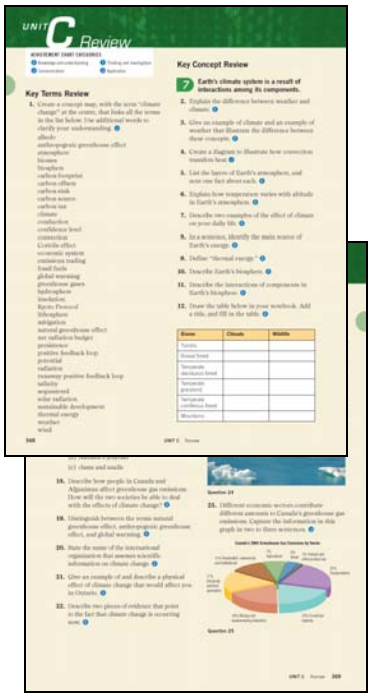
Pages 368–369



C Unit Review ANSWERS TO QUESTIONS

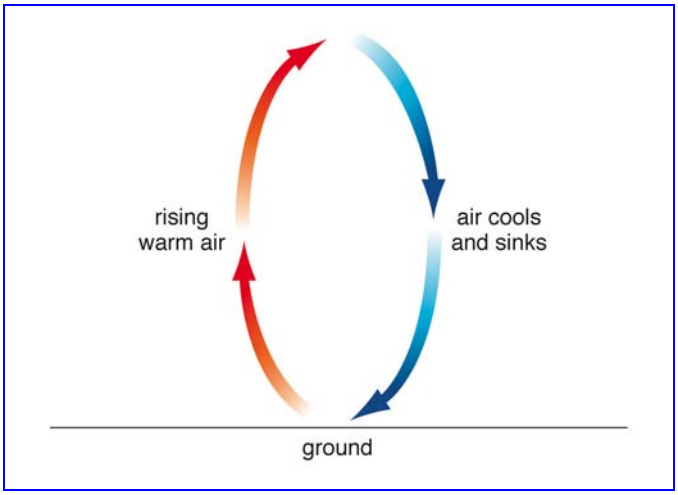
Key Terms Review

1. Answers will vary. Ensure that students understand the important concepts, such as the difference between weather and climate, how the natural and anthropogenic greenhouse effects are related, the fate of solar radiation, and the evidence for climate change.

Key Concept Review

7

2. Weather refers to the conditions that occur at a particular place at a particular time. Climate is the average weather conditions that occur in a region over a long time, usually a period of 30 years.
3. Weather: Today it is rainy and cold. Climate: June is usually warm and sunny, so it's nice to get out of school.
4.



5.

Layers of the Atmosphere from Top to Bottom	Characteristics
4. Thermosphere	very little gas, but upper zones can get very hot during the day
3. Mesosphere	air very thin and cold
2. Stratosphere	contains ozone, which protects life from UV rays
1. Troposphere	contains 80% of atmospheric gas and can support life
Earth's surface	lithosphere and liquid water; supports life

6. The temperature of the atmosphere generally decreases with altitude, except for the top of the thermosphere, where the temperature fluctuates daily.

7. Answers will vary. For example: Effects of climate on my daily life include putting winter clothing in storage in summer and vice versa in winter, and deciding the best time of the year to have a beach party.
8. The main source of the energy that warms the atmosphere, hydrosphere, and the surface of the lithosphere is solar radiation.
9. Thermal energy is the total kinetic energy of the molecules or atoms in a substance.
10. The biosphere is the relatively thin layer of Earth that has conditions suitable for supporting life. It is composed of all the living things on Earth and the physical environment that supports them. The biosphere includes the hydrosphere, the lower atmosphere, and the top of the lithosphere.
11. Organisms, and materials such as water, oxygen, and carbon dioxide, are constantly moving throughout the different parts of the biosphere.
12. See Table 7.4.
13. Solar energy is constantly received by the Earth and re-radiated back into space. If Earth's net radiation budget was not in balance and more energy was being received than was leaving, the temperature of the Earth's surface, atmosphere, and hydrosphere would constantly rise.
14. See Figures 7.22 and 7.24.
15. See Figure 7.26.
16. Effects of thermal energy transfer on Earth include warming of the atmosphere, warming of the hydrosphere, warming of the Earth's surface, winds, and ocean currents.

8

17. **(a)** Coral reefs are dying because the temperature of the ocean is rising.
    (b) Pacific salmon are adapted to cold temperatures, so their range may be moving northward as the ocean temperatures rise.
    (c) Frogs and toads are becoming extinct because their habitats are changing too quickly for them to adapt to the changes.
    (d) Naumra's jellyfish are increasing greatly in numbers.
    (e) The shells of clams and snails are weaker because the seawater is more acidic, as more carbon dioxide dissolves in it.
18. People in Canada have a much higher per capita greenhouse gas emissions rate than do people in Afghanistan. The Afghani people will be less able to deal with the global effects of climate change because their economy and infrastructure are not as well developed as in Canada.

Pages 370–371


UNIT C Review (continued)

19. The natural greenhouse effect, which has kept Earth warm for hundreds of thousands of years, is produced by water vapour, carbon dioxide, methane, and nitrous oxides. It has been operating since the formation of Earth's atmosphere. The anthropogenic greenhouse effect is a result of the extra greenhouse gases that humans have put into the atmosphere, mainly from burning fossil fuels. Global warming is the gradual warming of the climate over the past 200 years and particularly over the last 50 years.

20. Intergovernmental Panel on Climate Change (IPCC)

21. Answers will vary. For example: We could get longer, hotter summers and shorter winters. We may be able to grow a greater range of crops and garden plants. There may be more snow because the Great Lakes are not freezing, and thus the air can absorb more moisture from them.

22. Answers will vary. For example: The annual average world temperature has risen. Canada's alpine glaciers are melting. The summer area and thickness of Arctic sea ice are declining. The Antarctic and Greenland continental glaciers are melting. Sea levels are rising. Organisms' ranges are moving northward in Canada. There is an increased frequency of heat waves, droughts, wildfires, and storms.

23.

Physical Effect	Description
storms and droughts	increasing frequency and intensity
ocean currents	changes in temperature, salinity, and direction of flow
wildlife ranges	moving toward cooler areas
sea ice	rapid decrease in thickness and area
wildfires	increasing frequency
mountain glaciers	getting thinner and shorter

24. As the ice breaks up, more solar radiation can be absorbed by the darker-coloured water (it has a higher albedo). This is happening in the Arctic Ocean, around the Antarctic, and in the Great Lakes.

25. Transportation and electricity generation account for almost 40 percent of Canada's greenhouse gas emissions. The oil and gas extraction industry (mainly tar sands) account for about 20 percent of Canada's emissions, while agriculture, forestry, residential use, and other industries are responsible for most of the remaining 40 percent of emissions.

26. Some people are naturally skeptical and want definite proof before they will believe that climate change is occurring. Often they don't understand the difference between weather and climate, and think that if a particular winter is very long, cold, and snowy, climate change is not happening. Some people may have a vested interest in the fossil fuel industry and promote the idea that climate change is not happening so that their business will not suffer. Some people claim that they cannot see any changes in climate in their region. They have not looked at the other regions on Earth, particularly the polar regions.

27. **(a)** ENERGY STAR is an international symbol that shows consumers that a product, such as a clothes washer or window, has met certain standards for energy efficiency.

(b) Ontario's Drive Clean program requires drivers to submit their automobiles for regular emissions testing. If the minimum requirements are not met, the owner of the car must have the car repaired until it meets the standards.

28. Hanging laundry outside to dry reduces the greenhouse gas emissions that would have resulted if the washing had been dried using electrical energy. Answers for "similar ideas" will vary. For example: Turn the thermostat down and wear a sweater. Shower less frequently or for shorter periods of time. Carpool or use transit systems.

29. Developing countries generally produce far less greenhouse gas per capita than do developed countries and are therefore a much smaller part of the problem. Also, developing countries will probably increase their emissions as they develop and improve their living standards.

9

30. The citizens of G8 countries are responsible for a disproportionate amount of greenhouse gas emissions because of the activities they participate in. Many of these countries have cold winters and hot summers that require heating and air conditioning of homes and workplaces. Most of the citizens can afford fossil-fuel-consuming vehicles. Most of the citizens consume fossil fuels through the use of electricity for lighting, water heating, electronic devices, and labour-saving devices. Most of these countries produce greenhouse gases as a result of manufacturing and the extraction of resources such as oil, gas, and coal. Some of the countries are very large, and citizens must travel long distances, which consumes more fossil fuels.

31. People are concerned that some organisms would be negatively affected by climate change because this could lead to their extinction (polar bears). Other organisms such as the blacklegged tick, which carries Lyme disease, may be positively affected (from the tick's point of view) and spread into Canada.

32. It is important to learn about physical effects of climate change that may not have a direct or severe impact on our own regions because we live in an interdependent world, in which problems in one part eventually affect the entire planet. We also need to be concerned about the welfare of others, regardless of whether it affects us directly.

33. The photograph shows dominos arranged in such a way that if the first one is pushed over, all the others will also fall over. This is similar to the effects of climate change in that if people do not do something soon about slowing the rate of increase of greenhouse gas emissions, climate change will proceed beyond our ability to control it.

34. Developing countries produce less greenhouse gas per capita because fewer people own cars or use electrical lighting and household appliances.

Connect Your Understanding

35. The level of water vapour in the atmosphere varies considerably, depending on the temperature. Air can only hold a certain amount of water vapour at each temperature; any excess becomes precipitation. Thus, the amount of water vapour in the atmosphere now is about the same as it was hundreds of thousands of years ago. So even though water vapour may be released during industrial processes, it has little effect on climate change.

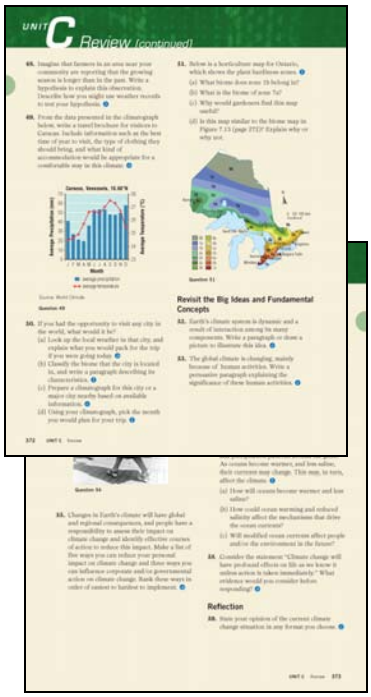
36. The position of the IPCC on the relationship between the average global temperature increase and greenhouse gas emissions is that climate change is being caused by greenhouse gas emissions in excess of those produced naturally. In other words, climate change is cause by anthropogenic greenhouse gas emissions.

37. Earth as a whole is a system, and an event that occurs in one region can spread out like waves to affect other events around the globe. Many factors are involved in maintaining Earth's balance. If several of those factors change in the same direction, they can unbalance Earth's system and cause problems such as climate change. Such situations are seen in events leading up to wars; climate change is similar in many ways.

38. Computer modelling has influenced political action on climate change by allowing everyone to see the negative effects of climate change in the future.

39. Answer will vary. For example: It is in the interests of developed countries to help developing countries limit their greenhouse gas emissions. We all share the same world, and the effects of global warming will be experienced by all nations. Thus, it is reasonable that the main producers of greenhouse gases, the developed nations, assist developing nations to the best of their ability (as well as reducing their own emissions).

Pages 372–373



40. Answers will vary. For example: Canada has large supplies of fresh water (moderate rainfall plus groundwater, lake and river water) and is less likely to suffer serious droughts. Areas in Africa and Australia that are close to existing deserts are already starting to suffer intense and prolonged droughts.

41. Answers will vary. Ensure that students have the important concepts correct. Science brought electricity and fossil fuels to humanity and showed us how to use them. Science is now researching the various effects on the biosphere that can be linked to this use. And science is now developing ways to mitigate climate change and to adapt to what we cannot control.

42. Answers will vary. For example: Science and technology will help society mitigate climate change by developing new ways of sequestering carbon dioxide or reducing or preventing its emission. They will also help society adapt to climate change by developing new ways to generate electricity without creating carbon dioxide emissions and new ways to keep coastal cities from being swamped by rising sea levels.

43. As aerosol pollution decreases, the net cooling effect on climate will be reduced and the rate of temperature increase will accelerate.

44. Answers will vary. See Table 9.3 on page 355 of the student textbook.

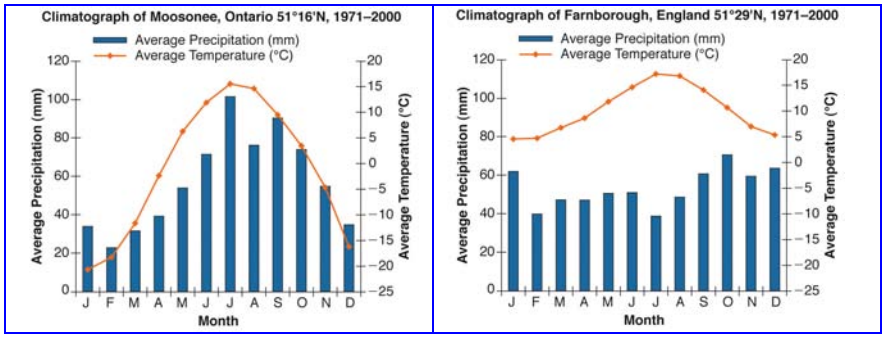
45. Answers will vary. The natural greenhouse effect is a natural process that has occurred since Earth developed an atmosphere. The anthropogenic greenhouse effect began in the 1700s when people began using large amounts of fossil fuels. Its effects are in addition to those of the natural greenhouse effect.

46. Answers will vary. Sample captions:

(a) Lake: Cool the climate and preserve our lakes.
(b) Flood: Stop greenhouse gas emissions or we'll get more of this.
(c) House of Commons: It's not just the people in here; we are all responsible for doing something about climate change.
(d) Crop: Don't waste energy—buy local food!
(e) Bikes and cars: Save the world—ride a bike!

Skills Practice

47.



Farnborough has moderate levels of precipitation and temperature throughout the year compared with Moosonee, where it is very cold and dry in the winter and hot and wet in the summer. Even though Moosonee is near the coast of James Bay, in winter that body of water is covered with ice. Therefore, Moosonee gets cold in winter. Farnborough in England is continuously subjected to the air blowing off a warm ocean current (the Gulf Stream).

48. Hypothesis: The growing season is longer than in the past because the climate has warmed slightly over the past few years.

Test of Hypothesis: Examine and graph two sets of climate data (each three decades long). Use the following data from a weather-recording station in the community: average monthly temperature, average monthly precipitation, and total monthly hours of sunlight. Note if there is any trend in climate data over time.

49. Answers will vary. For example: Caracas has a very pleasant tropical climate with very little variation between summer and winter temperatures. Its climate is often described as its best feature: never cold, seldom too hot. Average monthly temperatures range from 24.5°C to 27.5°C. June to December is somewhat more rainy than January to May. Just bring normal summer clothes and a light jacket for evenings. In some places, you can find accommodation in rustic cabins.

50. Answers will vary, depending on the city chosen.

(a) Ensure that students understand what the weather forecast dictates in terms of clothing.

(b) Students may use Figure 7.11 on page 268 of the student textbook to find the correct biome, and ScienceSource.ca or a Grade 9 textbook for descriptions of the biome.

(c) Ensure that the students have drawn the climatograph correctly. ScienceSource.ca can link them to climate data sites.

(d) Answers will vary, depending on the student's interests.

51. (a) Zone 1b is in the boreal forest biome.

(b) Zone 7a is in the temperate deciduous forest biome.

(c) The label on a plant states the zone that is the lowest limit for that plant. For example, if a peony is listed as Zone 3, it will grow in zones from 3 up.

(d) Answers will vary. Sample answer: The map is similar to the biome map because it shows areas with different climates. However, it shows more areas than the biome map.

Revisit the Big Ideas and Fundamental Concepts

52. Answers will vary. For example: The Earth's climate system is complex and constantly changing. It is an interactive system consisting of three components: the atmosphere, the hydrosphere, and the lithosphere. The energy from the Sun is transferred throughout the globe by winds and ocean currents.

53. Answers will vary. Some students may write that human activities are not significant in climate change. Ensure that they have defended this opinion.

54. Answers will vary. For example: My lifestyle today is very different from the lifestyle of the teenagers in the photograph. Today, I use much more energy than kids in the 1950s did because I use a computer, play computer games, listen to my stereo system, and shower more often than they did. Also my home is air-conditioned, and we probably set the thermostat too high in the winter. Unfortunately, my friends and I are producing more greenhouse gas emissions than we really need to. We are contributing to climate change.

55. Answers will vary. Ensure that students understand what can be done personally and what needs to be done by government and/or industry to reduce the impact of climate change.

Science, Technology, Society, and the Environment

56. Answers will vary. For example: My family do not use the green bin composting system. We have our own composters and we process all our vegetable and garden waste into new soil. We try to do what we can to reduce waste and recycle everything we can.

57. **(a)** One of the main components of climate change is the oceans. The top few metres alone store as much heat energy as the entire atmosphere, and the oceans are on average 3.7 km deep. Huge ocean currents carry thermal energy from warmer areas of the Earth to cooler ones. The oceans warm the winds in the atmosphere and are the original source of much of the precipitation. Scientists have found that as the oceans become warmer, ocean currents are changing in both direction and speed. Also as glaciers and sea ice melt, surface waters are becoming less saline. There are indications that this factor may be influencing the direction and depth of certain currents.

(b) Ocean warming has resulted in a 2 cm–5 cm rise in sea level. The melting of Arctic Ocean ice has opened up the Northwest Passage in summer and reduced polar bear habitat. Warming ocean water has caused some fish species to move northward because they prefer cooler water, and has affected coral and phytoplankton growth. Warmer water also produces more hurricanes and other storms, which cause damage to land and people.

58. Answers will vary. Evidence could include the following data.

- long-term atmospheric temperature readings for different areas of the Earth
- long-term ocean temperature readings for different areas of the Earth
- long-term precipitation measurements for different areas of the Earth
- long-term estimates of glacier size and sea-ice cover for different areas of the Earth
- long-term sea-level readings for different areas of the Earth

Reflection

59. Answers will vary. For example: The temperatures of the surface of the Earth as well as its atmosphere and hydrosphere are increasing, and the rate of this increase is also increasing. It is already too late to halt global warming; all we can do is to slow it down somewhat. Given the lack of real, concerted effort on the part of many nations, it is likely that we will all have to adapt to a much warmer world. All countries, including Canada, need to plan for the unavoidable consequences of climate change.