Chapter 8 Summary

8.1 Energy Transfer in the Climate System

Key Concepts

- Earth is a system of interrelated parts, including the atmosphere, hydrosphere, rocks, and living things.
- The interrelated processes in the Earth system form a variety of both positive and negative feedback loops, which affect the global climate system by increasing or decreasing the effects of climate change.
- The atmosphere redistributes heat, energy, and moisture around Earth's surface.
- Heat can be transferred by radiation, conduction, and convection.
- Earth's oceans transfer energy as water moves as a result of density differences that are caused by differences in the temperature and salinity of ocean water.
- El Niño and La Niña events are examples of the effects of heat transfer through the atmosphere and oceans.
- To maintain a stable average global temperature, incoming energy and outgoing energy must balance each other exactly. This balance is part of Earth's energy budget.

8.2 Greenhouse Gases and Human Activities

Key Concepts

- Earth emits thermal energy. Greenhouse gases in the atmosphere absorb this energy and radiate it in all directions. The thermal energy that returns to Earth gives rise to the greenhouse effect.
- Less than one gas molecule in a hundred is a greenhouse gas.
- The most common greenhouse gas is water vapour. Other major greenhouse gases include carbon dioxide, methane, ozone, nitrous oxides, and halocarbons.
- Human activities, such as agriculture and the burning of fossil fuels, are increasing the amounts of some of the greenhouse gases in the atmosphere.
- An increase in greenhouse gases has resulted in the anthropogenic greenhouse effect, which may be responsible for recent climate change.
- You can reduce your contribution of greenhouse gases by conserving electricity, improving home-heating efficiency, and minimizing waste as much as possible.

8.3 Cycling of Matter and the Climate System

Key Concepts

- Carbon and nitrogen cycle through living organisms quickly, but also have cycles that can store them in rocks for millions or billions of years.
- Carbon has five main stores: living things, oceans, rocks, fossil fuels, and the atmosphere.
- Human activities, such as the burning of fossil fuels, releases carbon dioxide into the atmosphere, which may result in climate change.
- Nitrogen fixation is the process by which atmospheric nitrogen is changed into forms that can be used by plants and other organisms. It can be done by lightning, by bacteria, or by industry.
- Human activities, especially the use of fertilizers for agriculture, have increased the amount of nitrogen in rivers, lakes, and oceans. This nitrogen causes algal blooms that result in dead zones in lakes and oceans.

Chapter 8 Review

Make Your Own Summary

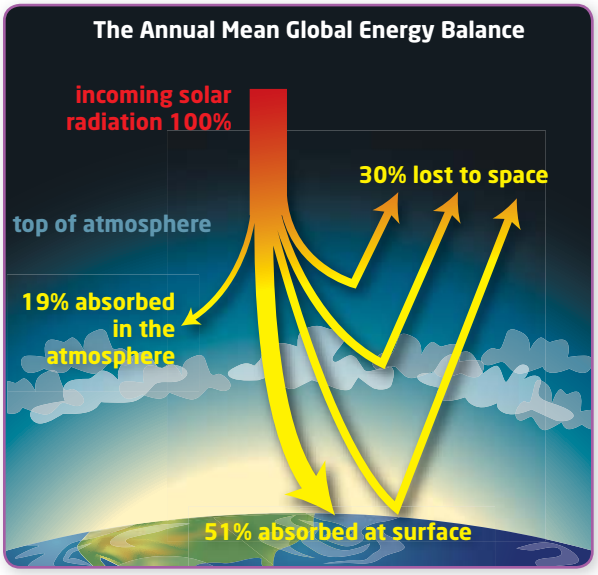
Summarize the key concepts of this chapter using a graphic organizer. The Chapter Summary on the previous page will help you identify the key concepts. Refer to Study Toolkit 4 on pages 565–566 to help you decide which graphic organizer to use.

Reviewing Key Terms

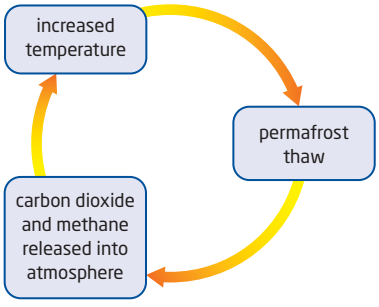
1. _____ can be measured in parts per million. (8.2)
2. Earth is an example of a closed _____. (8.1)
3. A(n) _____ describes the total energy exchange within a system. (8.1)
4. Because methane has a higher _____ than carbon dioxide, scientists are concerned about the increase in methane due to cattle. (8.2)
5. Through the process of _____, nitrogen is changed into forms that living things can use. (8.3)
6. Carbon dioxide, water vapour, and methane are all examples of _____. (8.2)
7. Energy and matter move through reservoirs in the Earth system as part of several _____. (8.3)
8. Matter can be stored in reservoirs, also called _____, for a few minutes to many million years. (8.2)
9. _____ may increase or decrease the effect of one small change on a biogeochemical cycle. (8.1)

Knowledge and Understanding K/U

10. What type of radiation do greenhouse gases allow to pass through the atmosphere? What type of radiation do greenhouse gases absorb?
11. How is an open system different from a closed system?
12. Why must scientists consider the global warming potential of different gases when recommending action to slow global warming?
13. Use the diagram below to explain what happens to most of the solar energy that enters the Earth system.



14. Give an example of how energy is transferred by convection in the Earth system.
15. How does a decrease in albedo affect a positive feedback loop that begins with a rise in the global average temperature?
16. Is the feedback loop shown below a positive or negative feedback loop? Explain your answer.



17. How have humans caused imbalances in the nitrogen cycle?
18. What is the relationship between halocarbons and climate change?
19. How is Earth's natural greenhouse effect different from the anthropogenic greenhouse effect?

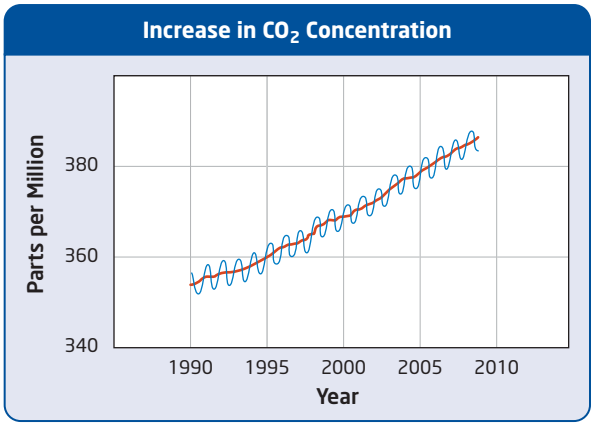
Thinking and Investigation T/I

20. Which would be more effective in reducing global warming: reducing methane levels to those of pre-industrial levels or reducing carbon dioxide levels to pre-industrial levels? Explain your choice.

21. How can El Niño, which occurs in the southern Pacific Ocean, affect weather in Canada?

22. Five hundred million years ago, carbon dioxide levels in the atmosphere were about 8000 ppm by volume. The current level is about 385 ppm by volume. Because Earth is a closed system and matter cannot be created or destroyed, what happened to the carbon?

23. The graph below shows carbon dioxide concentrations in Earth's atmosphere as measured at Mauna Loa, in Hawaii. Why do you think the concentration of carbon dioxide has a peak and a low point each year?



Communication C

24. BIG IDEAS Earth's climate is dynamic and is the result of interacting systems and processes. Create a model of an open system and a model of a closed system. Use your models to explain why Earth is a closed system.

25. BIG IDEAS Global climate change is influenced by both natural and human factors. Imagine that you have been asked to summarize the greenhouse effect for students in an elementary class. Write a paragraph that describes how the greenhouse effect regulates Earth's global temperature.

26. BIG IDEAS Climate change affects living things and natural systems in a variety of ways. Draw an example of a positive feedback loop for the melting of the Arctic icecap.

27. BIG IDEAS People have the responsibility to assess their impact on climate change and to identify effective courses of action to reduce this impact. Create a cartoon that illustrates one way in which people affect climate change. The cartoon should indicate how human activities affect climate change and how humans can adapt their lifestyles to reduce this impact.

Application A

28. Create a list of actions that you could take to limit greenhouse gas production.

29. One plan that has been suggested to counteract the greenhouse effect is to sprinkle iron dust over large patches of ocean, allowing algae to grow, die, and fall to the sea floor. Assess the benefits and drawbacks of this plan.

30. Why might a climate scientist be more concerned about an increase of 20 parts per billion of nitrous oxide in the atmosphere than an increase of 5000 parts per billion of carbon dioxide in the atmosphere?

31. A puddle of water lying in the sun on a black, paved road evaporates. Explain how convection, conduction, and radiation are involved in this process. Then explain how this process affects climate change.

32. Think about your everyday activities. Identify three of your activities that affect the nitrogen cycle and three of your activities that affect the carbon cycle. Then identify ways that you can reduce your personal impact on the nitrogen cycle and the carbon cycle.