

# Human Activity and Climate Change

Textbook pages 482–501

## Before You Read

How might climate change affect the region where you live? Record your thoughts in the lines below.

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## What are climate change and global warming?

**Climate change** refers to changes in long-term weather patterns in certain regions. These changes affect the redistribution of thermal energy around Earth. **Global warming** describes an increase in Earth's average global temperature. It is one aspect of climate change. As greenhouse gases increase, the atmosphere is able to absorb and emit more thermal energy. This is known as the **enhanced greenhouse effect**. **Global warming potential (GWP)** describes the ability of a substance to warm the atmosphere by absorbing and emitting thermal energy. The table below shows the GWP of various greenhouse gases. The greatest carbon source resulting from human activity is fossil fuel combustion. Water vapour accounts for approximately 65% of greenhouse gases, carbon dioxide 25%, and other gases 10%. Chlorofluorocarbons are thought to be the main cause of the depletion of Earth's protective ozone layer. Humans have very little effect on the amount of water vapour in the atmosphere. Ozone, while an important greenhouse gas, is continually forming and breaking down, so it is difficult to determine its global warming potential.

**Table 11.1** Green House Gases and Global Warming Potential

Greenhouse Gas	Chemical Formula	Atmospheric Lifetime (years)	Source from Human Activity	Global Warming Potential (GWP)
carbon dioxide	CO <sub>2</sub>	variable	<ul style="list-style-type: none"> <li>• combustion of fossil fuels</li> <li>• deforestation</li> </ul>	1
methane	CH <sub>4</sub>	about 12	<ul style="list-style-type: none"> <li>• combustion of fossil fuels</li> <li>• livestock agriculture</li> <li>• waste dumps</li> <li>• rice paddies</li> </ul>	25
nitrous oxide	N <sub>2</sub> O	114	<ul style="list-style-type: none"> <li>• production of chemical fertilizers</li> <li>• burning waste</li> <li>• industrial processes</li> </ul>	298
chlorofluorocarbons (CFCs)	various	45	<ul style="list-style-type: none"> <li>• liquid coolants</li> <li>• refrigeration</li> <li>• air conditioning</li> </ul>	4750–5310

Source: Intergovernmental Panel on Climate Change 2007



**Mark the Text**

### Check for Understanding

As you read this section, stop and reread any parts that you do not understand. Highlight any sentences that help you understand the concepts better.

 **Reading Check**

What is the global warming potential (GWP) of methane?

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• **How do GCMs model climate?**

• **General circulation models (GCMs)** are computer models designed to study climate. They take into account multiple factors, such as changes in greenhouse gas concentrations, ocean currents, winds, surface temperatures, and albedo. The **albedo** at Earth’s surface affects the amount of solar radiation that a region receives. GCMs are able to determine both past and present climate. Some models predict a temperature rise of 6°C in northern regions and a sea level rise of almost 88 cm within the next 100 years.

• The effects of global warming may be most severe in northern countries, such as Canada. GCMs predict heavier spring rains and longer heat waves in some parts of the country. These changes will affect biomes across Canada as well as important industries, such as fisheries and forestry. Water resources and the health of Canadians may also be affected. Most regions of British Columbia will also become warmer. Some GCMs predict a 30 cm rise in the sea level along the northern coast of British Columbia over the next century. This could result in serious flooding in coastal communities. Areas of **permafrost**, ground that usually remains frozen year-round, are melting. The ice cover in the Arctic Ocean is rapidly shrinking.

continued

• **How are governments addressing climate change?**

• The Intergovernmental Panel on Climate Change (IPCC)  
• was established to address global concern about climate  
• change and global warming. Its goal is to assess evidence  
• of the human influence on climate change and suggest  
• possible ways to respond. To encourage countries to reduce  
• greenhouse gas emissions, the United Nations has set up an  
• international environmental treaty called the United Nations  
• Framework Convention on Climate Change (UNFCCC). As  
• part of the treaty, countries determine what greenhouse gas  
• emission limits should be. Because predictions about climate  
• change cannot be certain, the United Nations suggests that  
• governments use the **precautionary principle** to guide their  
• responses to climate change. This principle states that a lack  
• of complete scientific certainty should not postpone cost-  
• effective measures to prevent serious environmental  
• damage. ✓

• To reduce the amount of greenhouse gases that Canada  
• produces, the Canadian government has reduced allowable  
• emissions from cars and trucks, required some industries  
• to reduce emissions, increased the types of energy-efficient  
• products available, and set guidelines for improving indoor  
• air quality.



**Reading Check**

What is the role of the Intergovernmental Panel on Climate Change (IPCC)?

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Use with textbook pages 482–496.

# Climate Change

1. Give three examples that illustrate that the Earth is undergoing a change in climate.

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2. List the greenhouse gases that are produced by human activity.

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3. How is nitrous oxide formed?

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4. What is the main cause of the depletion of Earth’s protective ozone layer?

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5. What does the term albedo mean?

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6. When computer general circulation models (GMCs) are designed to study climate, what factors are taken into account?

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7. What evidence illustrates that northern Canada is being affected by global warming?

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8. What plans have been implemented by the Canadian government to reduce our greenhouse gases?

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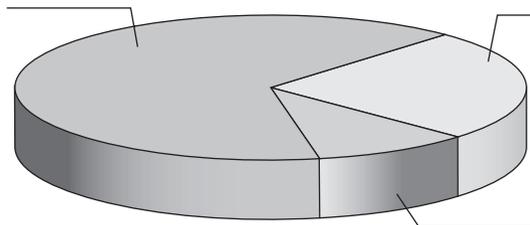
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Use with textbook pages 484–486.

## Greenhouse gases

The current increase in global temperature is caused by an increase in greenhouse gas emissions. Scientists have identified several produced by human activities.

1. Fill in the diagram below. Label the greenhouse gases and their approximate percent contributions to the greenhouse effect.



2. Complete the following table comparing greenhouse gases, their formulas, sources from human activity, and global warming potential (GWP).

Greenhouse gas	Chemical formula	Source from human activity	Global Warming Potential (GWP)
carbon dioxide			
methane			
nitrous oxide			
chlorofluorocarbons (CFCs)			

3. Explain why water vapour and ozone are not included on this table.

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*Use with textbook pages 494–499.*

## **Strategies for addressing climate change**

Greenhouse gas concentrations in the atmosphere will increase during the next century unless greenhouse gas emissions decrease substantially from present levels.

What can you do to reduce greenhouse gas emissions?

1. With a partner or small group, brainstorm ideas on how to reduce greenhouse gas emissions in your local community.

Brainstorm ideas:

2. What can you do personally to reduce your carbon footprint?

Use with textbook pages 482–496.

## Human activity and climate change

Match each Term on the left with the best Descriptor on the right. Each Descriptor may be used only once.

Term	Descriptor
1. _____ climate change	<b>A.</b> ground that remains frozen year-round
2. _____ enhanced greenhouse effect	<b>B.</b> the increase in global average temperature
3. _____ general circulation models	<b>C.</b> changes in long-term weather patterns in certain regions
4. _____ global warming	<b>D.</b> computer models designed to study the complex nature of climate
5. _____ global warming potential	<b>E.</b> the increased capacity of the atmosphere to trap thermal energy because of an increase in greenhouse gases
6. _____ permafrost	<b>F.</b> the principle that a lack of complete scientific certainty should not be used as a reason to postpone cost-effective measures to prevent serious environmental damage
7. _____ precautionary principle	<b>G.</b> the ability of a substance to warm the atmosphere by trapping thermal energy

### Multiple Choice

Circle the letter of the best answer.

8. Computer models investigating global temperatures estimate that in one hundred 100 years temperatures will increase by
  - A. 1 °C
  - B. 2.5 °C
  - C. 6.0 °C
  - D. 10.0 °C
9. Which gas contributes the most to the greenhouse effect?
  - A. carbon dioxide
  - B. chlorofluorocarbons
  - C. methane
  - D. water vapour
10. Which greenhouse gas is thought to be the main cause for the depletion of Earth's protective ozone layer?
  - A. carbon dioxide
  - B. chlorofluorocarbons
  - C. methane
  - D. nitrous oxide
11. Which of the following materials has the highest albedo?
  - A. forests
  - B. snow
  - C. soil
  - D. water
12. In Canada, greenhouse gas emissions come mostly from
  - A. agriculture
  - B. industry
  - C. commercial heating
  - D. transportation