6. Yes, the horse could outrun the lava flow.
   60 km/h × 0.621 mi/km = 37.26 mi/h
   48 mi/h > 37.26 mi/h
7. It took a year for the effects of the Tambora eruption to be experienced in New England because the ash and gases from the eruption had to be circulated by global winds.

SECTION: CAUSES OF VOLCANIC ERUPTIONS

1. Sample answer: A hot spot may form above a mantle plume. A rift zone is a series of cracks that form along a divergent plate boundary.
2. B
3. D
4. The Ring of Fire is a group of volcanoes that are located on convergent plate boundaries in the Pacific Ocean.
5. At convergent boundaries a plate is subducted. The subducted plate is heated and releases water. The water causes the melting point of the rock to decrease, forming magma. At divergent boundaries, mantle rock rises to fill the gap created by separating tectonic plates. As the rock rises, pressure decreases and the rock melts, forming magma.
6. Scientists monitor seismic activity associated with the volcano. If seismic activity increases, magma might be moving in the magma chamber. Scientists study the composition and volume of gases released from the volcano. If the composition of gases changes, an eruption may be imminent. Scientists also study the slope and temperature of volcanoes. If the slope or surface temperature change, an eruption might be imminent.
7. Oceanic plates tend to subduct because they are denser than continental plates.
8. 100 km ÷ 2 km/million years = 50 million years
9. New crust is constantly being created, but it is also being subducted at convergent boundaries.
10. The youngest layers would most likely be at the top because they were deposited over the older layers.

Chapter Review

1. Sample answer: A caldera forms when the magma chamber below a volcano partially collapses. A crater forms when the material above the main vent of a volcano is blasted out.
2. Sample answer: Magma is hot, liquid rock material beneath Earth's surface. Lava is magma that flows onto Earth's surface.
3. Sample answer: Lava is liquid magma that flows out of a volcanic vent onto the ground. Pyroclastic material is mostly ash and solid rock that is blasted into the air during an explosive volcanic eruption.
4. Sample answer: A vent is a spot in Earth's surface through which lava or pyroclastic material passes. A rift is a long crack in Earth's crust.
5. Sample answer: A cinder cone volcano forms when pyroclastic material erupts and piles up around a volcanic vent. A shield volcano forms when lava spreads out over large areas.
6. A
7. B
8. B
9. A
10. D
11. C
12. B
13. The presence of water in magma tends to cause explosive eruptions.
14. Earthquakes may indicate the movement of magma. Changes in the composition of volcanic gases may indicate changes in the magma chamber that may precede an eruption. Changes in the slope of a volcano may indicate that magma is rising. Finally, satellite data can reveal changes in surface temperature that may indicate that magma is rising.
15. Cinder cones are made from eruptions of pyroclastic materials. They are small and have steep sides. Shield volcanoes are made of lava that spreads over large distances before it solidifies, making very large, gently sloped volcanoes. Composite volcanoes are made of both lava and pyroclastic material.

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Composite volcanoes have large, gently sloping bases and steep sides.

16. Sample answer: Volcanoes form new crust and help create fertile soil.
17. An answer to this exercise can be found at the end of this book.
18. You would be traveling toward the volcano because the larger the pyroclastic material is, the closer it will be to the vent. It takes more energy to move larger particles than it does to move smaller particles.
19. The new island will be located southeast of Hawaii because the Pacific plate is moving toward the northwest.
20. Answers may vary. Students may suggest studying the composition and temperature of rock in the area where a mantle plume is thought to be.
21. The eruption probably happened in 1992 because that year had the lowest below-normal temperature. The volcanic ash that erupted into the atmosphere blocked the sunlight and lowered the temperature.
22. If the temperature were measured once a year, the graph would indicate that 1991 had the lowest temperature. This would indicate that the eruptions happened in 1991 instead of 1992.

Reinforcement

A VARIETY OF VOLCANOES

Composite volcano

is also known as a stratovolcano
has a broad base and steep sides toward the top
is formed by explosive eruptions that are followed by lava outpourings

Shield volcano

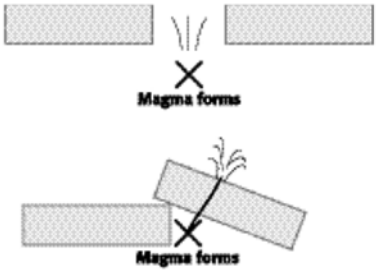
has sides that slope gently
forms from repeated nonexplosive eruptions
is made entirely of runny lava

Cinder cone volcano

consists entirely of pyroclastic material
is often found in clusters
erodes very quickly

PLATE MOVEMENT

1.



2. A rift forms between the diverging plates. Mantle rock rises to fill this rift. Lower pressure at the rift causes the rock to melt and become magma. Lower-density magma rises up through the higher-density crust, and volcanic activity occurs.
3. When the plates collide, one plate moves under the other. The rock of the descending plate begins to melt as the plate sinks deeper. The melted rock rises to the surface, and volcanic activity occurs.

Critical Thinking

1. Sample answer: The president faces problems concerning the health, safety, and economic welfare of the citizens. She must determine whether the farmers can still grow crops. She must also determine whether there are any health risks to the inhabitants, such as air pollution, water toxicity, or toxic fumes.
2. a. Sample answer: The land buried under 2 m of ash will be useless for years because the ash prevents sunlight from reaching the soil.
   b. Sample answer: Where only 1 cm of ash blankets the land, the ash will fertilize the soil. The land will be enriched for agriculture.
3. The president should not be overly concerned about another eruption. The magma in this volcano has a low water content and a low silica content. This type of magma is pliable, so it is not very likely to block the vent again.
4. Answers may vary. Students should give President Zinnson multiple options, along with the consequence of each option. Answers should address the health, safety, and economy of Zinn's citizenry.