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_2	• combustion of fossil fuels • deforestation	1
methane	NH_4	• combustion of fossil fuels • livestock • waste dumps • rice paddies	25
nitrous oxide	N_2O	• chemical fertilizers • burning waste • industrial processes	298
chlorofluoro carbons (CFCs)	various	• liquid coolants • refrigeration • air conditioning	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

1. Answers will vary. Table 11.4 on page 496 gives some general strategies for reducing greenhouse gas emissions.

2. Answers will vary depending on the individual and his or her local environment.

Assessment

Human activity and climate change
Page 206

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

Chapter 12 Thermal energy transfer drives plate tectonics.

Section 12.1 Evidence for Continental Drift

Cloze activity

Evidence for continental drift
Page 210

1. supercontinent

2. Pangaea

3. geological structures; fossils; ancient glaciers

4. mountain ranges

5. tectonic plates

6. Mid-Atlantic Ridge

7. magnetic striping

8. magma

9. spreading ridge

10. hot spot

11. plate tectonic theory

Applying Knowledge

Theories related to continental drift
Page 211

Continental drift Proposed by: Alfred Wegener Main points: • continents were in motion • Pangaea (supercontinent) existed • continental shelves matched up • compared geological structures, fossils, and evidence of ancient glaciers	**Paleomagnetism** Main points: • Earth's magnetic field does change—evidence shows an average of four to five changes per million years • magnetometer shows magnetic striping at Mid-Atlantic Ridge
Sea floor spreading Proposed by: Harry Hess Main points: • observed data on the age of ocean rocks, sediment thickness, and magnetic striping • convection currents under Earth's surface bring up magma which caused the sea floor to spread apart	**Plate tectonic theory** Proposed by: J. Tuzo Wilson Main points: • suggested chains of volcanic islands were formed when a tectonic plate passes over a stationary hot spot • continents break up at certain areas, move across Earth's surface, then rejoin

Interpreting Illustrations

Visual observations supporting continental drift
Page 212

1. Wegener used analysis of rocks and ridges, fossils, and evidence of ancient glaciers.

2. (a) These magnetic patterns were measured by a magnetometer.

(b) These patterns show that Earth's magnetic field switches over time.

3. The Hawaiian Islands were formed when a tectonic plate passed over a stationary hot spot.

Assessment

Evidence for continental drift
Page 213

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

Section 12.2 Features of Plate Tectonics

Interpreting Illustrations

Layers of the Earth

Page 218

1. **(a)** inner core
   (b) outer core
   (c) lower mantle
   (d) upper mantle
   (e) crust
2.

Layer	Thickness	State	General composition
(a) inner core	1216 km	solid	iron, nickel
(b) outer core	2270 km	liquid	iron, nickel
(c) lower mantle	2225 km	solid	magnesium, iron
(d) upper mantle	660 km	solid, molten	iron, magnesium
(e) crust	5–60 km	solid, brittle	granite, basalt

3. The lithosphere is the layer made up of the crust and the uppermost mantle while the asthenosphere is a partly molten layer in Earth's upper mantle just below the lithosphere.

Comprehension

Features of plate tectonics

Page 219

1. Geologists believe that the asthenosphere is heated by radioactive decay from large quantities of radioactive elements such as uranium.
2. Scientists hypothesize the mantle convection is one of the driving forces behind plate movement.
3. A rift valley occurs on land, while a spreading ridge occurs in the ocean.
4. The heavy oceanic plate will dive deep under the lighter continental plate in an event known as subduction.
5. Earthquakes and volcanic eruptions occur at subduction zones.
6. **(a)** divergent

(b) convergent

(c) transform

7.

Geographic location	Plate interaction
1. East African Rift	divergence
2. Juan de Fuca plate	oceanic-continental convergence
3. Islands of Japan	oceanic-oceanic convergence
4. Himalayan mountains	continental-continental convergence
5. San Andreas Fault	transform fault

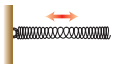
8. Subduction does not occur when continental plates collide. The plates have similar densities so this prevents either one from being forced down into the mantle.

Applying Knowledge

Seismic waves, earthquakes, and volcanoes

Page 220

1.

Seismic wave	Abbreviation	General diagram of wave	Description of action	Type of material it travels through	Speed it travels at
primary wave	P		ground squeezes and stretches	solids, liquids, gases	fast
secondary wave	S		ground motion is perpendicular to direction of wave travel	solids, but not liquids	slower
surface wave	L		rolling action	solids	slowest

2. A seismometer is a device that measures the amount of ground motion caused by an earthquake.
3. Magnitude is a number that rates the strength (energy) of an earthquake. Higher magnitude numbers indicate larger, more devastating earthquakes.
4. The Richter scale is often used to measure the magnitude of an earthquake.
5. The focus is the location inside Earth where an earthquake starts, and the epicentre is the point on Earth's surface directly above the focus.

6. Shallow focus occurs 1–70 km below the surface, intermediate focus occurs 70–300 km below the surface, while deep focus occurs at depths greater than 300 km.

7.

Geographic location	Type of volcano	Description of events
Mount Garibaldi volcano	composite	repeated eruptions at subduction zone
Anahim Volcanic Belt	shield	located over hot spot
Krafla volcano	rift eruptions	rift eruptions along cracks in lithosphere

Assessment

Features of plate tectonics

Page 221

1. E **2.** A **3.** J **4.** B **5.** H **6.** C **7.** D **8.** I **9.** F **10.** G **11.** A **12.** D **13.** C **14.** C **15.** C