost half of the population of Saskatchewan lives in rural areas. **T**
- ___ About 10% of Regina relies on groundwater for its water supply. **T**
- ___ There are more than ~~5000~~ glaciers in the eastern Rockies. **F, 1300**
- ___ The ~~1980's~~ were the warmest decade of that century. **F, 1990's**
- ___ Most forest fires in Canada are caused by ~~careless campers~~. **F, lightning strikes**
- ___ The hottest temperature ever recorded in Canada was 45 °C on July 5, ~~1997~~. **F, 1937**
- ___ The most expensive weather-related disasters are ~~ornadoes~~. **F, droughts**
- ___ Every litre of gas used in your car produces about ~~5 kg~~ of CO₂. **F, 2.5 kg**
- ___ The Calgary hailstorm of 1991 lasted for ~~45~~ minutes! **F, 30!**

Climates Do Change:

1. When was the last time most of Canada was covered with ice? (1)
At the peak of the last ice age, ~16 000 years ago.

2. Examine the 3 graphs:
 - a) Graph 1: What does the graph depict climate to have been like in: (1.5)
 1. 8000 BC?
Temps ~ 4°C below average, and today
 2. 4000 BC?
~ 2°C above average temps over the past 10 000 years
 3. The last 500 years?
Little ice age – below average temps for the last 10 000 years

 - b) Graph 2:
 1. What does the graph show for several hundred years before 1980? (.5)
Cooler than average temps – Little Ice Age

 2. What happened to the Rockies during this period of time? (.5)
The glaciers expanded

 - c) Graph 3:
 1. Describe what has happened to Earth's average temperature since 1980. (1)
It has risen considerably (~ 0.6°C)

 2. What is the projected temperature rise for the year 2100? (.5)
Close to 5°C

 3. Do you think this is a realistic projection? Why or why not? (.5)

3. Examine the map showing projected summer temperatures for 2080 – 2100. By how much will temperatures in North America have increased from the 1975 – 1995 time period? (1)
~ 3 - 5°C, depending on the location

4. What might happen to temperatures south of Greenland and eastward off the Canadian Atlantic coastline? (1)
May drop up to 4 - 5°C

Why is the Climate Changing Now?

1. Record the following information on incoming solar radiation: (2)

23% absorbed by atmosphere
25% reflected by atmosphere
46% absorbed by Earth's surface
6% reflected by Earth's surface

2. What are the 2 most important greenhouse gases? (.5) **H₂O & CO₂**
3. If there were no GHGs, what would not be possible on Earth? (1) **Life**
4. Examine the graph showing atmospheric CO₂ concentrations, and describe what occurred after the Industrial Revolution. (1)
Rise from ~280 ppm to >360 ppm by the year 2000
5. What specific human activities are responsible for the rapid build-up of CO₂ in our atmosphere? (1)
Burning fossil fuels, deforestation, and agricultural practices.
6. Summarize how the carbon cycle maintains balance on Earth by listing all factors involved in the capture and release of this element. (2)
Plants – photosynthesis, biota – respiration, deforestation, burning fossil fuels, atmosphere/lithosphere/hydrosphere transfers...
7. Where is most of Earth's carbon stored? (1) **75 000 000 billion tonnes in ROCKS!**
8. How many billion tonnes of carbon are stored in fossil fuels? (.5) **5 000 billion**
9. What are the "big three" GHGs we're concerned about? (1)
 - a) **CO₂**
 - b) **CH₄**
 - c) **N₂O**

How Are Climates Changing in the Prairies?

1. Despite the warming trend depicted in the Prairie temperature graph, what is also apparent on a year-to-year basis? (1)
Fluctuations above and below average temperatures
2. By how much has the yearly average temperature increased over the last 50 years? (1) **~ 1.2°C**
3. What province is particularly susceptible to drought? (.5) **Saskatchewan**
4. What will this mean to farmers there? (1)
Open...decreased yield, increased erosion, and increased irrigation...

Melting Glaciers:

1. What will be affected by retreating glaciers? (1)
Downstream water flows, wildlife habitats, hydroelectric production.
2. Examining the graph for glacier-fed stream flow, when is the peak time for glacial melt runoff? (.5) **June / July**

3. What fish may already have been impacted by a reduction in glacial-derived flows?
(.5) **Bull trout**

Water Resources:

1. Check off all of the following that **apply** to groundwater: (1)
- √ A good alternative source of water throughout the prairies
 - Provides an unlimited source of water
 - √ Is a renewable resource
 - √ Can become contaminated, and not safe for use
 - √ Is used for irrigation on the prairies
 - √ Provides many residences with all of their water needs
2. Examine the diagram showing Calgary. If you were to develop a management/conservation program for this city's water supply, what would you take into consideration? (1)
Glaciers/melt, population growth, increased evaporation...

Changing Vegetation:

1. Looking at the 2 maps of prairie vegetation, present and future, what is projected to happen to the percentage ground cover of: (1.5)
- a) Grasslands? **Increase by ~2x, extending northward**
 - b) Aspen parkland? **Increase by ~2x, extending northward**
 - c) Boreal forest? **Increase by ~2x, extending northward**
 - d) Foothills forest? **Not much change**
 - e) Subarctic? **Almost disappears (~1/7 original area)**
2. Write a short story describing what might happen to you if you were a tree in a prairie forest. (1.5)
- “Hi. I am _____.....”
3. Comment on the usefulness of satellite images for detecting forest fires. (.5)
Extremely useful!

Rivers in Flux:

1. Will all rivers be affected in the same way as climate warms? (1)
No. It depends on their location and source
2. Of the 4 types of rivers listed, which one will have an impact on Winnipeg, and how might we be affected? (1)
Prairie-source rivers will experience lower, but more variable flows, and larger extreme flows.

3. Answer the following regarding the Red River Flood of 1997: (2)
- The cost? **> \$800 million**
 - Number of military personnel? **7000**
 - How many people evacuated? **25 500**
 - What kind of protection saved most towns south of Winnipeg? **Ring-dikes**
 - What did Morris, Manitoba look like? **An island**
 - How were members of your group affected by the flood?
4. Examine the graph.
- How many years from the period 1892 – 1945 had flows over 2000 m³/s? (.5)
2
 - How many years from 1945 – 1999 had flows over 2000 m³/s? (.5) **11**
 - Predict what a graph showing the next 50 years might show, explaining your prediction. (1)

Extreme Weather:

- What are the specific extreme weather events that cause death and destruction on the prairies? (1)
Thunderstorms, tornadoes, hailstorms, heat waves.
- Rank your list in question 1 above in order of the risks to the citizens of Winnipeg. (1) **Open.... Depending on criteria chosen - economic risk might put hailstorms first, while heat waves might cause more risk to lives.**
- Examine the graph showing costs of weather-related disasters. How do the last 20 years appear different out of the last 70 depicted? (1)
Much higher costs, and more frequent large costs.
- What do you think the effect of this trend will be on insurance rates/premiums? (.5)
Up!
- Have you personally been affected by extreme weather? If so, how? (.5)

How Do We Measure Up?

- From the graph, rank the following nations (1 – 9) according to their CO₂ emissions: (2)

Canada	2	U.K.	5	India	9
Russia	3	China	8	Italy	7
Japan	6	Germany	4	U.S.	1

- How many citizens of India output CO₂ equivalent to a single Canadian? (1)

3. What activity is responsible for the greatest output from individual residences? (.5)
Transportation - 53%
4. What activities produce the 75% of GHGs not produced by residences? (1)
Industry, agriculture, transportation, electricity generation, fossil fuel production, waste.

Life in the North:

1. What animals are vulnerable to changes in sea ice, and why are the females particularly vulnerable? (1)
Polar bears. Females will have less time on the ice in spring to feed on seals.
2. What is permafrost? (1)
Frozen ground that remains below 0°C all year.
3. What will be affected if the permafrost melts with a warming climate? (1)
Infrastructure – buildings, railways, roadways, pipelines, etc.
4. Examine the 2 prairie maps.
 - a) Currently, approximately what percentage of the prairies has some permafrost? (.5) ~**50%**
 - b) Approximately what percentage does the future map depict? (.5) ~ **5 – 10%**

Life in the Prairies:

1. How might a person living in a prairie city be affected as climate warms? (1)
More enjoyable temperatures, more severe weather events, decreased air quality, higher air-conditioning costs, lower heating costs, new insects/diseases, increased grocery prices...
2. How might a person living in a farming community be affected as climate warms? (1)
Higher / lower yields, irrigation demands, crop type change, increased losses from severe weather...

Let's Meet the Challenge:

1. Pretend your group is the Federal department responsible for deciding what will be done on the prairies to address climate change issues. Make a list, from higher to lower priority, of what you will do to initiate changes (i.e. YOU decide the future). (1)