

Unit Review Answers (Student textbook pages 266–269)

Connect to the Big Ideas

1. Natural Factors Affecting Climate

Factor	Impact
<ul style="list-style-type: none"> • Sun 	<ul style="list-style-type: none"> • More activity in the Sun causes more energy to be given off, increasing Earth's surface temperature. • Earth's tilt affects climate; the area closest to the Sun is the warmest. • Earth's orbit, when it is circular, allows for even distribution of Sun energy.
<ul style="list-style-type: none"> • atmosphere 	<ul style="list-style-type: none"> • Moderates temperatures by absorbing and storing heat. • Transfers heat by having heat from lower latitudes moved to higher latitudes where it is generally cooler.
<ul style="list-style-type: none"> • natural greenhouse effect 	<ul style="list-style-type: none"> • Gases in the atmosphere absorb heat from the Sun and the heat radiated from Earth's surface, which warms the air.
<ul style="list-style-type: none"> • hydrosphere 	<ul style="list-style-type: none"> • Moderates temperature by absorbing and storing carbon dioxide and releasing it when air gets too cool. • Transfers heat by making cold, salty water sink, which displaces warmer less salty water, causing it to rise. This produces deep-water currents that move heat around globe.
<ul style="list-style-type: none"> • geography 	<ul style="list-style-type: none"> • Presence of land near or at poles has a cooling effect on atmosphere and planet, which affects precipitation. • Water around land has a cooling affect. • Volcanic ash spewed into the atmosphere blocks sunlight, cooling the planet. • Mountains make warm air rise and then cool down and gather moisture. When the air travels to the other side of the mountains, it loses its moisture as precipitation.

Human Activities Affecting Climate

Factor	Impact
<ul style="list-style-type: none"> • home heating 	<ul style="list-style-type: none"> • Burning wood and fossil fuels adds to greenhouse gases.
<ul style="list-style-type: none"> • deforestation 	<ul style="list-style-type: none"> • Cutting down trees means less carbon dioxide is removed from the air.
<ul style="list-style-type: none"> • oil sands 	<ul style="list-style-type: none"> • The Alberta oil sands project generates greenhouse gases through the production and disposal processes.
<ul style="list-style-type: none"> • land travel 	<ul style="list-style-type: none"> • Land vehicles burn fossil fuels, producing carbon dioxide and nitrous oxide.
<ul style="list-style-type: none"> • industry and manufacturing 	<ul style="list-style-type: none"> • Manufacturing processes produce carbon dioxide, methane, nitrous oxide, and halocarbons.

2. Answers may vary. Students should mention that climate change affects weather patterns, precipitation, and the frequency and severity of storms, and connect this to their effect on living things. Severe storms, for example, can have devastating effects on human populations, property, and wildlife.

Knowledge and Understanding

3. a) Both absorb and store a resource, and release it when levels elsewhere are low. The ocean is a carbon sink and the atmosphere is a heat sink.
- b) Weather is the conditions of the atmosphere for a specific place at a specific time. Climate is the pattern of weather conditions within a region over long period of time. Both are the condition of the atmosphere in a region but for different periods of time.
- c) In the natural greenhouse effect, solar energy enters the atmosphere, is absorbed by the surface, and is radiated again as heat. Gases in the atmosphere absorb the radiated heat. The gases radiate the heat they absorb, heating the atmosphere and warming Earth. In the anthropogenic greenhouse effect, greenhouse gases created by human activities enter the atmosphere and absorb heat from the Sun and Earth's surface. Both effects are similar in that heat is absorbed and radiated back to the atmosphere.

4. The hydrosphere moderates temperature because water has a great ability to absorb heat. This means the hydrosphere can absorb a lot of heat without causing a significant increase in air temperature. It helps moderate temperatures by acting like a carbon sink, absorbing and storing carbon dioxide and releasing carbon dioxide into the atmosphere to warm the air. The hydrosphere transfers heat through a system of deep-water currents called the great ocean conveyor belt.

The atmosphere moderates temperature by acting as a heat sink, absorbing and storing heat and releasing it when temperatures cool so temperature changes are gradual over 24 hours. It transfers heat through wind. Lower latitudes are warmer because they receive more direct sunlight. The unequal heating between lower and higher latitudes causes air to move, creating winds that transfer heat from one region to another.

5. Some scientists are worried about the warming trend on Earth because it is an indicator of global warming. Global warming is one aspect of climate change, which has a damaging effect on humans, animals, and their habitats.

6. Organizers may vary. For example:

Aquatic Ecosystems	Terrestrial Ecosystems
<ul style="list-style-type: none"> Melting sea ice threatens animals and people who live and hunt on sea ice. 	<ul style="list-style-type: none"> Changing climate forces animals to migrate. Animals that stay may die because they cannot tolerate the new conditions.
<ul style="list-style-type: none"> Warmer oceans mean aquatic organisms move to cooler waters, altering food chains. 	<ul style="list-style-type: none"> Melting permafrost makes soil shift, causing trees to tilt and buildings to lose their foundations or collapse.
<ul style="list-style-type: none"> Warmer oceans destroy coral reefs, slow the ocean currents, and change the temperatures on coastal lands. 	<ul style="list-style-type: none"> Increased temperatures and decreased precipitation creates desertification.
<ul style="list-style-type: none"> Rising sea levels force land animals and people in low-lying coastal regions to migrate. 	<ul style="list-style-type: none"> Flooding is caused by increased precipitation in some areas and rising sea levels in others.
<ul style="list-style-type: none"> Warmer oceans cause more movement in the air, creating more wind, and increasing the frequency and severity of storms. 	<ul style="list-style-type: none"> Heat waves, floods, hurricanes, and severe storms lead to property damage, homelessness, crop loss, disease, and death.

7. A global climate model is a computer program that uses mathematical equations to help scientists understand and estimate changes in Earth's climate. These tools are important to scientists because they help scientists predict how climate may change in the future.

8. a) The graph shows that before 1700, there was an increase in global temperatures for several hundreds of years, followed by a little ice age. Since 1700, global temperatures have increased.

b) The increase in global temperatures is due to an increase in greenhouse gas production. This is brought on by the industrial revolution and the heavy use of fossil fuels.

9. Answers may vary. For example: Earth's curved shape affects the concentration of light and warming at different parts of its surface. Diagrams should resemble Figure 3.8 on page 214 of the student textbook.

10. Ocean currents are created by cold, salty water sinking and displacing warm, less salty water. These movements create a system of deep-water currents that help transfer heat around the globe.

11. Technologies could include carbon dioxide capturing bacteria that convert carbon dioxide into usable calcium carbonate, artificial trees that capture carbon dioxide that is then stored in the ground, self-sufficient NetZero energy homes that use local building materials and solar and/or wind power for energy, clotheslines that use sun and wind to dry clothes, reducing greenhouse gas emissions, and white roofs that reflect sunlight, keeping houses cool in the summer and reducing the need for air conditioning.

12. a)

Type of Natural Greenhouse Gas	Common Sources
water vapour	<ul style="list-style-type: none"> evaporation from water given off by plants, animals, and other organisms
carbon dioxide	<ul style="list-style-type: none"> living organisms volcanoes, forest fires, decaying organisms, release from oceans
methane	<ul style="list-style-type: none"> certain bacteria and other microorganisms that live in and around bogs, wetlands, and melting permafrost certain bacteria that live in the gut of some animals, like cows and termites vents and other openings in Earth's crust on land and the ocean floor
nitrous oxide	<ul style="list-style-type: none"> bacteria that live in oceans and wet, warm soils, like those in the tropics

b)

Type of Human Made Greenhouse Gas	Common Sources
carbon dioxide	<ul style="list-style-type: none">• burning of fossil fuels• deforestation• burning of deforestation debris
methane	<ul style="list-style-type: none">• raising livestock• growing rice• landfills
nitrous oxide	<ul style="list-style-type: none">• farming crops and livestock• use of fertilizers• vehicle exhaust
halocarbons	<ul style="list-style-type: none">• solvents• coolants

- 13.** Warm water transfers heat to the air above it, making the air less stable and more favourable for developing tropical storms, and then hurricanes. The warmer the water gets, the less stable the air gets, and the more powerful the hurricanes can become.
- 14.** Answer may vary. For example, we have increased the levels of carbon dioxide in our atmosphere, which has led to global warming. We are reducing carbon dioxide emissions by biking, walking, and using public transit instead of driving.

Thinking and Investigation

- 15.** The record-breaking summer temperatures are an indication the weather is changing. If the records were broken over several summers in a row and for a larger region, say all of Ontario, then this would be an indication that the climate is changing.
- 16.** We are changing global temperatures at a much faster rate than the natural change in temperature that happened after the last ice age. The change might be too fast for animals and plants to adapt to, because it is not natural.
- 17.** In 1700, the industrial revolution began and fossil fuels were burned for energy on a large scale, producing carbon dioxide. People moved from the country to the factory towns, increasing the need for fossil fuels for living and for manufacturing. This urbanization continued at a very fast rate, increasing the levels of carbon dioxide emissions every year.
- 18.** As carbon dioxide levels increase, the average global temperature will increase over a period of time.

- 19.** If the glaciers in Greenland melt, the ocean currents coming from Greenland will no longer be cooled by the glaciers and the water will be warmer. This warmer current will warm the waters off the east coast of Canada.

Communication

- 20.** Answers may vary. Students should support their opinions with examples.
- 21.** Answers may vary. Students should use their understanding of climate and climate change to support their opinions.
- 22.** Answers could include examples of cooler or hotter temperatures, increased or decreased precipitation, increased frequency and severity of storms, melting glaciers, thawing permafrost, drought, or flooding.
- 23.** Answers could include taking public transit, cycling, or walking instead of driving a car, using a clothesline instead of a dryer, eating locally produced food, eating less red meat, and lowering the home furnace thermostat in winter.
- 24.** Letters should mention the amount of ash spewed into the atmosphere and how the ash will block sunlight from reaching Earth's surface, which will reduce the planet's temperature.
- 25.** The carbon dioxide was produced by an increase in burning fossil fuels for transportation, manufacturing, and home heating. Deforestation has also reduced the amount of carbon dioxide taken from the atmosphere. Nitrous oxide was produced from vehicle exhaust and farming practices. Methane gas was produced through cattle farming and growing rice, and from landfills. Halocarbons were produced through the use of chemical solvents and coolants.
- 26.** Answers may vary. Examples could include bacteria that convert carbon dioxide into calcium carbonate, artificial trees that trap carbon, NetZero homes, or white roofs.
- 27.** Rockets will add to greenhouse gas emissions. The reflective particles might not be oriented correctly to reflect sunlight away from Earth and might actually increase the amount of sunlight reaching the surface. The particles might form space junk or come down in precipitation if they are not high enough in the atmosphere.

Application

28. To understand Earth's climate history, scientists have to take isolated evidence and make links to create an acceptable theory of how the climate has changed over time. Fossils and ice cores give scientist clues about past climates; tree rings show scientists more recent climate changes. Global temperatures have been recorded since the 1880s, helping scientists track the change in climate over time.

29. Answers may vary. For example, change the animals' diet so they produce less methane gas.

30. a) Answers may vary. For example:

Climate Change	Positive Impact	Negative Impact
milder winters	<ul style="list-style-type: none">longer growing season	<ul style="list-style-type: none">increase in harmful insects and plant diseases, since they are not killed off by the cold
melting polar sea ice	<ul style="list-style-type: none">more shipping lanes through the Arctic	<ul style="list-style-type: none">fewer ice roads in the winter, leading to higher food costs in the Arctic
warmer coastal waters	<ul style="list-style-type: none">new fish species to catch	<ul style="list-style-type: none">animals, such as puffins, lose their food sources as fish species move
increased rainfall	<ul style="list-style-type: none">more water for crops	<ul style="list-style-type: none">increase in water borne diseases
decreased rainfall	<ul style="list-style-type: none">decrease in flooding	<ul style="list-style-type: none">desertification
hotter temperatures	<ul style="list-style-type: none">fruits and vegetables ripen more quickly	<ul style="list-style-type: none">more forest fires

b) Answers may vary. Students should describe the climate change impact and show how the people are adapting to it.

31. a) Answers could include scared, sad, and angry.

b) There will be less ice and more open sea. There will be fewer polar bears, seals, and other animals that live and hunt on the sea ice. The permafrost will melt, causing buildings to sink.

32. Melting sea ice in the Arctic puts more water into the oceans. This can result in flooding in areas farther south. Less ice and permafrost can result in warmer temperatures all around the world, since this ice now helps to keep the planet cool. Since all living things are connected in some way, if Arctic species become extinct owing to global warming this will affect other species farther south. Their predators may increase in number, or their prey may move to a new area.

33. a) By reducing power consumption, water consumption, and greenhouse gas emissions, Metro Hall has reduced its carbon footprint and its impact on climate change.

b) These large installations need lots of land and water to be effective so the technology could disturb aquatic and terrestrial ecosystems. More jobs at these plants mean more greenhouse gas emissions.

Literacy Test Prep

Note: the questions have been renumbered in the second printing of the student textbook to run consecutively from the Unit 3 Review.

Multiple Choice

34. b)

35. c)

36. a)

37. d)

Written Answer

38. Answers may vary. Students should use specific details from the selection and their own ideas to support their answers.