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# 6-1 What is continental drift?

## Lesson Review

**PART A** Complete the following.

1. Explain continental drift in your own words. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
2. Who was Alfred Wegener? \_\_\_\_\_  
\_\_\_\_\_

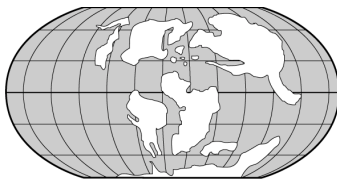
**PART B** Place a check mark beside each statement that supports continental drift.

- \_\_\_\_\_ 1. Alfred Wegener named a giant landmass Pangaea.
- \_\_\_\_\_ 2. There are seven continents.
- \_\_\_\_\_ 3. *Mesosaurus* fossils are found in Africa and South America.
- \_\_\_\_\_ 4. Canada, the United States, and northern Europe have similar climates.
- \_\_\_\_\_ 5. Mountain ranges on different continents seem to match.
- \_\_\_\_\_ 6. Rocks along the edges of one continent match those along the edge of another continent.
- \_\_\_\_\_ 7. The continents are surrounded by water.
- \_\_\_\_\_ 8. The coastlines of South America and Africa seem to fit together like jigsaw-puzzle pieces.

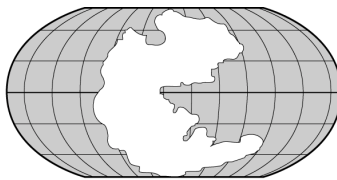
## Skill Challenge

**Skills:** sequencing, inferring

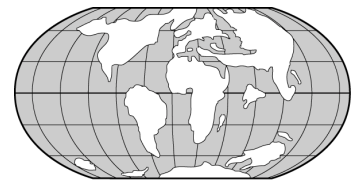
Place the drawings of the way Earth looked in the correct order based upon continental drift. Write the number of years ago in the space provided. Use these labels: *225 million years ago*, *180 million years ago*, *100 million years ago*, *50 million years ago*, and *present*.



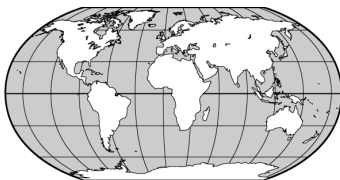
1. \_\_\_\_\_



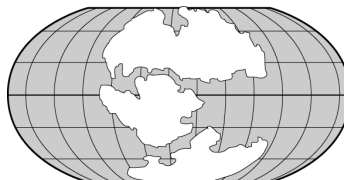
2. \_\_\_\_\_



3. \_\_\_\_\_



4. \_\_\_\_\_



5. \_\_\_\_\_

## 6-2 Why is the seafloor spreading?

### Lesson Review

Write *true* if the statement is true. If the statement is false, change the underlined term to make the statement true.

- \_\_\_\_\_ 1. The two kinds of crust are oceanic crust and land.
- \_\_\_\_\_ 2. Series of underwater mountain chains are called mid-ocean ridges.
- \_\_\_\_\_ 3. Iceland is part of the Mid-Pacific Ridge.
- \_\_\_\_\_ 4. Oceanic crust near a mid-ocean ridge is older than crust farther away.
- \_\_\_\_\_ 5. The deep crack running down the center of an ocean ridge is called a trench.
- \_\_\_\_\_ 6. New continental crust is formed at the mid-ocean ridges.
- \_\_\_\_\_ 7. Seafloor spreading is a process that forms new oceanic crust.

### Skill Challenge

**Skills:** modeling, identifying

Complete the following.

1. Label the lettered parts of Figure A. Use these labels: *oceanic crust*, *Iceland*, and *Mid-Atlantic Ridge*.

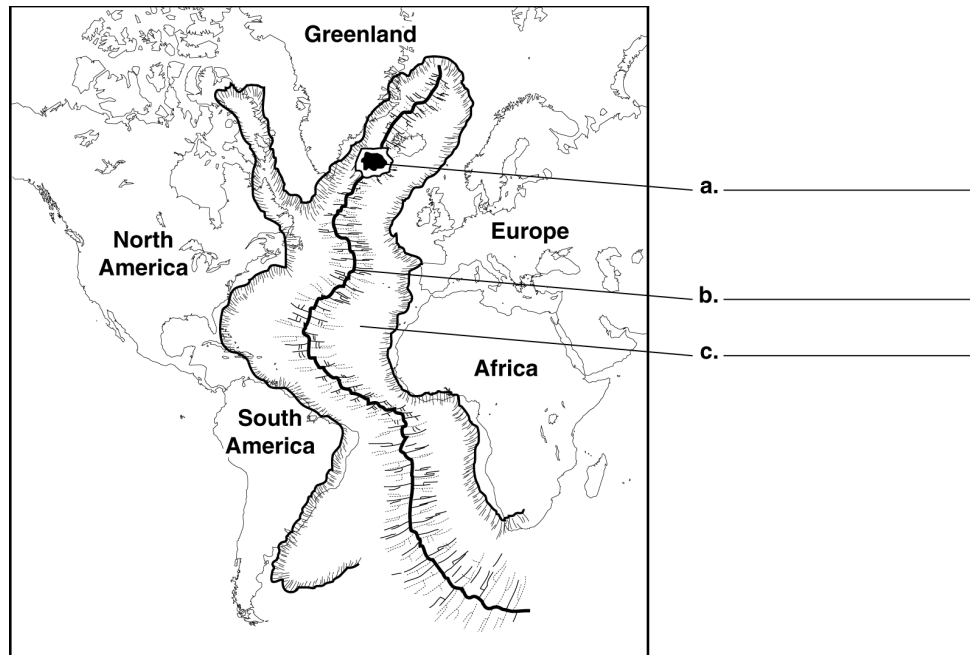


Figure A

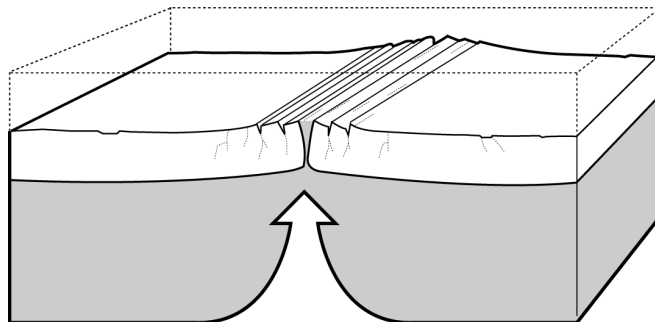


Figure B

2. Label Figure B. Use these terms: *rising magma*, *ocean crust*, *mid-ocean ridge*, and *rift valley*.
3. Draw arrows on Figure B to show seafloor spreading.

## 6-3 What evidence supports seafloor spreading?

### Lesson Review

**PART A** Place check marks in the spaces provided to show where you would most likely find each place.

1. trench:            \_\_\_\_\_ a. mountains            \_\_\_\_\_ b. Pacific Ocean            \_\_\_\_\_ c. valleys
2. subduction zone:   \_\_\_\_\_ a. Ring of Fire            \_\_\_\_\_ b. Pacific Ocean            \_\_\_\_\_ c. mid-ocean ridge
3. Ring of Fire:        \_\_\_\_\_ a. Atlantic Ocean            \_\_\_\_\_ b. Iceland.            \_\_\_\_\_ c. Pacific Ocean

**PART B** Complete the following.

1. Explain the relationship between trenches and seafloor spreading. \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_
2. Explain how changes in Earth's magnetic field are used as evidence to support seafloor spreading.  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

### Skill Challenge

**Skill:** modeling

On Diagram A, draw an arrow showing what happens at subduction zones. Study the key on Diagram B. Draw magnetic stripes and arrows to show changes in Earth's magnetic field as found in magnetic particles in rocks on the ocean floor. Then, draw arrows to show seafloor spreading.

Diagram A

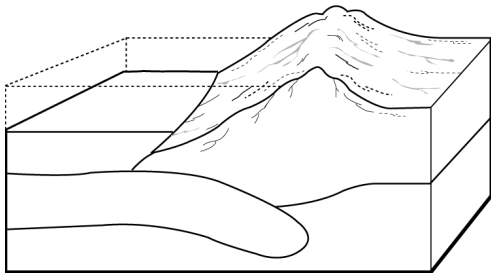
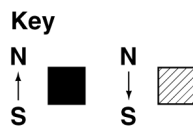
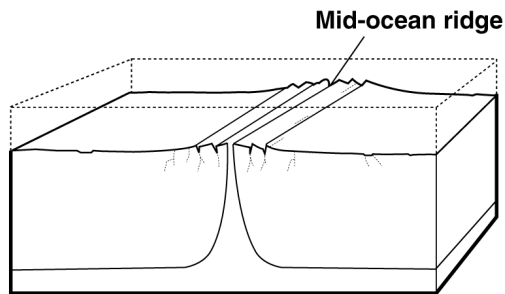


Diagram B



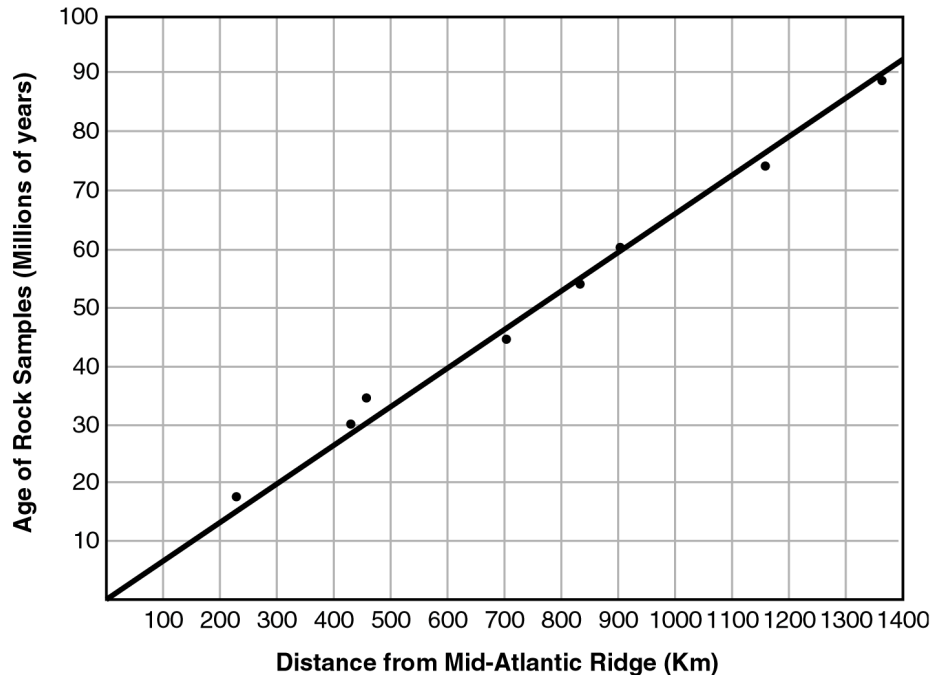
# Seafloor Spreading

## Enrichment Activity for Lessons 6-2 and 6-3

**Skills:** *interpreting, organizing, recording data*

Deep-sea drilling has brought up rock samples from the ocean floor. Scientists have measured the ages of these rock samples. Some of their measurements are shown in the graph below. Use the information in the graph to answer the following questions.

1. About how old are rock samples found 700 km from the Mid-Atlantic Ridge? \_\_\_\_\_
2. About how old are rock samples found 425 km from the Mid-Atlantic Ridge? \_\_\_\_\_
3. How many kilometers from the Mid-Atlantic Ridge are rock samples that are 75 million years old? \_\_\_\_\_



4. What is the relationship between the age of rocks on the ocean floor and their distance from the Mid-Atlantic Ridge? \_\_\_\_\_  
\_\_\_\_\_
5. What generalization can you make about the ages of rocks that are close to the Mid-Atlantic Ridge? \_\_\_\_\_  
\_\_\_\_\_
6. How does seafloor spreading explain why the youngest rocks are found near the Mid-Atlantic Ridge? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
7. Would you expect a rock sample found 1,500 km from the Mid-Atlantic Ridge to be younger or older than 90 million years? Explain. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

# 6-4 What is plate tectonics?

## Lesson Review

**PART A** Complete the following.

1. What are tectonic plates? \_\_\_\_\_
2. About how many tectonic plates have been identified? \_\_\_\_\_
3. On what part of Earth do the tectonic plates float? \_\_\_\_\_
4. State the theory of plate tectonics in your own words. \_\_\_\_\_  
\_\_\_\_\_

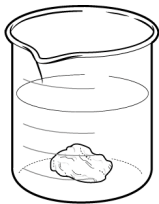
**PART B** Read each statement. If the statement refers to continental drift, write C in the space provided. If the statement refers to seafloor spreading, write S in the space provided.

- \_\_\_\_\_ 1. Earth's lithosphere is made up of separate plates.
- \_\_\_\_\_ 2. The continents have moved during Earth's history.
- \_\_\_\_\_ 3. New ocean floor is formed at the mid-ocean ridges.
- \_\_\_\_\_ 4. The continents were once part of one giant landmass.
- \_\_\_\_\_ 5. Old crust is pushed into the mantle at subduction zones.

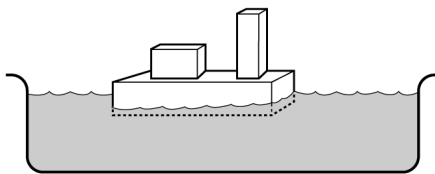
## Skill Challenge

**Skills:** *interpreting a model, synthesizing information*

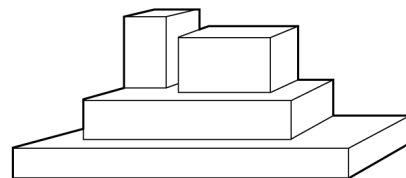
Place a check mark beneath the diagram that would be best to use to help explain plate tectonics to someone.



a. \_\_\_\_\_



b. \_\_\_\_\_



c. \_\_\_\_\_

Explain your choice. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

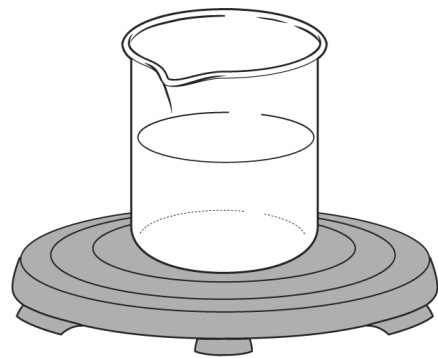
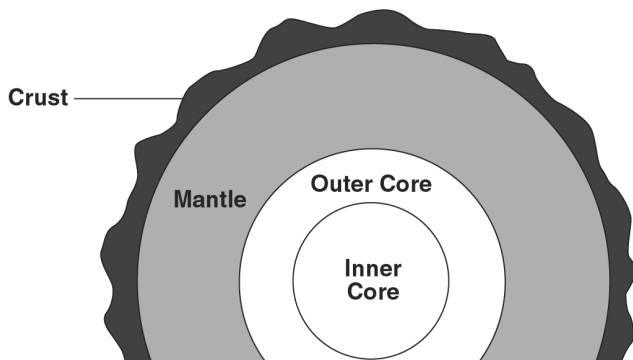
## 6-5 What causes plate tectonics?

### Lesson Review

**PART A** Write the letter of the term that best completes each statement in the spaces provided.

- \_\_\_\_\_ 1. A convection current is caused by differences in  
**a.** temperature. **b.** air pressure. **c.** mass. **d.** color.
- \_\_\_\_\_ 2. Scientists think that the movement of tectonic plates is caused by  
**a.** conveyor belts **b.** heat in Earth's core.  
**c.** pressure in Earth's crust. **d.** convection currents.
- \_\_\_\_\_ 3. Tectonic plates that move apart most likely are located along  
**a.** mountains. **b.** continents. **c.** islands. **d.** rift valleys.
- \_\_\_\_\_ 4. In Earth, hot melted rock rises from near the  
**a.** core. **b.** crust. **c.** inner core. **d.** mantle.

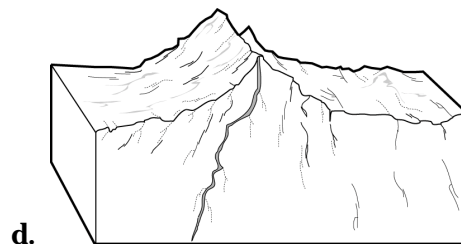
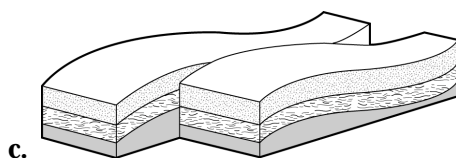
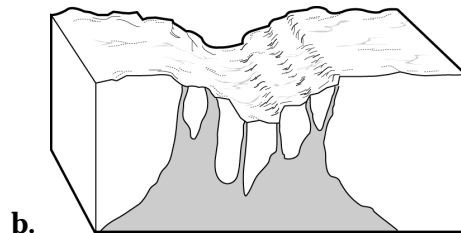
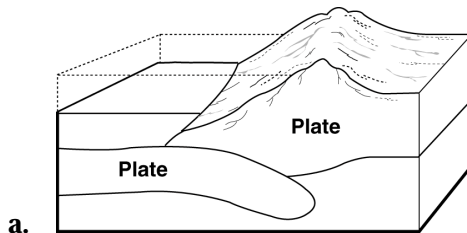
**PART B** Draw arrows on each diagram to show a convection current. Use red arrows for hot and blue arrows for cool.



### Skill Challenge

**Skills:** modeling, analyzing

On each diagram below, draw arrows to show the different ways in which tectonic plates move.



## 6-6 What are some effects of plate tectonics?

### Lesson Review

**PART A** Complete the following.

1. What is the name of the large fault in California? \_\_\_\_\_
2. What is a hot spot? \_\_\_\_\_
3. What is a magma chamber? \_\_\_\_\_
4. Name three features on Earth's surface that can be formed by plate tectonics activity. \_\_\_\_\_  
\_\_\_\_\_

**PART B** Match the event or feature of Earth to what caused it.

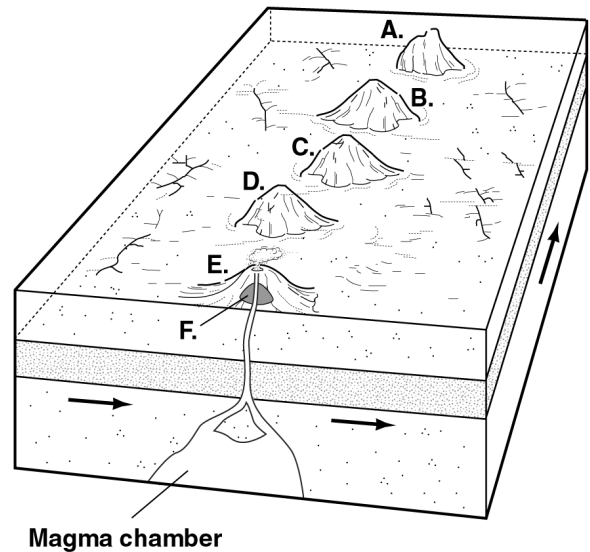
- |   |                                     |
|---|-------------------------------------|
| _____ 1. two tectonic plates sliding past each other            | a. eruption of Mount St. Helens     |
| _____ 2. two tectonic plates carrying continents colliding      | b. San Francisco earthquake of 1906 |
| _____ 3. underground magma chambers forming at subduction zones | c. the Hawaiian Islands             |
| _____ 4. hot spots forming in a tectonic plate                  | d. the Himalayas                    |

### Skill Challenge

**Skills:** modeling, analyzing, inferring

Study the diagram. Then, answer the questions that follow.

1. At what point is the hot spot located? \_\_\_\_\_  
\_\_\_\_\_
2. Which volcano is oldest—A, B, C, D, or E?  
\_\_\_\_\_
3. a. Which volcano is active? \_\_\_\_\_  
b. Which volcanoes are inactive? \_\_\_\_\_
4. Label the location where rocks in the crust melt.





# Plate Tectonics and Earthquakes

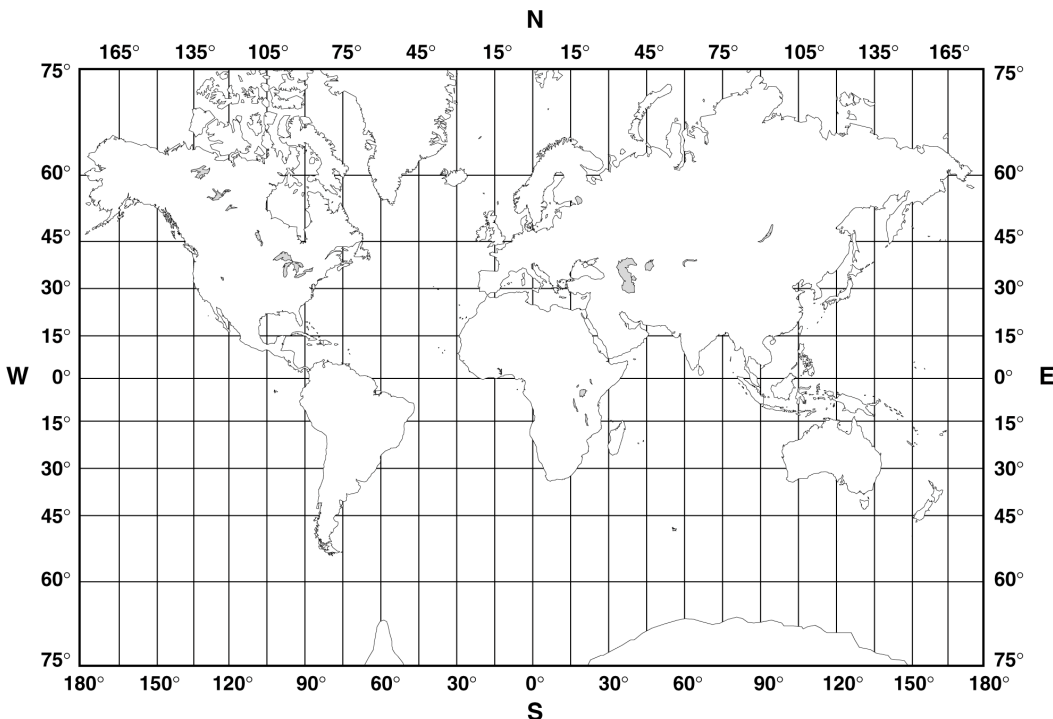
## Enrichment Activity for Lessons 6-4 to 6-6

**Skills:** researching, identifying, interpreting

**PART A** The movement of tectonic plates along boundaries can cause earthquakes. Using reference materials, find ten places in which earthquakes have occurred during the past 25 years. Fill in the latitude and longitude of each location in the table below.

EARTHQUAKE LOCATIONS			
Earthquake	Latitude	Longitude	Tectonic Plates
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

**PART B** Plot each of the earthquakes listed in your table on the world map below. Determine which tectonic plates moved to cause the earthquake. (*Hint:* Review the map on page 144 of your text showing Earth's tectonic plates.) Fill in the tectonic plates in the above table.



THE **Big** IDEA

*Integrating Geography*

**Chapter 6 How does plate tectonics affect countries around the world?**

**Lesson Review**

Refer to the article, call outs, and map on pages 152 and 153 of your text to answer the following questions.

1. What kind of boundaries surround the Caribbean plate? \_\_\_\_\_
2. The Great Rift Valley is on what kind of boundary? \_\_\_\_\_
3. Which kind of boundary is closest to the Alps? \_\_\_\_\_

**Skill Challenge**

**Skills:** *inferring, synthesizing*

Complete the following.

1. The island of Surtsey in Iceland was formed by plate tectonics. How did plate tectonics create this island? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
2. If a geographer were studying the San Andreas fault, what might he or she say about the ways of the people living near the fault? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
3. Plate movements have brought dramatic changes to the land and seafloor over the Earth's lifetime. Name some of these changes and how they affect our lives. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Science Log Writing Activity**

Complete the Science Log on a separate sheet of paper. To complete the Big Idea Online, go to [www.conceptsandchallenges.com](http://www.conceptsandchallenges.com). Follow the online instructions.

## Chapter 6 Key Term Review

In the spaces provided, write the term that best fits each description. Unscramble the letters in brackets [ \_\_\_ ] to spell a feature of Earth's surface. Write the name of the feature in the space provided at the bottom of the page. Then, describe the feature in one or two sentences.

1. Deep crack in the Mid-Atlantic Ridge \_\_\_\_\_ [ \_\_\_ ] \_\_\_\_\_
2. Underground pocket of molten rock \_\_\_\_\_ [ \_\_\_ ] \_\_\_\_\_
3. Process that forms new ocean floor \_\_\_\_\_ [ \_\_\_ ] \_\_\_\_\_  
[ \_\_\_ ] \_\_\_\_\_
4. Theory that Earth's landmasses were once a single landmass that broke apart and eventually moved into the positions they are in today \_\_\_\_\_ [ \_\_\_ ] \_\_\_\_\_
5. Theory that Earth's crust is broken into plates that float on the upper part of the mantle  
\_\_\_\_\_ [ \_\_\_ ] \_\_\_\_\_ [ \_\_\_ ] \_\_\_\_\_
6. A place where two plates meet \_\_\_\_\_ [ \_\_\_ ] \_\_\_\_\_
7. Deep canyon on the ocean floor \_\_\_ [ \_\_\_ ] \_\_\_\_\_
8. Place where old crust is pushed down into a trench \_\_\_\_\_ [ \_\_\_ ] \_\_\_\_\_ [ \_\_\_ ] \_\_\_\_\_
9. Large piece of the solid part of Earth \_\_\_\_\_ [ \_\_\_ ] \_\_\_\_\_
10. Place where magma reaches the surface within a tectonic plate \_\_\_\_\_ [ \_\_\_ ] \_\_\_\_\_
11. Giant landmass from which today's continents were formed \_\_\_\_\_ [ \_\_\_ ] \_\_\_\_\_
12. Movement of a gas or liquid caused by changes in temperature  
\_\_\_\_\_ [ \_\_\_ ] \_\_\_\_\_
13. Underwater mountain chain \_\_\_\_\_ - \_\_\_\_\_ [ \_\_\_ ] \_\_\_\_\_

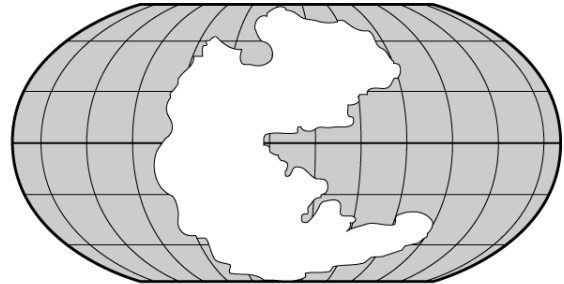
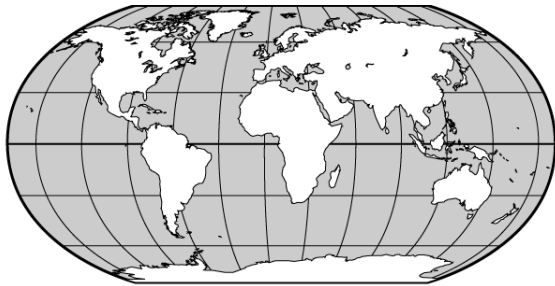
**Topic:** \_\_\_\_\_

**Explanation:** \_\_\_\_\_

\_\_\_\_\_

# Chapter 6 Test

**Interpreting Maps** Use the maps to answer the following questions.



1. What does the map on the left show? \_\_\_\_\_
2. What is the name of the giant landmass shown on the map on the right? \_\_\_\_\_
3. Who first stated the theory of continental drift? \_\_\_\_\_
4. What does the theory of continental drift state? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
5. What evidence shown on the map on the left is used to support the theory of continental drift?  
\_\_\_\_\_
6. How many continents are there on Earth today? \_\_\_\_\_

**Multiple Choice** Write the letter of the term or phrase that best completes each statement in the space provided.

- \_\_\_\_\_ 1. Earth's large landmasses are  
a. mountains. b. plains. c. continents. d. trenches.
- \_\_\_\_\_ 2. The fossil animal that is used to support the idea of continental drift is  
a. Pangaea. b. *Mesosaurus* c. Gondwana. d. Tethys.
- \_\_\_\_\_ 3. The crust that makes up the ocean floor is the  
a. continental crust. b. mid-ocean ridge. c. oceanic crust. d. seafloor crust.
- \_\_\_\_\_ 4. New seafloor is formed by  
a. subduction. b. convection. c. ridging. d. seafloor spreading.
- \_\_\_\_\_ 5. Underwater mountain ranges are called  
a. subduction zones. b. trenches. c. mid-ocean ridges. d. rift valleys.

## Chapter 6 Test *(continued)*

- \_\_\_\_\_ 6. The deep crack running down the center of the Mid-Atlantic Ridge is a  
a. subduction zone.   b. trench.   c. vent.   d. rift valley.
- \_\_\_\_\_ 7. A deep canyon on the ocean floor is a  
a. subduction zone.   b. trench.   c. vent.   d. rift valley.
- \_\_\_\_\_ 8. The place in which old crust is pushed down into a trench is a  
a. subduction zone.   b. rift valley.   c. vent.   d. magma chamber.
- \_\_\_\_\_ 9. Scientists estimate that Earth's age is about  
a. 150 million years.   b. 4.6 million years.   c. 4.6 billion years.   d. 10 million years.
- \_\_\_\_\_ 10. The oldest rocks found on the ocean floor are about  
a. 160 million years old.   c. 4.6 billion years old.  
b. 4.6 million years old.   d. 10 million years old.
- \_\_\_\_\_ 11. Many trenches are located along the  
a. coast of Iceland.   b. Ring of Fire.   c. Atlantic coast.   d. San Andreas Fault.
- \_\_\_\_\_ 12. Scientists use the magnetic properties of some minerals as evidence of  
a. continental drift.   b. seafloor spreading   c. plate tectonics.   d. Pangaea.
- \_\_\_\_\_ 13. The idea that Earth's crust is made up of separate plates that float on the upper mantle is the theory of  
a. plate tectonics.   b. continental drift.  
c. seafloor spreading.   d. tectonic movement.
- \_\_\_\_\_ 14. Scientists have identified about  
a. 7 tectonic plates.   b. 13 tectonic plates.   c. 21 tectonic plates.   d. 50 tectonic plates.
- \_\_\_\_\_ 15. The movement of a gas or liquid caused by differences in temperature is a  
a. magma chamber.   b. tectonic movement.   c. plate tectonic.   d. convection current.
- \_\_\_\_\_ 16. Two plates move toward each other at a  
a. transform boundary.   b. divergent boundary.  
c. convergent boundary.   d. rift valley.
- \_\_\_\_\_ 17. Features formed at divergent boundaries are  
a. rift valleys.   b. subduction zones.   c. mountain ranges.   d. magma chambers.
- \_\_\_\_\_ 18. Scientists think that the movement of Earth's tectonic plates are caused by convection currents in the  
a. oceans.   b. crust.   c. core.   d. mantle.
- \_\_\_\_\_ 19. The movement of tectonic plates at a fault is a cause of  
a. mountains.   b. earthquakes.   c. volcanoes.   d. hot spots.
- \_\_\_\_\_ 20. The Hawaiian Islands formed when the Pacific plate moved over  
a. a mountain.   b. an earthquake.   c. a fault.   d. a hot spot.

## Chapter 6 Test *(continued)*

**Written Response** Answer the following questions in complete sentences.

**21. EXPLAIN:** How do fossils help support the theory of continental drift? \_\_\_\_\_

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**22. COMPARE:** What is the difference between a convergent boundary between an oceanic plate and a continental plate and a convergent boundary between two continental plates? \_\_\_\_\_

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# Answer Key

## CHAPTER 6: PLATE TECTONICS

### 6-1 What is continental drift?

#### Lesson Review

##### PART A

1. Possible answer: a theory suggesting that there was once only one large landmass that, over time, broke apart into seven continents and spread out to new locations 2. a German scientist who first stated the idea of continental drift

##### PART B

Students should place check marks beside statements 3, 5, 6, and 8.

#### Skill Challenge

1. 100 million years ago 2. 225 million years ago  
3. 50 million years ago 4. present 5. 180 million years ago

### 6-2 Why is the seafloor spreading?

#### Lesson Review

1. continental crust 2. true 3. Mid-Atlantic Ridge  
4. younger 5. rift 6. oceanic 7. true

#### Skill Challenge

1. a. Iceland b. Mid-Atlantic Ridge c. oceanic crust  
2. Check students' drawings. 3. Drawings should show arrows pointing in opposite directions in the ocean crust on each side of the mid-ocean ridge.

### 6-3 What evidence supports seafloor spreading?

#### Lesson Review

##### PART A

1. b 2. a, b. 3. c

##### PART B

1. As new seafloor is formed at mid-ocean ridges, the old seafloor is pushed down into trenches at subduction zones. 2. The pattern of the changes in Earth's magnetic field is locked into the rocks on the seafloor. The pattern is the same on each side of the mid-ocean ridge.

#### Skill Challenge

**Diagram A:** Check students' drawings to be sure that the arrow they have drawn shows ocean crust being subducted beneath the continent

### 6-3 What evidence supports seafloor spreading? (continued)

**Diagram B:** Check students' drawings to be sure that magnetic stripes are mirror images on either side of the mid-ocean ridge. Arrows should be vertical and point in opposite directions. Arrows showing seafloor spreading should be horizontal and point away from the trench on either side.

### 6-3 What evidence supports seafloor spreading?

#### Enrichment Activity: Seafloor Spreading

1. 45 million years 2. 30 million years 3. 1,150 km  
4. As age increases, distance from the mid-ocean ridge increases. 5. New ocean floor is constantly being formed at the mid-ocean ridge. 6. Below the mid-ocean ridges, magma rises through the crust. As the magma cools, it forms new crust on both sides of a rift. The new crust pushes the seafloor apart at the ridges. 7. Rocks found 1,300 km from the mid-ocean ridge are about 90 million years old. Rocks found farther away would be older.

### 6-4 What is plate tectonics?

#### Lesson Review

##### PART A

1. large solid pieces of Earth's lithosphere 2. 21  
3. athenosphere 4. The theory states that Earth's lithosphere is broken into plates that float on the upper part of the mantle.

##### PART B

1. C 2. C, S 3. S 4. C, S 5. S

#### Skill Challenge

Students should place a check mark next to letter b. Accept all logical explanations based upon the theory of plate tectonics. The blocks represent part of Earth's crust and mantle floating on a part of the mantle that is like a liquid.

# Answer Key

## 6-5 What causes plate tectonics?

### Lesson Review

#### PART A

1. a 2. d 3. d 4. a

#### PART B

Check students' drawings for correct placement of arrows. Red should be used for rising currents, and blue should be used for sinking currents.

#### Skill Challenge

Check students' drawings for correct placement of arrows. a. Subducting plate moves right and down; Continental plate moves left. b. Plates move apart. c. Front plate slides right; Rear plate moves left. d. Plates move toward each other.

## 6-6 What are some effects of plate tectonics?

### Lesson Review

#### PART A

1. San Andreas Fault 2. place where magma moves to the surface within a tectonic plate  
3. underground pocket of molten rock 4. islands, mountains, and volcanoes

#### PART B

1. b 2. d 3. a 4. c

#### Skill Challenge

1. F 2. A 3. a. E b. A, B, C, D 4. Check students' label to make sure the arrow points to the hot spot at the surface, point F.

## 6-6 What are some effects of plate tectonics?

### Enrichment Activity: Plate Tectonics and Earthquakes

#### PART A

Answers will vary, depending on the earthquakes chosen.

#### PART B

Answers will vary, depending on the earthquakes chosen.

## The Big Idea

### Lesson Review

1. transform and convergent 2. divergent  
3. convergent

#### Skill Challenge

1. The island was formed as the Eurasian plate drifted over a hot spot in which magma had worked its way to the surface. As the plate moved over the hot spot, new layers of volcanic mountains were built up, forming the island of Surtsey. 2. Possible answer: The people who live along the San Andreas Fault have grown accustomed to minor earthquakes that occur frequently in that region. Areas near the fault are well prepared to repair buildings and roads following a major earthquake. 3. Possible answers: Plate movements have caused major earthquakes which have resulted in death and widespread destruction of buildings and roads in some cases.

Two plates colliding have formed mountains which have changed weather patterns and altered the landscapes of the continents. Plate movements at subduction zones have caused volcanoes which have resulted in death and destruction of cities in some cases. Volcanoes have made the immediate areas around them uninhabitable. Plate movements have also caused the formation of islands which have provided inhabitable land.

## CHAPTER 6: PLATE TECTONICS

### Key Term Review

1. rift valley 2. magma chamber 3. seafloor spreading 4. continental drift 5. theory of plate tectonics 6. plate boundary 7. trench  
8. subduction zone 9. tectonic plate 10. hot spot  
11. Pangaea 12. convection current 13. mid-ocean ridge

**Topic:** continental crust

**Explanation:** Continental crust makes up Earth's continents. It is less dense than oceanic crust.



# Answer Key

## CHAPTER 6: PLATE TECTONICS

### Chapter Test

#### Interpreting Maps

1. Earth's landmasses as they appear today
2. Pangaea 3. Alfred Wegener 4. The continents were once part of a giant landmass that broke apart and drifted to their current positions. 5. The shapes of some continents seem to fit together like puzzle pieces. 6. seven

#### Multiple Choice

1. c 2. b 3. c 4. d 5. c 6. d 7. b 8. a 9. c 10. a
11. b 12. b 13. a 14. c 15. d 16. c 17. a 18. d
19. b 20. d

#### Written Response

21. The fact that fossils of the freshwater animal *Mesosaurus* have been found in Africa and South America suggests that at the time *Mesosaurus* lived, Africa and South America were joined as one landmass that later drifted apart.
22. At a convergent boundary between an oceanic plate and a continental plate, a subduction zone occurs because the denser oceanic crust slides under the continental crust. At a convergent boundary between two continental plates, the plates crumple upward and mountains are sometimes formed.