Chapter Review

USING KEY TERMS

1. Use each of the following terms in a separate sentence: seismic wave, P wave, and S wave.

For each pair of terms, explain how the meanings of the terms differ.

2. seismograph and seismogram

3. epicenter and focus

4. gap hypothesis and seismic gap

UNDERSTANDING KEY IDEAS

Multiple Choice

5. When rock is _____, energy builds up in it. Seismic waves occur as this energy is _____.
   a. plastically deformed, increased
   b. elastically deformed, released
   c. plastically deformed, released
   d. elastically deformed, increased

6. Reverse faults are created
   a. by divergent plate motion.
   b. by convergent plate motion.
   c. by transform plate motion.
   d. All of the above

7. The last seismic waves to arrive are
   a. P waves.
   b. body waves.
   c. S waves.
   d. surface waves.
8. If an earthquake begins while you are in a building, the safest thing for you to do is
   a. to run out into an open space.
   b. to get under the strongest table, chair, or other piece of furniture.
   c. to call home.
   d. to crouch near a wall.

9. How many major earthquakes (magnitude 7.0 to 7.9) happen on average in the world each year?
   a. 1       c. 120
   b. 18      d. 800

10. _____ counteract pressure that pushes and pulls at the side of a building during an earthquake.
    a. Base isolators       c. Active tendon systems
    b. Mass dampers         d. Cross braces

Short Answer
11. Can the S-P time method be used with one seismograph station to locate the epicenter of an earthquake? Explain your answer.

12. Explain how the Richter scale and the Modified Mercalli Intensity Scale are different.

13. What is the relationship between the strength of earthquakes and earthquake frequency?

14. Explain the way that different seismic waves affect rock as they travel through it.

15. Describe some steps you can take to protect yourself and your property from earthquakes.
CRITICAL THINKING

16. Concept Mapping Use the following terms to create a concept map:
focus, epicenter, earthquake start time, seismic waves, P waves, and S waves.
17. Identifying Relationships Would a strong or light earthquake be more likely to happen along a major fault where there have not been many recent earthquakes? Explain. (Hint: Think about the average number of earthquakes of different magnitudes that occur annually.)

18. Applying Concepts Japan is located near a point where three tectonic plates converge. What would you imagine the earthquake-hazard level in Japan to be? Explain why.

19. Applying Concepts You learned that if you are in a car during an earthquake and are out in the open, it is best to stay in the car. Can you think of any situation in which you might want to leave a car during an earthquake?

20. Identifying Relationships You use gelatin to simulate rock in an experiment in which you are investigating the way different seismic waves affect rock. In what ways is your gelatin model limited?
The graph below illustrates the relationship between earthquake magnitude and the height of tracings on a seismogram. Charles Richter initially formed his magnitude scale by comparing the heights of seismogram readings for different earthquakes. Use the graph below to answer the questions that follow.

<table>
<thead>
<tr>
<th>Seismogram Height Vs. Earthquake Magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
</tr>
<tr>
<td>80</td>
</tr>
<tr>
<td>60</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>Maximum seismogram height (mm)</td>
</tr>
<tr>
<td>1</td>
</tr>
</tbody>
</table>

21. According to the graph, what would the magnitude of an earthquake be if its maximum seismograph height is 10 mm?

22. According to the graph, what is the difference in maximum seismogram height (in mm) between an earthquake of magnitude 4.0 and an earthquake of magnitude 5.0?

23. Look at the shape of the curve on the graph. What does this tell you about the relationship between seismogram heights and earthquake magnitudes? Explain.
6. Answers will vary. Sample answer: Flexible pipes that are able to twist and bend during earthquakes prevent water and gas lines from breaking. A base isolator made of rubber and steel wrapped around lead absorbs seismic waves. A mass damper placed in the roof of a building counteracts the movement of the building during an earthquake. Cross braces placed between floors in a building counteract pressure that pushes and pulls at the side of a building.

7. Answers will vary. Sample answer: nonperishable food, a flashlight, a portable radio, a fire extinguisher, and a first-aid kit.

8. \[ \frac{140}{420,000} \times 100 = .03\% \]

9. No, the hypothesis is not incorrect because there was only a 20% probability an earthquake would fill the seismic gap.

10. Aftershocks follow a large earthquake because the earthquake causes elastically deformed rock along other nearby faults to break.

Chapter Review

1. Answers will vary. Sample answer: A seismic wave is released when elastically deformed rock along a fault slips. A P wave is the fastest seismic wave and can move through all parts of the Earth. An S wave moves rock from side to side as it travels through the Earth.

2. Answers will vary. Sample answer: A seismograph is an instrument that is used to record seismic waves. A seismogram is the tracing of earthquake motion created by a seismograph.

3. Answers will vary. Sample answer: A focus is the point along a fault line where an earthquake starts. An epicenter is the point on Earth's surface above the focus.

4. Answers will vary. Sample answer: The gap hypothesis states that strong earthquakes are likely to occur along sections of active faults that have had relatively few earthquakes. Seismic gaps are areas along active faults where relatively few earthquakes have occurred.

5. B

6. B

7. D

8. B

9. B

10. D

11. No, a minimum of three seismograph stations are needed to find an earthquake’s epicenter using the S-P time method.

12. The Richter magnitude scale measures the ground motion from an earthquake and adjusts for distance to find earthquake strength. The Modified Mercalli Intensity Scale measures the degree to which an earthquake is felt by people and the amount of damage caused by an earthquake.

13. With each step down in earthquake strength or magnitude, the number of earthquakes per year is greater.

14. P waves move rock back and forth, squeezing and stretching the rock. S waves stretch rock sideways. Surface waves move rock up, down, and around or in a back-and-forth motion.

15. Answers will vary. Sample answer: You should protect yourself and your property against earthquakes by storing items you may need after a strong, damaging earthquake. You should put heavy items closer to the floor so that they do not fall during earthquakes. You should find safe places within each room of your home or outdoors in the event there is an earthquake.

16. An answer to this exercise can be found at the end of the Teacher Edition.

17. Answers will vary. Sample answer: Based on the average number of earthquakes of different magnitudes that happen annually, a light earthquake would be more likely to happen along a major fault where there have not been many major earthquakes.

18. Because most earthquakes occur at tectonic plate boundaries, the earthquake-hazard level in Japan would be high.

19. Answers will vary. Sample answer: You might want to leave your car if it was stranded on or beneath a highway overpass.
20. A gelatin model is limited because it does not have the same properties as rock, such as density and hardness.
21. 4
22. 100 mm – 10 mm = 90 mm
23. Students should recognize that seismogram heights increase at a greater rate with each increase in earthquake magnitude. The relationship is logarithmic, not linear.

Reinforcement

COMPLETE A SEISMIC STORY

seismologist
fault
seismology
fault
deformation
plastic deformation
elastic deformation
seismograph
elastic rebound
seismogram
seismologist
epicenter
epicenter
focus
focus

Critical Thinking

1. Answers will vary. Sample answer: Based on their descriptions in the letter, the earthquakes probably measure about a 3 or a 4 on the Richter scale.
2. Answers will vary. Sample answer: No; although a major earthquake is always possible, frequent major ones are not. There is an inverse relationship between earthquake frequency and strength. The more frequently earthquakes occur, the less intense the quakes are and the less damage they cause.
3. Answers will vary. Sample answer: I would offer them building materials and specialized designs that could help prevent structural damage to their buildings. For example, I could send flexible pipes, steel cross braces, mass dampers, base isolators, and active tendon systems. I could also help them develop an earthquake strategy.
4. Answers will vary. Sample answer: Citizens: Fear not; you face no dire threat. In fact, the frequent small earthquakes may mean fewer stronger quakes. Should large quakes hit, they will be few and far between.

Section Quizzes

SECTION: WHAT ARE EARTHQUAKES?

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

SECTION: EARTHQUAKE MEASUREMENT

1. D
2. A
3. F
4. C
5. B
6. E
7. C
8. A
9. C

SECTION: EARTHQUAKES AND SOCIETY

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