Other Assessment Opportunities

- BLM 4-39, Chapter 12 Quiz
- BLM 4-40, Unit 4 Test
- Assessment Checklist 1, Making Observations and Inferences
- Assessment Checklist 2, Asking Questions
- Assessment Checklist 4, Laboratory Report
- Assessment Checklist 6, Developing Models
- Assessment Checklist 7, Scientific Drawing
- Assessment Checklist 12, Classification System
- Assessment Checklist 23, Learning Skills
- Process Skills Rubric 1, Developing Models
- Process Skills Rubric 2, Hypothesizing
- Process Skills Rubric 7, Predicting
- Process Skills Rubric 8, Interpreting Data
- Process Skills Rubric 9, Questioning
- Assessment Rubric 1, Concept Rubric
- Assessment Rubric 4, Scientific Drawing Rubric
- Assessment Rubric 11, Communication Rubric

CHAPTER 12 ASSESSMENT, p. 538–539

PREPARE YOUR OWN SUMMARY

Students' summaries should incorporate the following main ideas:

1. Continental Drift Theory
   - Present-day continents can be fitted together along their continental shelves into a supercontinent, Pangaea, which existed up to about 200 million years ago.
   - Further evidence for Pangaea can be obtained from matching mountain belts, rock types, zones of ancient fossils, and paleoglacial deposits.
   - Evidence for sea floor spreading has been obtained from dating ocean floor rocks and sediments, paleomagnetism, and the existence of ocean ridges and rifts.
2. Plate Tectonics
   - Earth's rigid upper mantle and crust, the lithosphere, is composed of a series of slow-moving plates that are likely driven by convection currents in the plastic-like asthenosphere and lower mantle.
   - Much of the energy for the convection currents is produced during the radioactive decay of elements such as uranium.
3. Plate Boundaries
   - Lithosphere tectonic plates converge, diverge, or slide past one another.
   - Where two plates diverge, a continental rift or an oceanic ridge system forms.
   - Where plates converge, a subduction zone forms as one oceanic plate slides beneath another plate. If two continents converge, a mountain belt is formed.
   - Where two plates slide past each other, huge transform faults are produced.
4. Volcanoes
   - Magma and volcanoes are produced when tectonic plates diverge or converge or when a plate passes over a hot spot in the mantle.
   - The movement of tectonic plates produces three distinct types of volcanoes: composite volcanoes, shield volcanoes, and rift eruptions.
5. Earthquakes
   - Where plates converge, diverge, or slide past each other, huge segments of crust rub together and earthquakes are produced.
   - Energy released in an earthquake travels from the focus out in all directions, in the form of primary (P) and secondary (S) seismic waves. Surface (L) waves are produced by the vibrations of S- and P-waves and travel along Earth's surface.
   - Seismic waves can be used to investigate the layers within Earth.
   - Seismic waves are detected and recorded using a seismometer. Seismic data can be used to estimate the location of the epicentre of an earthquake as well as its magnitude.

CHAPTER REVIEW ANSWERS

Checking Concepts

1. Pangaea means "all world."
2. Sample answers:

(a)

Asthenosphere	Both	Lithosphere
– Partly-molten layer of upper mantle – Flows – Found below lithosphere	– Involved in plate tectonics	– Solid, rocky layer of crust and upper mantle – Rigid – Found above asthenosphere

(b)

Shield Volcano	Both	Rift Eruption
– Produces a large cone with gentle slopes	– Not explosive – Produces lava	– Lava erupts from long, narrow cracks

Discuss the formation of hollow, horizontal lava tubes present on Earth and the Moon that may be tens of kilometres long. Discuss the viscosity of the magma. Ask students to predict what plutonic and volcanic features would have formed if the wax had behaved more like molasses or warm peanut butter.

Analyze Answers

1. The wax melted and rose up through the sand and cold water.
2. Students' answers will vary but could include magma chamber, magma feeder pipe, lava flow, fissure flow, and shield volcano.

Conclude and Apply Answers

1. Students' answers will vary but could include:
   (a) The model showed magma melting, rising up through the crust and solidifying when in contact with colder material and when reaching the surface.
   (b) Melting and solidifying occur much too rapidly, viscosity of magma is too low, no crystals form, and few subsurface structures form, such as dykes, sills, and batholiths
2. (a) The wax cooled and solidified.
   (b) Magma and lava
3. Yes. **Note:** This is a challenge question for students.

USING THE FEATURE

Career Connect: Volcanologist, p. 536

This feature is an excellent example of one of the wide variety of professions associated with geology. The Career Connect shows the different types of work that volcanologists and geologists engage in and emphasizes the opportunities for travel, exploration, and outdoor physical activities.

Career Connect Answers

1. Students' answers will vary but could include any four of: Understand the processes that created a particular volcano; understand volcanic hazards; work with communities regarding volcanic hazards; geological mapping; keep track of active volcanoes; volcanic rock age dating.
2. Age dating can help geologists figure out when a volcano is likely to erupt again.
3. Ash can reflect sunlight and cool the atmosphere. Volcanic gases are greenhouse gases and can help warm the atmosphere.

SECTION 12.2 ASSESSMENT, p. 537

Check Your Understanding Answers

Checking Concepts

1. Transform boundary, diverging boundary, converging boundary
2. Ridge push occurs at a spreading centre, or ridge, where two plates are being pushed apart by rising magma.
3. The pattern of earthquakes and volcanoes follows the plate boundaries around the world.
4. (a) Convection currents are currents of magma rising and falling in the mantle (asthenosphere).
   (b) Mantle (asthenosphere)
   (c) Convection currents help drive the motion of plates.
5. Magma bubbles up through weak parts of the lithosphere, forming large shield volcanoes.
6. Lava plateaus (large, flat areas of cooled lava)
7. P-waves
8. Seismometers measure the amount of ground shaking in an earthquake (i.e., magnitude)
9. Time-distance graphs show the amount of time earthquake waves take to travel certain distances.
10. P-waves

Understanding Key Ideas

11. (a) Plates move apart.
    (b) Plates move together.
    (c) Plates slide past one another.
12. At subduction zones, the subducting plate material melts, forming material that creates volcanoes. At transform boundaries, there is no source of magma.
13. The ground motion of a P-wave is a squeezing and stretching in the direction of travel. For an L-wave, the ground tends to ripple and roll.
14. P-wave = 5000 km, S-wave = 2250 km, L-wave = 1750 km
15. (a) Composite cone (strato)
    (b) Rift eruption
    (c) Cinder cone. **Note:** This is a challenge question for students.

Pause and Reflect Answer

Answers will vary but should include the idea that oceanic rock gets "recycled" at subduction zones whereas continental rock tends to remain untouched for billions of years.

(c)

P wave	Both	S wave
– Compressional wave – Fastest wave – Travels through anything	– Travel through ground – Caused by earthquake – Cause damage – Make ground shake	– Shear wave – Slower than P – Cannot travel through liquid

(d)

Seismometers	Both	Seismogram
– Instrument to measure earthquakes – Measures ground shaking – Produces seismogram	– Record ground shaking in an earthquake	– Paper record of an earthquake – Displays ground shaking of P-, S- and L-waves

(e)

Focus	Both	Epicentre
– Point in Earth where earthquake actually begins	– Focus and epicentre can be same location on Earth's surface. – Both give the specific location of an earthquake. – Both are used to describe an earthquake.	– Point on Earth's surface directly above the focus – Used for geographical location of an earthquake

3. (a) Matching continental margins suggest the continents were once part of a single large continental mass.
   (b) Similar animal fossils suggest the continents were once together, because it is unlikely the same organism that produced the fossil would develop identically on continents several thousands of kilometres apart.
   (c) Rocks of the same age and matching mountain ranges suggest the forces that produced them were acting on a single large continental mass that has since broken apart.
   (d) **Note:** You may wish to have students delete this question.
4. **Note:** As an alternative question, ask "Why do *earthquakes* occur at tectonic plate boundaries?" Earthquakes occur at plate boundaries because large slabs of rock are trying to slide past each other or into each other. The rock resists this motion, and stress (pressure) builds up. When that pressure is released, an earthquake occurs.
5. Rocks increase in age as distance increases from a spreading ridge.
6. Subduction zones experience the deepest earthquakes, because one plate is diving deep beneath another.
7. Magma rises and breaks through the lithosphere at spreading ridges. The magma solidifies into rock. New magma rising through the ridge pushes the new rock material away.
8. Shield volcanoes occur over hot spots.
9. The magma that forms composite volcanoes traps gas, which increases the pressure. When the pressure becomes too great, the volcano erupts violently.
10. Sample answer: Similarities: Both are caused by earthquakes; both cause the ground to vibrate/shake; both start at the same focus; both cause damage to buildings/structures; and both can travel through solids.
    Differences: P-waves squeeze and stretch the ground in the direction they travel, and are faster than S-waves; S-waves squeeze and stretch the ground at 90 degrees to the direction they travel; S-waves are slower than P-waves; and S-waves cannot travel through liquids.
11. Earthquakes are caused by the build-up of stress between tectonic plates, caused by friction.

Understanding Key Ideas

12. Continental drift
13. (a) Transform plate boundary
    (b) Convergent plate boundary
    (c) Divergent plate boundary
14. There is no source of magma at these types of plate boundaries.
15. Rocks of the same age and matching mountain ranges suggest the forces that produced them were acting on a single large continental mass that has since broken apart.
16. If mantle convection stopped, there would be no plate movement and therefore no earthquakes or volcanoes.
17. Material from volcanoes (lava from magma) originated deep in Earth.
18. Volcanoes occur at subduction plate boundaries and diverging plate boundaries, where magma from the mantle rises and breaks through the lithosphere.

19. A rift eruption may produce a great deal of lava, which could cause damage to buildings, bridges, rivers, and agriculture. Ash released from the eruption may affect climate.
20. Earthquakes are difficult, if not impossible, to predict.
21. A. Trench
    B. Volcanic island arc
    C. Upper mantle
    D. Oceanic crust
    E. Mantle
22. She can conclude that the rock in the middle layer formed at a time when Earth's polarity was reversed.
23. (a) Convergent
    (b) Toward each other
    (c) 0 m to –35 m
    (d) **Note:** As an alternative question, ask "Would you expect to find volcanoes in this area? Explain." Answer: Yes, the depth of foci indicates that one plate is subducting beneath another plate. The results would be volcanoes in the area of the subduction zone.

Pause and Reflect Answer

The Hawaiian Islands increase in age the farther you get from the hot spot. As the Pacific Plate moved over the hot spot, new islands were formed. The islands were carried, as if on a conveyor belt, away from the hot spot.

UNIT 4 ASSESSMENT

PROJECT

Minimizing Your School's Carbon Footprint, p. 542

Purpose

- Students work in groups to plan a strategy for reducing their school's carbon footprint.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1 week before	Book the computer lab for Internet access. Gather research materials.	For each group: – poster paper – notebooks – felt pens or pencil crayons

Time Required

- 120 min

Safety Precautions

- None

Science Background

Most people seem to be convinced that Earth's atmosphere is warming because of the greenhouse effect, caused by increasing quantities of greenhouse gases, such as carbon dioxide, methane, etc. In this project, students are given the opportunity to suggest actions within the school environment that will contribute toward the net reduction of greenhouse gas emissions. Students should brainstorm ideas for greenhouse gas reduction. However, they may find it useful to try to adapt some of the strategies outlined in Table 11.4, Strategies for Addressing Climate Change, on page 496 in the student book, to the school situation.

Activity Notes

- Students should work in groups of two or three for this activity.
- Ask students to read the procedure carefully before starting.
- Remind students that they should come up with five or more ideas individually before starting the group discussion.
- If Internet access is available, students may wish to research some strategies that are working in other situations.
- After each group has created a master list, they should create a poster that outlines a carbon reduction plan.
- After presenting group posters, the class can vote on the top three ideas.

Supporting Diverse Student Needs

- ESL students will require a detailed explanation of the expectations of this activity and should be partnered with a student with strong language skills.
- This is an excellent activity for visual-spatial learners and those with interpersonal and existential intelligence.

Other Assessment Opportunities

- Assessment Checklist 1, Making Observations and Inferences
- Assessment Checklist 2, Asking Questions
- Assessment Checklist 5, Investigating an Issue
- Assessment Checklist 9, Oral Presentation
- Assessment Checklist 11, Poster