

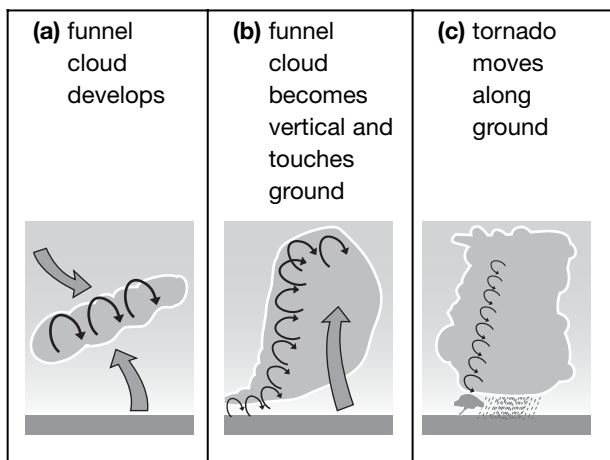
7. Wind is the movement of air from an area of higher pressure to lower pressure while an air mass is a parcel of air with similar temperature and humidity throughout.
8. When a high pressure system forms, the air mass cools, particles in the air lose kinetic energy, and the air becomes more dense. Wind is created. Clear skies often occur.
9. When a low pressure system forms, the air mass warms, it expands and rises, making the layer of air thicker. As the air rises, it cools. The water vapour may condense, producing clouds or precipitation.

### Interpreting Illustrations

#### Weather patterns

##### Page 190

1. (a) cool temperatures, forming rain or snow, depending on elevation  
(b) strong, dry, warm winds called Chinooks form
2. Arrows should deflect to the right in the northern hemisphere and to the left in the southern hemisphere.
3. (a) polar easterlies  
(b) prevailing westerlies  
(c) northeast trade winds  
(d) southeast trade winds  
(e) prevailing westerlies  
(f) polar easterlies
4. (a) Warm air replaces cold air, therefore precipitation will result.  
(b) Cold air replaces warm air, therefore cooler, drier weather will occur.
- 5.



6. Warm ocean water and winds lift moist air high into the atmosphere. The water vapour condenses, producing clouds and rain. The rising air produces a

low pressure area at the ocean's surface. Warm air rushes down towards the low pressure area. The Coriolis effect forces the air to rotate, causing a massive, spinning storm.

### Assessment

#### Energy transfer in the atmosphere

##### Page 192

1. C 2. D 3. B 4. G 5. H 6. F 7. A 8. E 9. C 10. D 11. B 12. C

## Chapter 11 Climate change occurs through natural processes and human activities.

### Section 11.1 Natural Causes of Climate Change

#### Cloze Activity

##### Natural causes of climate change

##### Page 196

1. climate
2. paleoclimatologists
3. natural greenhouse effect
4. tilt; wobble; shape
5. water vapour
6. convection currents
7. Coriolis effect
8. El Niño–Southern Oscillation
9. carbon sink
10. weathering
11. catastrophic events

#### Comprehension

##### Factors that affect climate

##### Page 197

1. A decrease in the amount of greenhouse gases would lower the temperature on Earth.
2. An increase in the tilt of Earth would result in extreme seasonal changes. In the northern hemisphere, winters would be colder and summers would be warmer.
3. A change in Earth's wobble will affect the angle of incidence of the Sun's rays.
4. When Earth's orbit is elliptical, Earth's orbit takes it farther from the Sun, and less solar radiation reaches Earth's surface.
5. As yearly temperatures increase, the atmosphere holds more water vapour and traps more thermal energy. The resulting increase in temperature causes more water to evaporate.

6. Melting glaciers add large amounts of salt-free water to the oceans. This raises the water levels and changes the environment of the ocean, threatening the survival of many species living in the ocean.
7. As the levels of carbon dioxide increase, the temperature on Earth increases.
8. A volcanic eruption results in molten rock and ash blocking out sunlight, and a release of water vapour and sulphur dioxide, which forms sulphuric acid. The sulphuric acid can reflect solar radiation and result in the lower levels of the atmosphere cooling.

**Interpreting Illustrations**  
**El Niño and La Niña**  
**Page 198**

1.

<p><b>(a) El Niño</b> <b>(b)</b></p> <ul style="list-style-type: none"> <li>• Winds blowing west weaken and may even reverse.</li> <li>• Warm waters in the Pacific move eastward, preventing cold water from upwelling.</li> <li>• Alters precipitation and temperatures across North America.</li> </ul>	<p><b>(c) La Niña</b> <b>(d)</b></p> <ul style="list-style-type: none"> <li>• Stronger-than-normal winds push warm Pacific waters farther west, toward Asia. Cold, deep-sea waters then well up strongly in the Eastern Pacific, bringing cooler temperatures to northwestern North America.</li> </ul>
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2.

<p><b>(a) La Niña.</b> <b>(b)</b></p> <ul style="list-style-type: none"> <li>• Warm ocean water, clouds, and moisture are pushed away from North America.</li> <li>• A weaker jet stream brings cooler weather to the northern parts of the continent and hot, dry weather to southern areas.</li> </ul>	<p><b>(c) El Niño</b> <b>(d)</b></p> <ul style="list-style-type: none"> <li>• Sun-warmed surface water spans the Pacific Ocean.</li> <li>• Clouds form above the warm ocean, carrying moisture aloft.</li> <li>• The jet stream helps bring warm, moist air to the United States.</li> <li>• Coasts of Canada will be warmer than usual.</li> </ul>
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**Assessment**

**Natural causes of climate change**

**Page 199**

1. D 2. A 3. E 4. B 5. H 6. C 7. G 8. F 9. D 10. B 11. D  
 12. C 13. C 14. B

**Section 11.2 Human Activity and Climate Change**

**Comprehension**

**Climate Change**

**Page 203**

1.

- amount of Arctic sea ice is shrinking by 2 percent to 3 percent every decade
- average sea level is rising by about 3 mm per year
- average global temperature has risen by about 0.55°C since 1970

2. The greenhouse gases produced by human activity are carbon dioxide, methane, nitrous oxide (dinitrogen oxide), ozone, and chlorofluorocarbons.
3. Nitrous oxide is formed from the biological process of bacteria in ocean water, soil, and manure. Humans produce large amounts of nitrous oxide from the use of nitrogen-rich chemical fertilizers in farming and the improper disposal of human and animal waste.
4. The main cause of the depletion of Earth's protective ozone layer are chlorofluorocarbons (CFCs).
5. Albedo is the amount of radiation reflected by a surface.
6. GMCs take into account changes in greenhouse gas concentrations, albedo, ocean currents, winds, and surface temperatures.
7. Northern Canada has rising temperatures especially in the arctic regions. Areas of permafrost are melting, and the ice cover in the Arctic Ocean is rapidly shrinking.
8. The plans by the Canadian government include reducing greenhouse gas emission from trucks and cars, introducing policies requiring greenhouse gas-producing industries to reduce emissions, increasing the types of energy-efficient products available, and setting guidelines for improving indoor air quality.

**Applying Knowledge**

**Greenhouse gases**

**Page 204**

1. See figure 11.16 on page 484 in BC Science 10 textbook.

Water vapour: 65 percent

Carbon dioxide: 25 percent

Other gases, such as methane, nitrous oxide, CFCs, and ozone: 10 percent

2.

Greenhouse gas	Chemical formula	Source from human activity	Global Warming Potential (GWP)
carbon dioxide	CO <sub>2</sub>	<ul style="list-style-type: none"> <li>combustion of fossil fuels</li> <li>deforestation</li> </ul>	1
methane	NH <sub>4</sub>	<ul style="list-style-type: none"> <li>combustion of fossil fuels</li> <li>livestock</li> <li>waste dumps</li> <li>rice paddies</li> </ul>	25
nitrous oxide	N <sub>2</sub> O	<ul style="list-style-type: none"> <li>chemical fertilizers</li> <li>burning waste</li> <li>industrial processes</li> </ul>	298
chlorofluoro carbons (CFCs)	various	<ul style="list-style-type: none"> <li>liquid coolants</li> <li>refrigeration</li> <li>air conditioning</li> </ul>	4750–5310

3. Water vapour is not included in the table because human activities have very little direct effect on the amount of water vapour in the atmosphere. Ozone is not included in the table because it is continually broken down and reformed in the atmosphere, and so it is very difficult to determine its GWP.

### Extension Activity

#### Strategies for addressing climate change

##### Page 205

- Answers will vary. Table 11.4 on page 496 gives some general strategies for reducing greenhouse gas emissions.
- Answers will vary depending on the individual and his or her local environment.

### Assessment

#### Human activity and climate change

##### Page 206

- C 2. E 3. D 4. B 5. G 6. A 7. F 8. C 9. D 10. B 11. D
- B

## Chapter 12 Thermal energy transfer drives plate tectonics.

### Section 12.1 Evidence for Continental Drift

#### Cloze activity

##### Evidence for continental drift

##### Page 210

- supercontinent
- Pangaea
- geological structures; fossils; ancient glaciers

- mountain ranges
- tectonic plates
- Mid-Atlantic Ridge
- magnetic striping
- magma
- spreading ridge
- hot spot
- plate tectonic theory

### Applying Knowledge

#### Theories related to continental drift

##### Page 211

<p><b>Continental drift</b> Proposed by: Alfred Wegener</p> <p>Main points:</p> <ul style="list-style-type: none"> <li>continents were in motion</li> <li>Pangaea (supercontinent) existed</li> <li>continental shelves matched up</li> <li>compared geological structures, fossils, and evidence of ancient glaciers</li> </ul>	<p><b>Paleomagnetism</b></p> <p>Main points:</p> <ul style="list-style-type: none"> <li>Earth's magnetic field does change—evidence shows an average of four to five changes per million years</li> <li>magnetometer shows magnetic striping at Mid-Atlantic Ridge</li> </ul>
<p><b>Sea floor spreading</b> Proposed by: Harry Hess</p> <p>Main points:</p> <ul style="list-style-type: none"> <li>observed data on the age of ocean rocks, sediment thickness, and magnetic striping</li> <li>convection currents under Earth's surface bring up magma which caused the sea floor to spread apart</li> </ul>	<p><b>Plate tectonic theory</b> Proposed by: J. Tuzo Wilson</p> <p>Main points:</p> <ul style="list-style-type: none"> <li>suggested chains of volcanic islands were formed when a tectonic plate passes over a stationary hot spot</li> <li>continents break up at certain areas, move across Earth's surface, then rejoin</li> </ul>

### Interpreting Illustrations

#### Visual observations supporting continental drift

##### Page 212

- Wegener used analysis of rocks and ridges, fossils, and evidence of ancient glaciers.
- (a) These magnetic patterns were measured by a magnetometer.  
(b) These patterns show that Earth's magnetic field switches over time.
- The Hawaiian Islands were formed when a tectonic plate passed over a stationary hot spot.

### Assessment

#### Evidence for continental drift

##### Page 213

- G 2. F 3. D 4. E 5. I 6. B 7. H 8. A 9. C 10. C 11. B
- C 13. A