Chapter 9 Summary

## 9.1 Discovering Past Climates
Key Concepts

- Paleoclimatologists reconstruct past climates by using the evidence that climate leaves behind in tree rings, ice, sedimentary rock, and fossils.

- Tree rings can provide evidence about growing conditions, such as temperature and precipitation, during the lifetime of the tree.

- Ice cores can provide information about global temperature and the composition of the atmosphere thousands of years in the past.

- Scientists use chemical analyses of sediment cores from lakes and oceans to reconstruct past conditions of the atmosphere and the hydrosphere.

- Rocks can provide information about the conditions that existed when they formed.

- Fossils are remains of living things. Their distribution and characteristics provide clues about the climate at the time the organisms lived.

9.2 Monitoring and Modelling Climate Change
Key Concepts

- Dozens of satellites monitor Earth's climate to provide scientists with data to analyze changes in the Earth system and to project changes in climate. Each satellite focuses on a different aspect of climate and weather.

- Scientists predict future climates by using computer simulations of Earth.

- General circulation models (GCMs) are three-dimensional models that represent how currents of water and air interact and move around the planet over specified periods of time.

- The predictions of climate models are not 100 percent accurate because of imprecision in the data and difficulties in the calculations.

- The major climate models agree on approximately how much some factors such as greenhouse gases contribute to climate change. However, the effects of other factors, such as clouds, are not as well understood.
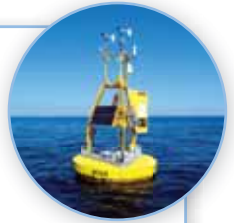
9.3 Taking Action to Slow Climate Change
Key Concepts

- Educating yourself about the facts related to the issue of climate change is important in making informed decisions about how your actions affect climate change.

- Everybody has a carbon footprint, which means that everyone's actions influence the amount of greenhouse gases emitted into the atmosphere. As a result, everybody is responsible for reducing greenhouse gas emissions.

- You can reduce your carbon footprint by performing actions that lower your dependence on burning fossil fuels and by purchasing carbon offsets.

- Governments and international panels are trying to reduce greenhouse gas emissions by passing laws, by educating consumers, and by using economic means to combat climate change.

Chapter 9 Review

Reviewing Key Terms

Match each key term listed below to its definition.

a. paleoclimatologist (9.1)

b. isotope (9.1)

c. ice core (9.1)

d. geostationary (9.2)

e. monitor (9.2)

f. general circulation model (9.2)

g. carbon offset (9.3)

h. carbon footprint (9.3)

i. bias (9.3)

1. refers to a satellite that remains in the same position above Earth

2. a computer model that simulates the global climate system

3. a tendency toward a particular point of view that prevents objective assessment of a topic

4. a long cylinder of ice obtained by drilling into a glacier

5. a way to measure the amount of carbon produced by a person's activities

6. a form of an element that has a different number of neutrons than other atoms of that element

7. to measure something systematically and repeatedly

8. actions or purchased credits that reduce the amount of carbon that individuals emit

9. a scientist who studies the history of Earth's climate system

Knowledge and Understanding K/U

10. Identify four types of evidence that help scientists construct a history of climate change.

11. The diagram below shows two satellites. Which satellite is a polar orbiting satellite and which is a geostationary satellite? Explain your answer.
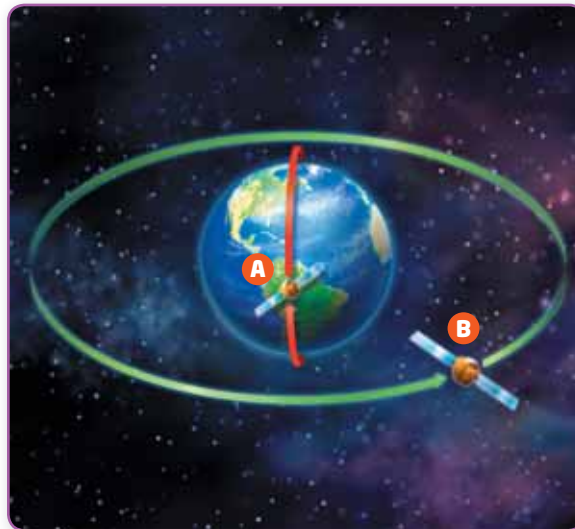
12. How have satellites changed the ability of scientists to monitor global climate?

13. What is a general circulation model (GCM), and how is it useful to climate scientists?

14. How do scientists refine their climate models?

15. How does the ENERGY STAR® program affect climate change?

16. Identify two laws that international governing bodies have enacted to address the causes or effects of climate change.

17. Compare how a cap-and-trade system works with how a carbon-tax system works.

18. What factors are slowing down a global switch to alternative energy sources? How are governments working to help overcome those factors?

19. How does measuring the mass of water from long ago tell scientists about the temperatures in that era?

Thinking and Investigation T/I

20. Explain why the sources of weather and climate data are important in assessing whether the climate has changed.

21. Imagine that you are developing a computer model to simulate climate. Identify the natural and anthropogenic variables you would include in your model.

22. What energy source provides most of the electrical energy in Canada? Give this source of energy a grade (A, B, C, D, or F) relative to its effect on the concentration of greenhouse gases in Earth's atmosphere, and justify the grade you gave.

23. The table below describes the relative carbon footprints of ten nations. What ranking does Canada have? How does Canada's contribution to climate change compare to that of the United States? Why do you think Canada is ranked this way relative to the other nations on the list?

Top Ten Carbon-Emitting Nations on Earth 2008

Country	Ranking	CO_2 emissions (millions of tonnes)
United States	1	5957.00
China	2	5323.00
Russia	3	1696.00
Japan	4	1230.00
India	5	1166.00
Germany	6	844.17
Canada	7	631.26
United Kingdom	8	577.17
South Korea	9	499.63
Italy	10	466.64

24. Many factors are known to affect the climate. Why do scientists think that human contribution to greenhouse gases is so significant?

Communication C

25. **BIG IDEAS** Global climate change is influenced by both natural and human factors. Create a short multimedia presentation that illustrates how general circulation models (GCMs) incorporate both natural and anthropogenic factors when predicting future climate changes.

26. **BIG IDEAS** Climate change affects living things and natural systems in a variety of ways. Draw a negative feedback loop that demonstrates how reducing your carbon footprint may have an effect on global warming.

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. Write a brief paragraph that explains the importance of Canada's participation in the Kyoto Protocol.

28. **BIG IDEAS** Earth's climate is dynamic and is the result of interacting systems and processes. Create a poster presentation that explains how a person's carbon footprint can be minimized by using carbon offsets.

Application A

29. What source of evidence would be most useful for determining the climate of Ontario over the past 4000 years?

30. In Japan, the blossoming of the cherry trees is a special day, and records showing the dates on which this event happened go back for centuries. Because the blossoms open after a certain number of days when the temperature is over 5°C, some people have proposed that this record might be one way of tracking temperature changes for Japan over recent centuries. Assess how valuable and reliable these records might be.

31. Why do solar energy and geothermal energy provide so little of Canada's electrical energy?

32. A tree experienced a dry year in which only a little rain fell in the spring, followed by a wet, cool year. Sketch the resulting tree rings.

33. The map in **Figure 9.21** shows only the amount of greenhouse gases actively emitted by various countries. How do you think the map would change if the impact of cutting down forests were calculated into the total?