

Unit 3 Summary

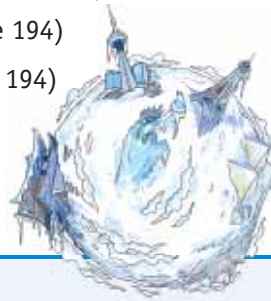
Topic 3.1: What is climate, and how has it changed during Earth's history?

Key Concepts

- Climate is different from weather, but they are also linked.
- Climate has changed frequently throughout Earth's past.
- Climate is currently changing around the world.

Key Terms

- atmosphere (page 194)
- weather (page 194)
- climate (page 194)



Big Ideas

- Global climate change is affected by both natural and human factors.
- Climate change affects living things and natural systems in a variety of ways.

Topic 3.2: Where are the effects of climate change felt, and what is their impact?

Key Concepts

- Climate change affects aquatic ecosystems.
- Climate change affects terrestrial ecosystems.
- Both positive and negative impacts of climate change are occurring worldwide.

Big Ideas

- Climate change affects living things and natural systems in a variety of ways.



Topic 3.3: What natural factors affect climate, and how do they affect it?

Key Concepts

- Interactions of the Sun and Earth affect climate.
- The atmosphere affects climate around the world.
- The natural greenhouse effect moderates Earth's temperature, indirectly affecting climate.
- The hydrosphere affects global climate.
- Moving continents have a variety of effects on climate.
- The interaction of all natural factors affects climate in ways that are hard to predict.

Key Terms

- heat sink (page 216)
- greenhouse effect (page 218)
- hydrosphere (page 220)
- carbon sink (page 220)



Big Ideas

- Global climate change is affected by both natural and human factors.
- Climate change affects living things and natural systems in a variety of ways.

Topic 3.4: How do human activities affect the natural greenhouse effect?

Key Concepts

- Human activities produce more greenhouse gases, which enhance the natural greenhouse effect.
- Canadians add to the increase of greenhouse gases in the atmosphere.

Key Terms

anthropogenic greenhouse effect
(page 232)



Big Ideas

- Global climate change is affected by both natural and human factors.

Topic 3.5: How can we assess present climate change and reduce our impact?

Key Concepts

- Studying past climates helps us understand how climate changes over time.
- We use various instruments to collect data to help us assess present climate change.
- We use computer models and projections to estimate future climate change.
- We can use our ingenuity to reduce our impact on climate change.
- We can make personal choices that reduce our impact on climate change.

Key Terms

global climate model (page 248)
carbon footprint (page 252)



Big Ideas

- Global climate change is affected by both natural and human factors.
- Climate change affects living things and natural systems in a variety of ways.

Unit 3 Projects

Inquiry Project: Reflecting on White Roofs

One way to keep Earth cooler is to reduce the amount of heat absorbed by land and buildings. Another way is to reflect more incoming sunlight. Clouds reflect a lot of sunlight. So do certain surfaces on Earth. In this project, you will investigate how painting roofs white can affect reflectivity and absorption of heat.

Inquiry Question

Do white roofs absorb less heat than black roofs?

Initiate and Plan

1. Design an investigation to answer the Inquiry Question above. Include:
 - a hypothesis predicting the results
 - a materials and equipment list
 - a step-by-step procedure
 - a list of dependent, independent, and controlled variables
 - any relevant safety precautions
 - a method to measure and record your results, such as a table
2. Get your teacher's approval before you start.

Perform and Record

3. Complete your investigation.
4. Create a graph to summarize your results.

Analyze and Interpret

1. a) Based on your results, will a white or black roof absorb more heat?
b) Did your results match your hypothesis?
2. Explain any sources of error and changes you would make if you repeated your investigation.

Communicate Your Findings

3. In your opinion, should the Canadian government give grants to people who paint their roofs white to reduce their carbon footprint? Justify your opinion.

Assessment Checklist

Review your project when you complete it. Did you...

- generate a hypothesis? **T/I**
- make a list of equipment and materials? **T/I**
- include a step-by-step procedure that controls as many variables as possible? **T/I**
- list the dependent, independent, and controlled variables? **K/U**
- record your results in an appropriate table and summarize them using a graph? **C**
- write a supported-opinion piece to explain whether the Canadian government should offer grants to people who paint their roofs white? **C**

An Issue to Analyze: Dealing with Climate Change

A cost-benefit analysis can help you decide what should be done about climate change.

Issue

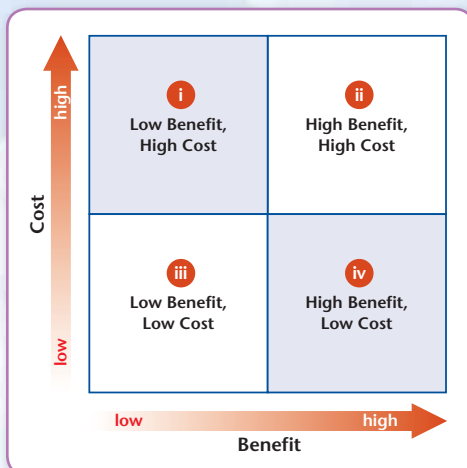
What actions could be taken to deal with the possible effects of climate change?

Initiate and Plan

1. Make a list of actions and initiatives related to climate change. You can find some in this unit and must research more.
2. Research the projected costs and benefits of these actions and initiatives.

Perform and Record

3. Draw a cost-benefit matrix like the one shown below.
4. Choose one action or initiative that would help to reduce future climate change. Place the name of the action or initiative in one of the cells of the matrix, based on its cost and its perceived benefit. For example, an initiative that would cost a lot but would yield greatly beneficial results would be placed in the “High Benefit, High Cost” cell.
5. Repeat step 4 for each of the other actions and initiatives.



Analyze and Interpret

1. Which actions or initiatives would you recommend, based on their costs and benefits? Explain your reasoning.
2. For each action or initiative you recommend, identify two ways that you could contribute.
3. Collaborate with your classmates to reach a consensus on the most highly recommended action or initiative.
4. For your choice, identify the costs and strategies for implementing and enforcing it. Prepare a brief summary that describes the recommendations of your class.

Communicate your Findings

5. Use what you have learned and decided to write a persuasive letter to your MP or MPP to express your opinion about Ontario's course of action regarding climate change.

Assessment Criteria

Once you complete your project, ask yourself these questions. Did you...

- make a list of actions and initiatives related to climate change? **K/U**
- consider the evidence from your cost-benefit analysis when recommending actions or initiatives? **A**
- identify two personal contributions you could make to help your recommended actions or initiatives? **A**
- survey the personal opinions of your classmates before choosing one action or initiative? **A**
- reach a consensus with your classmates? **A**
- collect information from a variety of sources? **C**
- communicate the information accurately for its audience and purpose? **C**

Unit 3 Review

Connect to the Big Ideas

1. Global climate change is affected by both natural and human factors. Draw two charts in your notebook similar to the one shown below. In the first chart identify five natural factors that affect global climate change and summarize the impact of each factor. In the second chart, identify five human activities that are thought to affect global climate change and summarize the impact of each activity on Earth's climate.

Factors or Activities	Impact on Global Climate Change

2. "Climate change affects living things and natural systems in a variety of ways." Use words, pictures, or a graphic organizer to explain this statement.

Knowledge and Understanding K/U

3. Describe how the following terms are related:

- heat sink and carbon sink
- weather and climate
- natural green house effect and anthropogenic greenhouse effect

4. Summarize how the hydrosphere and atmosphere moderate temperature and transfer heat.

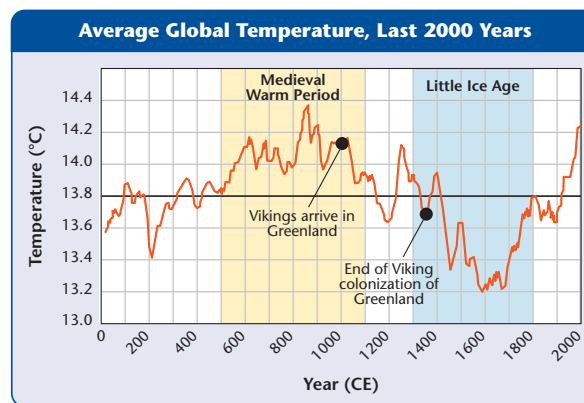
5. Discuss why some scientists are concerned about the current warming trend on Earth.

6. Use a spider map or other graphic organizer to record six or more impacts of climate change that are occurring in aquatic and terrestrial ecosystems.

7. Define the phrase "global climate model" and briefly explain the importance of these tools to scientists.

8. Examine the change in global average temperature shown in the graph.

- Write a sentence to describe what this graph is showing.
- Write a hypothesis to explain why this temperature change might be occurring.



9. Use a diagram to summarize one way that the Sun affects Earth's climate.

10. Describe how ocean currents affect climates around the world.

11. Efforts to reduce the amount of carbon dioxide released into the atmosphere require lifestyle changes and place heavy demands on the global economy. List five technologies that have been developed to reduce carbon dioxide emissions and/or to slow down global warming.

12. Use a double-bubble organizer or a graphic organizer of your choice to compare the following:

- four naturally occurring greenhouse gases and their sources
- four anthropogenic greenhouse gases and the human activities that produce them

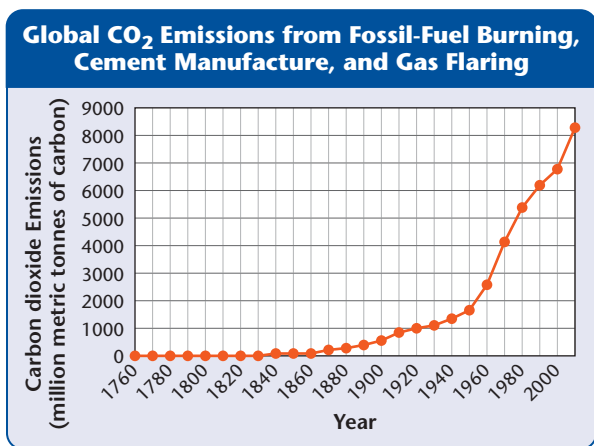
13. As oceans become warmer as a result of climate change, storms such as hurricanes are becoming more violent and they are happening more frequently. Explain why this might be the case.

14. Describe one way that humans are affecting Earth's climate and one way that we are trying to reduce our impact.

Thinking and Investigation **T/I**

- 15.** In 2009, some regions of Ontario experienced record-breaking summer temperatures. Explain whether this is evidence that the climate is changing, the weather is changing, or both.
- 16.** After the last ice age, many plants and animals were able to adapt to global warming. Predict why some scientists believe such adaptation may be more difficult now that humans are altering the climate.

Use the following graph to answer the next question



- 17.** Interpret the data provided in this graph and explain possible reasons for this trend.
- 18.** Compare the graph from question 17 to the graph from question 8. Formulate a possible hypothesis about the link between carbon dioxide levels and average global temperatures.
- 19.** Scientists believe that if average global temperature continues to rise at its current rate, up to one-quarter of the world's glaciers may have melted by 2050. The east coast of Canada is currently affected by a cold ocean current. Explain how eastern coastal waters might warm up as glaciers continue to melt. Hint: Greenland, located north of the Maritime Provinces, is home to a large number of glaciers.

Communication **C**

- 20.** Imagine that an environmental communications officer made the following statement during a speech on global warming. This statement was later printed in a newspaper: "Many species have gone extinct over the past million years from natural causes such as global warming. Extinction is natural. So why are people concerned about endangered species?" Write a letter to the editor responding to this speaker.
- 21.** Use your understanding of climate and climate change to write a letter to your local member of parliament to express your feelings and ideas about the following statement: "In the twentieth century wars were fought over oil. In the twenty-first century, they will be fought over fresh water."
- 22.** An exchange student visiting your school from Zambia explains how climate change affects her country. She asks how climate change affects Canada. How do you respond?
- 23.** Many people wonder what they can do to help reduce the emission of anthropogenic greenhouse gases. Use words, drawings, or a graphic organizer to identify five ways individuals can reduce their carbon footprint.
- 24.** Imagine you were in the Philippines when Mount Pinatubo erupted. Send a postcard home describing the changes you observed in the atmosphere due to the eruption and how you believe global climate will react to these changes.
- 25.** You've been visited by aliens! It turns out that they have visited Earth before—2000 years ago. They notice that the atmospheric composition is quite different now. Describe to these intergalactic visitors how specific human activities have been adding carbon dioxide, nitrous oxide, methane, and halocarbons into the atmosphere.

Unit 3 Review

- 26.** Your blog, “Green Machine,” is about technology that helps reduce global greenhouse gas emissions. Write a new blog post describing two Canadian technologies that are helping to lower Canada’s greenhouse gas emissions.
- 27.** You are a youth representative at a global climate change conference. A scientist has just explained that by adding large numbers of reflective particles into the atmosphere with rockets, the atmosphere would reflect more sunlight. This would reduce global temperature. The conference moderator asks for your opinion. Explain to the other representatives why this might not be such a good idea.

Application **A**

- 28.** Use examples to interpret this statement. “To understand the Earth’s climate history, scientists must bring together scattered threads of information into a single, seamless story.”
- 29.** Cattle and sheep ranching contribute to global warming. These animals produce and release large amounts of methane as they digest their food. Overgrazing of pasture lands can deplete the ground cover over large areas, which reduces the amount of vegetation that would take in carbon dioxide. Propose a way to reduce anthropogenic greenhouse gas emissions from cattle and sheep ranching. Keep in mind the importance of cattle and sheep ranching in providing jobs, food, and clothing.
- 30.** In human terms, adapting to climate change means adjusting to negative impacts, while also taking advantage of positive ones.
- Identify six positive and negative impacts of climate change.
 - Write a story, draw a graphic novel, or record a podcast about people adapting to climate change impacts today or in the near future.

- 31.** In 2005, several hundred people gathered in the Arctic to send a message in the form of an Inuit drum dancer about the dangers that climate change poses to the people of the Arctic.
- How would you feel if you were seeing your way of life disappear before your eyes?
 - What kinds of changes will the Arctic experience if global warming continues?
- 32.** In 2005, the Chair of the Inuit Circumpolar Conference, Sheila Watt-Cloutier, delivered the following message to the United States Senate: “Use what is happening in the Arctic—the Inuit Story—as a vehicle to reconnect us all, so that we may understand that the planet and its people are one.”

Explain how the impacts of global warming being felt in the Arctic can affect you and your way of life in Ontario or anywhere else in North America.

- 33.** Metro Hall, a 27 storey office building in Toronto, went online with the Lake Ontario *Deep Lake Water Cooling* system in June 2006. Metro Hall’s energy savings are shown in the table below:

Item	Value
Reduction in power consumption	3 000 000 kilowatt-hours per year
Power saved is sufficient to supply	300 homes
Reduction in water consumption from cooling towers	4 400 cubic metres per year
Greenhouse gas reduction: carbon dioxide	732 tonnes per year
Number of cars with equivalent emissions	160

- Evaluate the positive environmental impacts this type of technology has with respect to global warming.
- Predict possible negative aspects of installing this technology on a large scale.

Literacy Test Prep

Read the selection below, and answer the questions that follow it.

Governments must find ways to support both economic growth and climate change initiatives. How do politicians encourage individuals and corporations to reduce greenhouse gas emissions and encourage the growth of new “eco-friendly” industries? Two responses, cap-and-trade systems and carbon-tax systems have been developed.

In a cap-and-trade system, an authoritative body, most commonly a government, establishes a ceiling (or cap) on how much carbon may be produced. Corporations that produce *less* carbon than their limit may sell or trade their credits to corporations that produce *more* carbon than their limit. Over time, the caps are gradually lowered.

In a carbon-tax system, the government levies a tax on either the source of carbon compounds or the emission of greenhouse gases. Under this policy, the price of anything that depends on carbon fuels goes up. As a result, consumers have an incentive to spend their money on alternatives that do not produce carbon emissions. Without the carbon tax, these alternatives are usually more expensive than their carbon-producing counterparts.

Multiple Choice

- 29.** Which word is closest in meaning to “incentive” as used in paragraph 3 of this selection?
- a) gift
 - b) motivation
 - c) money
 - d) deterrent
- 30.** What is the main purpose of this passage?
- a) to promote economic growth
 - b) to reduce climate change
 - c) to provide information about government climate change initiatives
 - d) to promote consumer spending
- 31.** In this selection, quotation marks around the word “eco-friendly” are used to
- a) emphasize an unfamiliar word
 - b) indicate someone is speaking
 - c) show the word has more than one meaning
 - d) emphasize the environment
- 32.** In a carbon-tax system, the government
- a) allows trading of carbon credits
 - b) limits the amount of carbon that can be produced
 - c) raises the price of fuels
 - d) taxes the source of carbon compounds or greenhouse gas emissions

Written Answer

- 33.** If you had to vote on one of these systems to be implemented in Canada, which one would you choose? Use specific details from the selection and your own ideas to support your answer.