Glencoe Science

Chapter Resources

Plate Tectonics

Includes:

Reproducible Student Pages

ASSESSMENT

- ✔ Chapter Tests
- ✔ Chapter Review

HANDS-ON ACTIVITIES

- ✔ Lab Worksheets for each Student Edition Activity
- ✔ Laboratory Activities
- ✔ Foldables–Reading and Study Skills activity sheet

MEETING INDIVIDUAL NEEDS

- ✔ Directed Reading for Content Mastery
- ✔ Directed Reading for Content Mastery in Spanish
- ✔ Reinforcement
- ✔ Enrichment
- ✔ Note-taking Worksheets

TRANSPARENCY ACTIVITIES

- ✔ Section Focus Transparency Activities
- ✔ Teaching Transparency Activity
- ✔ Assessment Transparency Activity

Teacher Support and Planning

- ✔ Content Outline for Teaching
- ✔ Spanish Resources
- ✔ Teacher Guide and Answers

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Additional Assessment Resources available with Glencoe Science:

- Exam*View*® Pro Testmaker
- Assessment Transparencies
- Performance Assessment in the Science Classroom
- Standardized Test Practice Booklet
- MindJogger Videoquizzes
- Vocabulary PuzzleMaker at **msscience.com**
- Interactive Chalkboard
- The Glencoe Science Web site at: **msscience.com**
- An interactive version of this textbook along with assessment resources are available online at: **mhln.com**

To the Teacher

This chapter-based booklet contains all of the resource materials to help you teach this chapter more effectively. Within you will find:

Reproducible pages for

- Student Assessment
- Hands-on Activities
- Meeting Individual Needs (Extension and Intervention)
- Transparency Activities

A teacher support and planning section including

- Content Outline of the chapter
- Spanish Resources
- Answers and teacher notes for the worksheets

Hands-On Activities

MiniLAB and Lab Worksheets: Each of these worksheets is an expanded version of each lab and MiniLAB found in the Student Edition. The materials lists, procedures, and questions are repeated so that students do not need their texts open during the lab. Write-on rules are included for any questions. Tables/charts/graphs are often included for students to record their observations. Additional lab preparation information is provided in the *Teacher Guide and Answers* section.

Laboratory Activities: These activities do not require elaborate supplies or extensive pre-lab preparations. These student-oriented labs are designed to explore science through a stimulating yet simple and relaxed approach to each topic. Helpful comments, suggestions, and answers to all questions are provided in the *Teacher Guide and Answers* section.

Foldables: At the beginning of each chapter there is a *Foldables: Reading & Study Skills* activity written by renowned educator, Dinah Zike, that provides students with a tool that they can make themselves to organize some of the information in the chapter. Students may make an organizational study fold, a cause and effect study fold, or a compare and contrast study fold, to name a few. The accompanying *Foldables* worksheet found in this resource booklet provides an additional resource to help students demonstrate their grasp of the concepts. The worksheet may contain titles, subtitles, text, or graphics students need to complete the study fold.

Meeting Individual Needs (Extension and Intervention)

Directed Reading for Content Mastery: These worksheets are designed to provide students with learning difficulties with an aid to learning and understanding the vocabulary and major concepts of each chapter. The *Content Mastery* worksheets contain a variety of formats to engage students as they master the basics of the chapter. Answers are provided in the *Teacher Guide and Answers* section.

Directed Reading for Content Mastery (in Spanish): A Spanish version of the *Directed Reading for Content Mastery* is provided for those Spanish-speaking students who are learning English.

Reinforcement: These worksheets provide an additional resource for reviewing the concepts of the chapter. There is one worksheet for each section, or lesson, of the chapter. The *Reinforcement* worksheets are designed to focus primarily on science content and less on vocabulary, although knowledge of the section vocabulary supports understanding of the content. The worksheets are designed for the full range of students; however, they will be more challenging for your lower-ability students. Answers are provided in the *Teacher Guide and Answers* section.

Enrichment: These worksheets are directed toward above-average students and allow them to explore further the information and concepts introduced in the section. A variety of formats are used for these worksheets: readings to analyze; problems to solve; diagrams to examine and analyze; or a simple activity or lab which students can complete in the classroom or at home. Answers are provided in the *Teacher Guide and Answers* section.

Note-taking Worksheet: The *Note-taking Worksheet* mirrors the content contained in the teacher version—*Content Outline for Teaching*. They can be used to allow students to take notes during class, as an additional review of the material in the chapter, or as study notes for students who have been absent.

Assessment

Chapter Review: These worksheets prepare students for the chapter test. The *Chapter Review* worksheets cover all major vocabulary, concepts, and objectives of the chapter. The first part is a vocabulary review and the second part is a concept review. Answers and objective correlations are provided in the *Teacher Guide and Answers* section.

Chapter Test: The *Chapter Test* requires students to use process skills and understand content. Although all questions involve memory to some degree, you will find that your students will need to discover relationships among facts and concepts in some questions, and to use higher levels of critical thinking to apply concepts in other questions. Each chapter test normally consists of four parts: Testing Concepts measures recall and recognition of vocabulary and facts in the chapter; Understanding Concepts requires interpreting information and more comprehension than recognition and recall—students will interpret basic information and demonstrate their ability to determine relationships among facts, generalizations, definitions, and skills; Applying Concepts calls for the highest level of comprehension and inference; Writing Skills requires students to define or describe concepts in multiple sentence answers. Answers and objective correlations are provided in the *Teacher Guide and Answers* section.

Transparency Activities

Section Focus Transparencies: These transparencies are designed to generate interest and focus students' attention on the topics presented in the sections and/or to assess prior knowledge. There is a transparency for each section, or lesson, in the Student Edition. The reproducible student masters are located in the *Transparency Activities* section. The teacher material, located in the *Teacher Guide and Answers* section, includes Transparency Teaching Tips, a Content Background section, and Answers for each transparency.

Teaching Transparencies: These transparencies relate to major concepts that will benefit from an extra visual learning aid. Most of these transparencies contain diagrams/photos from the Student Edition. There is one *Teaching Transparency* for each chapter. The *Teaching Transparency Activity* includes a black-and-white reproducible master of the transparency accompanied by a student worksheet that reviews the concept shown in the transparency. These masters are found in the *Transparency Activities* section. The teacher material includes Transparency Teaching Tips, a Reteaching Suggestion, Extensions, and Answers to Student Worksheet. This teacher material is located in the *Teacher Guide and Answers* section.

Assessment Transparencies: An *Assessment Transparency* extends the chapter content and gives students the opportunity to practice interpreting and analyzing data presented in charts, graphs, and tables. Test-taking tips that help prepare students for success on standardized tests and answers to questions on the transparencies are provided in the *Teacher Guide and Answers* section.

Teacher Support and Planning

Content Outline for Teaching: These pages provide a synopsis of the chapter by section, including suggested discussion questions. Also included are the terms that fill in the blanks in the students' *Note-taking Worksheets.*

Spanish Resources: A Spanish version of the following chapter features are included in this section: objectives, vocabulary words and definitions, a chapter purpose, the chapter Activities, and content overviews for each section of the chapter.

Reproducible Student Pages

Reproducible Student Pages

■ Hands-On Activities

■ Meeting Individual Needs

Extension and Intervention

■ Assessment

■ Transparency Activities

Hands-On Activities

TRY AT HOME Mini LAB

Interpreting Fossil Data

Procedure

1. Build a three-layer landmass using **clay** or **modeling dough**.
2. Mold the clay into mountain ranges.
3. Place similar "**fossils**" into the clay at various locations around the landmass.
4. Form five continents from the one landmass. Also, form two smaller landmasses out of different clay with different mountain ranges and fossils.
5. Place the five continents and two smaller landmasses around the room.
6. Have someone who did not make or place the landmasses make a model that shows how they once were positioned.
7. Return the clay to its container so it can be used again.

Analysis

What clues were useful in reconstructing the original landmass?

Mini LAB

Modeling Convection Currents

Procedure

1. Pour **water** into a **clear, colorless casserole dish** until it is 5 cm from the top.
2. Center the dish on a **hot plate** and heat it.
   WARNING: *Wear **thermal mitts** to protect your hands.*
3. Add a few drops of **food coloring** to the water above the center of the hot plate.
4. Looking from the side of the dish, observe what happens in the water.
5. In the space below, illustrate your observations.

Analysis

1. Determine whether any currents form in the water.

_____

2. Infer what causes the currents to form.

_____

_____

Seafloor Spreading Rates

Lab Preview

Directions: *Answer these questions before you begin the Lab.*

1. Where can you find the data about each peak that you need for this lab?

2. What formula do you use to calculate the rate of movement in this lab?

How did scientists use their knowledge of seafloor spreading and magnetic field reversals to reconstruct Pangaea? Try this lab to see how you can determine where a continent may have been located in the past.

Real-World Question

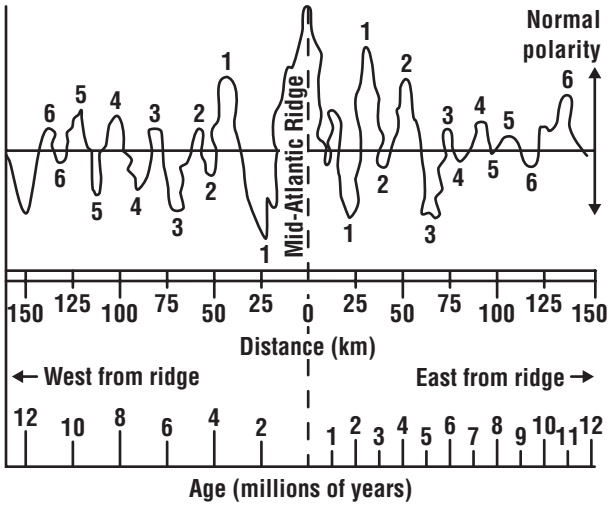
Can you use clues, such as magnetic field reversals on Earth, to help reconstruct Pangaea?

Materials

metric ruler pencil

Goals

- **Interpret** data about magnetic field reversals. Use these magnetic clues to reconstruct Pangaea.



Procedure

1. Study the magnetic field graph below. You will be working only with normal polarity readings, which are the peaks above the baseline in the top half of the graph.
2. Place the long edge of a ruler vertically on the graph. Slide the ruler so that it lines up with the center of peak 1 west of the Mid-Atlantic Ridge.
3. **Determine** and record the distance and age that line up with the center of peak 1 west. Repeat this process for peak 1 east of the ridge.
4. **Calculate** the average distance and age for this pair of peaks.
5. Repeat steps 2 through 4 for each remaining pair of normal-polarity peaks.
6. **Calculate** the rate of movement in cm per year for the six pairs of peaks. Use the formula rate = distance/time. Convert kilometers to centimeters. For example, to calculate a rate using normal-polarity peak 5, west of the ridge:

$$\text{rate} = \frac{125 \text{ km}}{10 \text{ million years}} = \frac{12.5 \text{ km}}{\text{million years}}$$

$$= \frac{1{,}250{,}000 \text{ cm}}{1{,}000{,}000 \text{ years}} = 1.25 \text{ cm/year}$$

LAB (continued)

Data and Observations

Peaks	Peak 1	Peak 2	Peak 3	Peak 4	Peak 5	Peak 6
Distance west normal polarity (km)						
Distance east normal polarity (km)						
Average distance (km)						
Average age from scale (millions of years)						
Rate of movement (cm/year)						

Conclude and Apply

1. **Compare** the age of igneous rock found near the mid-ocean ridge with that of igneous rock found farther away from the ridge.

2. If the distance from a point on the coast of Africa to the Mid-Atlantic Ridge is approximately 2,400 km, calculate how long ago that point in Africa was at or near the Mid-Atlantic Ridge.

3. How could you use this method to reconstruct Pangaea?

Use the Internet

Predicting Tectonic Activity

The movement of plates on Earth causes forces that build up energy in rocks. The release of this energy can produce vibrations in Earth that you know as earthquakes. Earthquakes occur every day. Many of them are too small to be felt by humans, but each event tells scientists something more about the planet. Active volcanoes can do the same, and volcanoes often form at plate boundaries.

Think about where earthquakes and volcanoes have occurred in the past. Make a hypothesis about whether the locations of earthquake epicenters and active volcanoes can be used to predict tectonically active areas.

Real-World Question

Can you predict tectonically active areas by plotting locations of earthquake epicenters and volcanic eruptions?

Goals

- **Research** the locations of earthquakes and volcanic eruptions around the world.
- **Plot** earthquake epicenters and the locations of volcanic eruptions obtained from **msscience.com** site.
- **Predict** locations that are tectonically active based on a plot of the locations of earthquake epicenters and active volcanoes.

Data Sources

Visit **msscience.com/internet_lab** for more information about earthquake and volcano sites and data from other students.

Make a Plan

1. Study the data table shown below. Use it to record your data.
2. Collect data for earthquake epicenters and volcanic eruptions for at least the past two weeks. Your data should include the longitude and latitude for each location. For help, refer to the data sources given above.

Locations of Epicenters and Eruptions

Earthquake Epicenter/Volcanic Eruption	Longitude	Latitude

LAB (continued)

Follow Your Plan

1. Make sure your teacher approves your plan before you start.
2. **Plot** the locations of earthquake epicenters and volcanic eruptions on a map of the world. Use an overlay of tissue paper or plastic.
3. After you have collected the necessary data, predict where the tectonically active areas on Earth are.
4. **Compare** and **contrast** the areas that you predicted to be tectonically active with the plate boundary map shown in **Figure 9** in your textbook.

Analyze Your Data

1. What areas on Earth do you predict to be the locations of tectonic activity?

2. How close did your prediction come to the actual location of tectonically active areas?

Conclude and Apply

1. How could you make your predictions closer to the locations of actual tectonic activity?

2. Would data from a longer period of time help? Explain.

3. What types of plate boundaries were close to your locations of earthquake epicenters? Volcanic eruptions?

4. **Explain** which types of plate boundaries produce volcanic eruptions. Be specific.

Communicating Your Data

Find this lab using the link below. Post your data in the table provided. **Compare** your data with those of other students. Combine your data with those of other students, and **plot** these combined data on map to **recognize** the relationship between plate coundaries, volcanic eruptions, and earthquake epicenters.

Science Online **msscience.com/internet_lab**

LAB 1 Laboratory Activity

Paleogeographic Mapping

Paleo- means old as in paleontology, the study of old life (fossils). *Geo-* means Earth, as in geology, the study of Earth. *Graphic* refers to a drawing or painting. Therefore, paleogeographic could be translated as "Old Earth Picture." Scientists often use fossil evidence to help them develop a picture of how Earth was long ago. By examining and dating rock formations and fossils of various plants and animals, scientists are able to formulate hypotheses about what Earth's surface might have looked like during a particular period in history. For example, similar rock formations and certain types of plant and animal fossils of a particular age could indicate whether two, now separate, land areas might have been connected during that period. Further analysis of the samples and data could also provide clues to the climate of that area or whether it was dry land or covered by an ocean. To classify events in the geologic past, scientists have divided the millions of years of Earth's history into segments, called *eras.* In this activity, you will examine evidence from the fossil record relative to a current map of an imaginary continent and develop a map of what the continent and the surrounding area might have looked like during the Mesozoic Era (248 million to 65 million years ago).

Strategy

You will determine how fossil evidence can be used to infer information about a continent during the geologic past.

You will interpret fossil evidence to draw a map showing how a continent appeared during the Mesozoic Era.

Materials

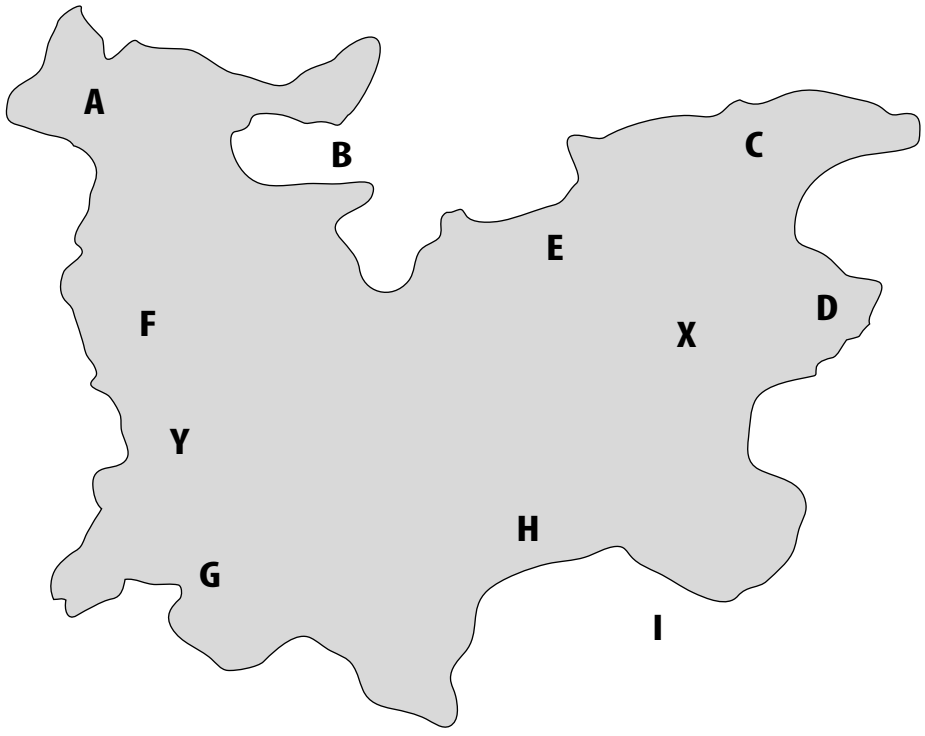
colored pencils or markers

Procedure

1. Figure 1 shows a map of a present-day imaginary continent. Locations *A* through *I* are places where fossils have been found in rocks dating to the Mesozoic Era. Study the map and look at the fossils key below the map.
2. From the locations of the different fossils, infer where the land areas were at the time the fossil organisms lived. Keep in mind that the way the modern continent looks may have no relationship to where the land/ocean boundaries were during the Mesozoic Era.
3. Use one color of pencil or marker to color in the land areas on the map in Figure 1. Fill in the block labeled Land with the same color. Use a different color of pencil or marker to color in the ocean areas on the map in Figure 1. Fill in the block labeled Ocean with this color.
4. In the space provided under Data and Observations, draw a map showing land and water areas during the Mesozoic Era. Use the color boundaries you added to Figure 1 as your guideline. Based on these boundaries, add all of the symbols from the map key in Figure 1 to your map.
5. Color all the areas around and between the labeled areas on your map as either land or ocean. Fill in the blocks labeled Land and Ocean with the colors you used.

Laboratory Activity 1 (continued)

Figure 1



Fossils found in Mesozoic rocks

A (shark teeth)
B (petrified wood)
C (sea stars)
D (leaf and fern imprints)
E (seashell fragments)
F (teeth/bones of small mammals)
G (dinosaur bones)
H (corals)
I (dinosaur footprints)
X, Y (Areas to be identified after completing your map)

Laboratory Activity 1 (continued)

Data and Observations

Mesozoic Map

❒ Land ❒ Ocean

Questions and Conclusions

1. According to your map, was location Y land or water during the Mesozoic Era? Explain how you decided.

2. According to your map, was location X land or water during the Mesozoic Era? Explain how you decided.

3. Compare your map with those of other students. Why do you think that not everyone agreed on whether location X was land or water? How could you find out which interpretation was correct?

Laboratory Activity 1 (continued)

4. Corals grow only in warm, shallow oceans near the coastlines of continents that are relatively near the equator. Would knowing this fact make you revise your map? Why or why not?

5. Suppose the modern continent shown in Figure 1 was located in an area that is extremely cold. Using the evidence you have, plus the information in Question 4, what could you infer about the continent?

Strategy Check

_____ Can you determine how fossil evidence can be used to infer information about a continent during the geologic past?

_____ Can you interpret fossil evidence to draw a map showing how a continent appeared during the Mesozoic Era?

LAB 2 Laboratory Activity

How do continental plates move?

One of the models that helps explain how tectonic plates move is the convection model. In this hypothesis, the molten magma of the mantle boils like water in a pot. The pattern of the moving water forms a circular wave or current as hot water rises to the top and cooler surface water is forced to the side of the pot and back down to be heated again. Inside the Earth it is believed there are many convection cells, or regions in the mantle, that boil like this. The different cells have their own currents and constantly move independently of one another. The crust of the Earth has a much lighter mass and density than the magma. As a result, the plates of crust are moved by convection currents and broken up on the boiling surface of the mantle.

Strategy

You will model convection currents and the movement of tectonic plates.
You will predict what will happen to tectonic plates at the margins of convection cells.

Materials

hot plate scissors tongs
water medium to large–mouthed pot
sheets of plastic foam wrap for padding packages (not made from corn or organic materials)

Procedure

1. The hot plates should be turned on high. Carefully fill the pot 2/3 full of water and place it on the hot plate. It will take a while for the water to boil.
2. Obtain a piece of flat plastic foam wrap. Use scissors to cut several shapes that represent tectonic plates. If you are working in a group you may mark your tectonic plates with a pencil or pen if you wish so that you can recognize it when the water boils.
3. Carefully place your pieces of foam on the surface of the water. If the water has any steam or tiny bubbles at the bottom of the pan, ask your teacher to place the foam in the pot for you.
4. As the water heats, watch the action of the bubbles as they rise from the bottom of the pot. Observe everything you can about what happens to them when they rise under a piece of foam. Record your observation in the table provided.
5. Once the water begins to boil, watch your pieces of foam. How do they move? In what direction do they go? Do they stay in one place in the pot or do they move ? Do they crash into other pieces of foam? Record the answers to these observations in the data table. Be sure to observe the boiling pot for a while. It may first seem there is no pattern to the action in the pot, but careful observation will reveal certain movements in the boiling water.

Figure 1

Laboratory Activity 2 (continued)

6. When the experiment is over, your teacher will turn off the hot plates and remove the foam with tongs for cooling. DO NOT remove the pieces yourself. They will cool quickly. When they are cooled, find your pieces and return to your lab station or seat.

7. In your data table write down any observed changes in your foam. Does it still have water in it? Have any of the corners been melted or damaged? Write down any other observations in your table.

Data and Observations

Action of bubbles	**1.**
Movement of foam pieces in boiling water	**2.**
Condition of foam after experiment	**3.**

Questions and Conclusions

1. How did you describe what happened to the bubbles as they gathered under the foam? What happened at the sides of the foam?

Laboratory Activity 2 (continued)

2. What type of natural feature is similar to the action of the bubbles? Explain your answer.

3. Describe the movement of the plastic pieces when the water started to boil. Could you see a pattern?

4. How does this experiment model the moving tectonic plates?

5. How is this experiment different from the real world in terms of tectonic plates? (Hint: What were your foam pieces like after the experiment?)

6. Predict what would happen if the convection currents of the molten magma changed direction or stopped altogether?

Strategy Check

_____ Can you model convection currents and the movement of tectonic plates?

_____ Can you predict what will happen to tectonic plates at the margins of convection cells?

Plate Tectonics

Directions: *Use this page to label your Foldable at the beginning of the chapter.*

Know

Like to know

Learned

Meeting Individual Needs

Directed Reading for Content Mastery

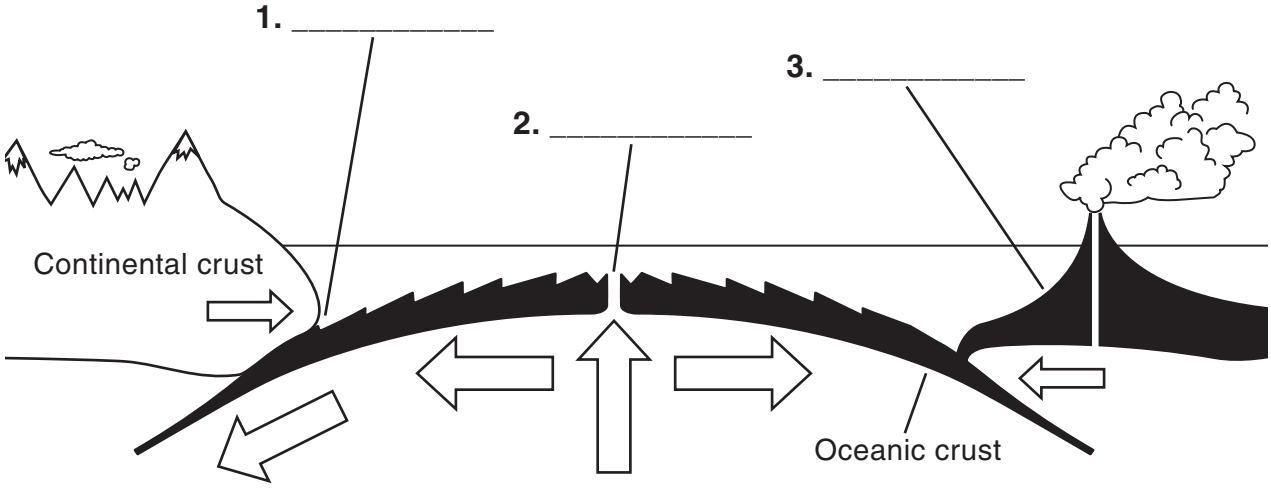
Overview Plate Tectonics

Directions: *Study the following diagram. Then label each part with the letter of the correct description below.*

A. A mid-ocean ridge forms whenever diverging plates continue to separate, creating a new ocean basin. As the rising magma cools, it forms new ocean crust.

B. When an oceanic plate converges with a less dense continental plate, the denser oceanic plate sinks under the continental plate.

C. When two oceanic plates converge, the denser plate is forced beneath the other plate and volcanic islands form above the sinking plate.



Directions: *Circle the words in parentheses that best complete the sentences below.*

4. (Fossils, Human bones), rocks, and climate provided Wegener with support for his continental drift theory.

5. The fact that the (youngest, oldest) rocks are located at the mid-ocean ridges is evidence for seafloor spreading.

6. The transfer of (solar, heat) energy inside Earth moves plates.

Name Date Class

Directed Reading for Content Mastery

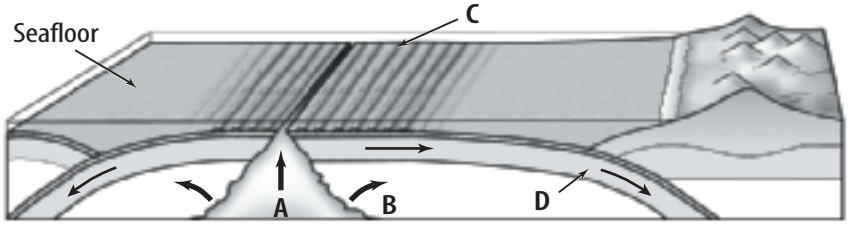
Section 1 ▪ Continental Drift
Section 2 ▪ Seafloor Spreading

Directions: *Complete the paragraph by filling in the blanks using the words below.*

Pangaea	**Arctic**	**rock**
continents	**Africa**	**seafloor spreading**

Alfred Wegener was one of the first people to suggest that all of the **1.** _____ were joined together in the past. He called the one large continent **2.** _____. Evidence exists to support his hypothesis. For example, similar fossils have been found in South America and **3.** _____. Also, fossils of warm weather plants have been found in the **4.** _____. Similar **5.** _____ structures exist in the Appalachian Mountains and in Greenland and western Europe. But until clues on the ocean floor led to Harry Hess's theory of **6.** _____, scientists could not think of how the continents might move.

Directions: *Study the following diagram of the seafloor. Then match the letters to the statements below.*



_____ **7.** Molten rock flows onto the seafloor and hardens as it cools.

_____ **8.** Hot, molten rock is forced upward toward the seafloor at a mid-ocean ridge.

_____ **9.** New seafloor moves away from the ridge, cools, becomes denser, and sinks.

_____ **10.** Molten rock pushes sideways in both directions as it rises, moving the mantle with it.

Meeting Individual Needs

Directed Reading for Content Mastery

Section 3 ▪ Theory of Plate Tectonics

Directions: *In the blank at the left, write the letter of the term that best completes the sentence.*

_____ **1.** Earth's crust and upper mantle are broken into sections called _____
a. lava. **b.** plates.

_____ **2.** The collision of one continental plate with another may produce _____
a. oceans. **b.** mountains.

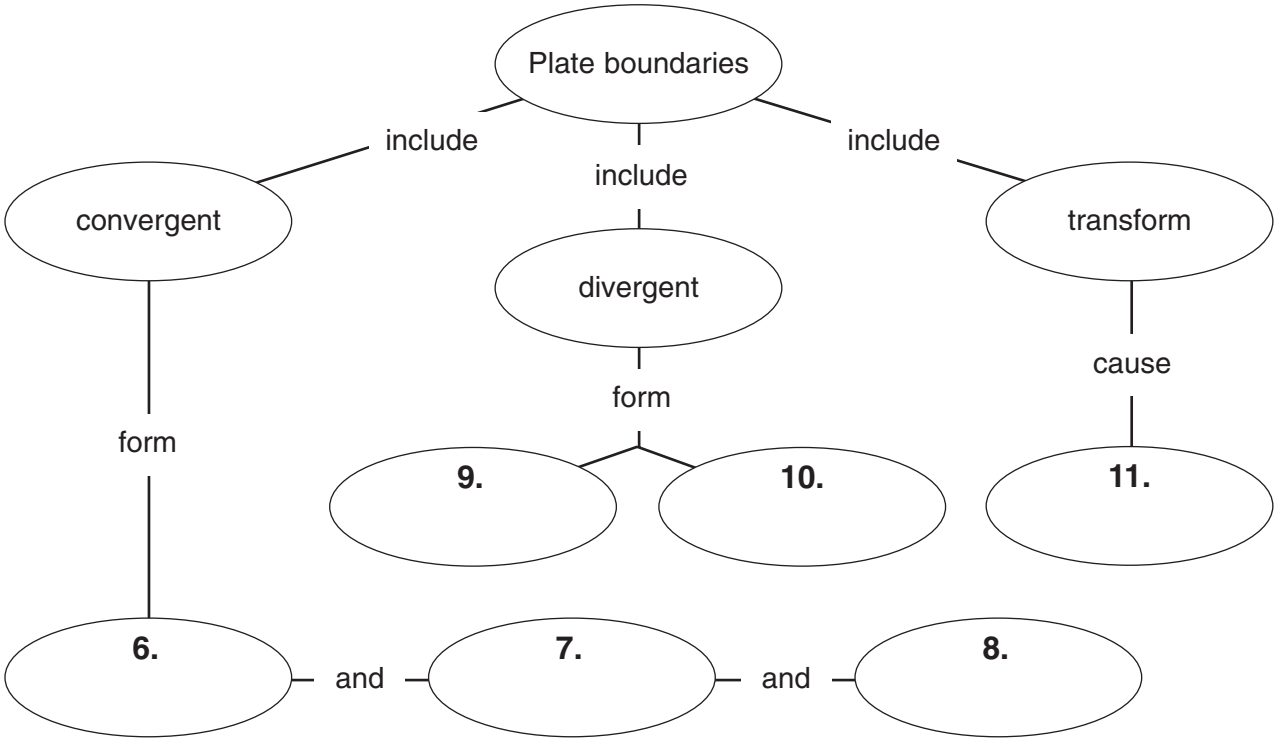
_____ **3.** New ocean crust is formed at a _____
a. rift valley. **b.** mid-ocean ridge.

_____ **4.** A rift valley can form where two continental plates are _____
a. moving apart. **b.** colliding.

_____ **5.** Where Earth's plates move, they may slide alongside one another, pull apart, or _____
a. collide. **b.** divide.

Directions: *Complete the concept map using the terms in the list below.*

mid-ocean ridges **volcanic islands** **major earthquakes**
rift valleys **deep-sea trenches** **volcanic mountains**



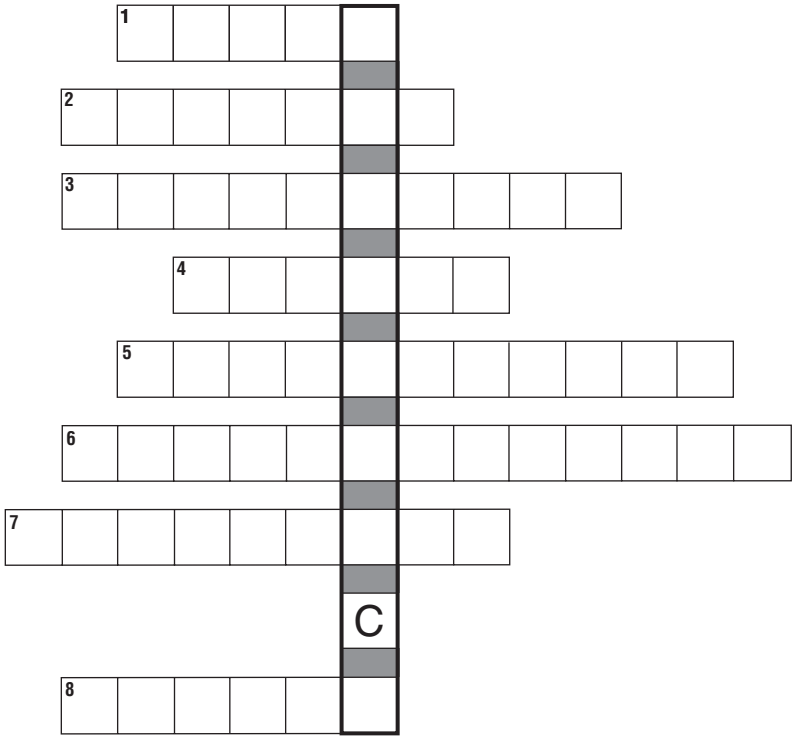
Meeting Individual Needs

Directed Reading for Content Mastery

Key Terms
Plate Tectonics

Directions: *Use the following terms to complete the puzzle below. The letters in the darker, vertical box complete question 9.*

Pangaea	**mantle**	**spreading**	**lithosphere**
convection	**plates**	**drift**	**asthenosphere**



1. The hypothesis that continents move slowly is called continental _____.
2. All continents once might have been connected in a large landmass called _____.
3. The cycle of heating, rising, cooling, and sinking is a _____ current.
4. Just below Earth's crust is the _____.
5. The crust and part of the upper mantle are known as the _____.
6. Continental plates move on the plasticlike layer of Earth's surface called the _____.
7. Hot magma forced upward at mid-ocean ridges produces seafloor _____.
8. Sections of Earth's crust and part of the upper mantle are called _____.
9. The theory that Earth's crust and upper mantle are in sections that move is called plate _____.

Lectura dirigida para Dominio del contenidio

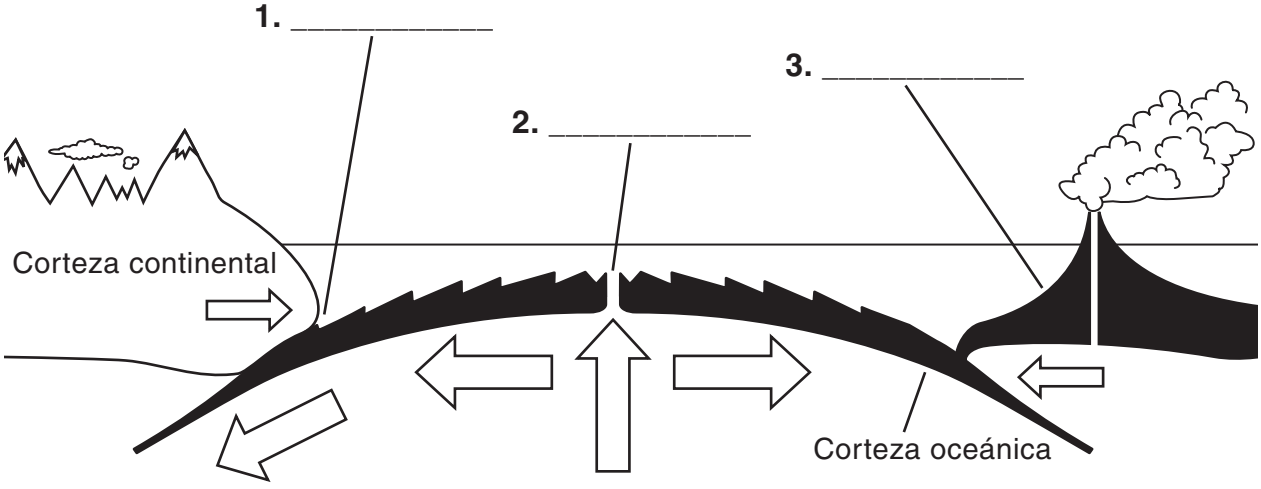
Sinopsis Tectónica de las placas

Instrucciones: *Estudia el siguiente diagrama. Luego rotula cada parte con la letra de la descripción correcta.*

A. Una dorsal mediooceánica se forma cuando las placas divergentes continúan separándose, creando una cuenca oceánica. A medida que se eleva y se enfría, el magma forma nueva corteza oceánica.

B. Cuando una placa oceánica converge con una placa continental menos densa, la placa oceánica más densa se hunde debajo de la placa continental.

C. Cuando dos placas oceánicas convergen, la placa más densa es forzada a moverse debajo de la otra placa y se forman islas volcánicas sobre la placa que se está hundiendo.



Instrucciones: *Haz un círculo alrededor de las palabras que mejor completan las siguientes oraciones.*

4. Las principales pruebas que Wegener usó para apoyar su teoría de la deriva continental fueron (las rocas, los lenguajes), (los huesos humanos, los fósiles) y (el clima, antiguos cuentos populares).

5. El hecho de que las rocas (más recientes, más antiguas) están ubicadas en las dorsales mediooceánicas es una prueba de la expansión del suelo marino.

6. La transferencia de energía (solar, térmica) dentro de la Tierra mueve las placas.

Satisface las necesidades individuales

Lectura dirigida para Dominio del contenidio

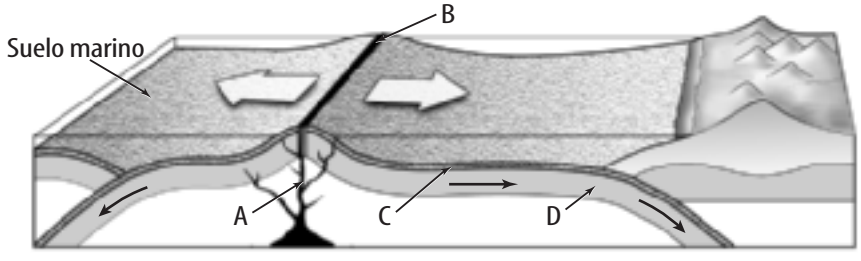
Sección 1 ▪ Deriva continental
Sección 2 ▪ Expansión del suelo marino

Instrucciones: *Completa el párrafo llenado los espacios en blanco con las siguientes palabras:*

Pangaea	**el Ártico**	**roca**
continentes	**África**	**expansión del suelo marino**

Alfred Wegener fue una de las primeras personas que sugirió que todos los **1.** _____ estuvieron unidos en el pasado. Él llamó a este gran continente único **2.** _____. Existen pruebas que apoyan su hipótesis. Por ejemplo, se han encontrado fósiles similares en Sudamérica y en **3.** _____. Además, se han encontrado fósiles de climas cálidos en **4.** _____. Existen estructuras de **5.** _____ que son similares en las montañas Apalaches y en Groenlandia y el oeste de Europa. Pero no fue sino hasta que pistas encontradas en el suelo marino llevaron a la teoría de Harry Hess de la **6.** _____, que los científicos pudieron pensar sobre cómo podrían moverse los continentes.

Instrucciones: *Estudia el siguiente diagrama del suelo marino. Aparea luego las letras con las afirmaciones de abajo.*



_____ **7.** La roca fundida fluye sobre el suelo marino y se endurece al enfriarse.

_____ **8.** La roca caliente y fundida es forzada hacia arriba hacia el suelo marino en las dorsales mediooceánicas.

_____ **9.** El nuevo suelo marino se aleja de la dorsal, se enfría, se hace más denso y se hunde.

_____ **10.** La roca fundida fluye hacia los lados en ambas direcciones, dividiendo la corteza.

Lectura dirigida para Dominio del contenidio

Sección 3 ▪ Teoría de la tectónica de placas

Instrucciones: *Escribe en el espacio a la izquierda, la letra del término que completa mejor cada oración.*

_____ **1.** La corteza y el manto superior de la Tierra están quebrados en secciones llamadas _____

a. lava. **b.** placas.

_____ **2.** La colisión de una placa continental con otra puede producir _____

a. océanos. **b.** montañas.

_____ **3.** Se forma corteza oceánica nueva en un(a) _____

a. valle de dislocación. **b.** dorsal mediooceánica.

_____ **4.** Un valle de dislocación se puede formar cuando dos placas continentales están _____

a. separándose. **b.** chocando.

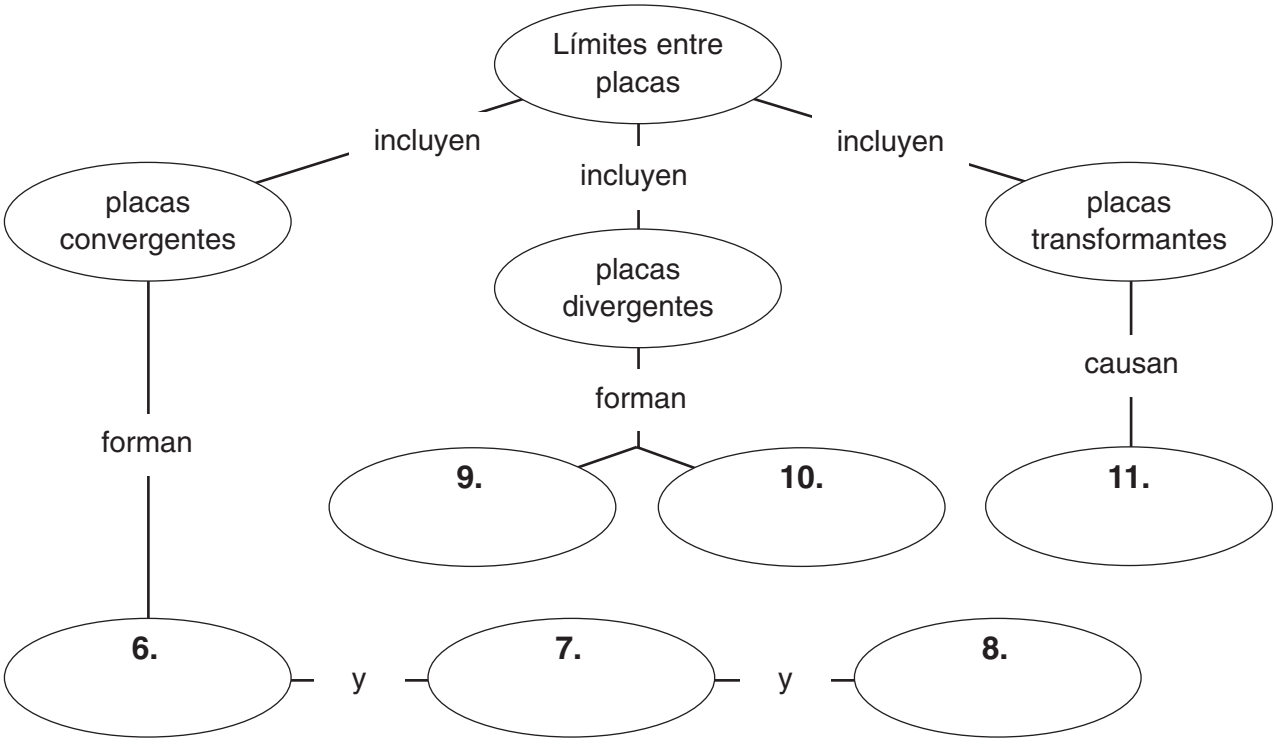
_____ **5.** En los sitios en donde las placas de la Tierra se mueven, éstas pueden deslizarse una al lado de la otra, separarse o _____

a. chocar. **b.** dividirse.

Instrucciones: *Completa el mapa conceptual con los siguientes términos.*

dorsales mediooceánicas **islas volcánicas** **terremotos fuertes**

valles de dislocación **fosas oceánicas** **montañas volcánicas**



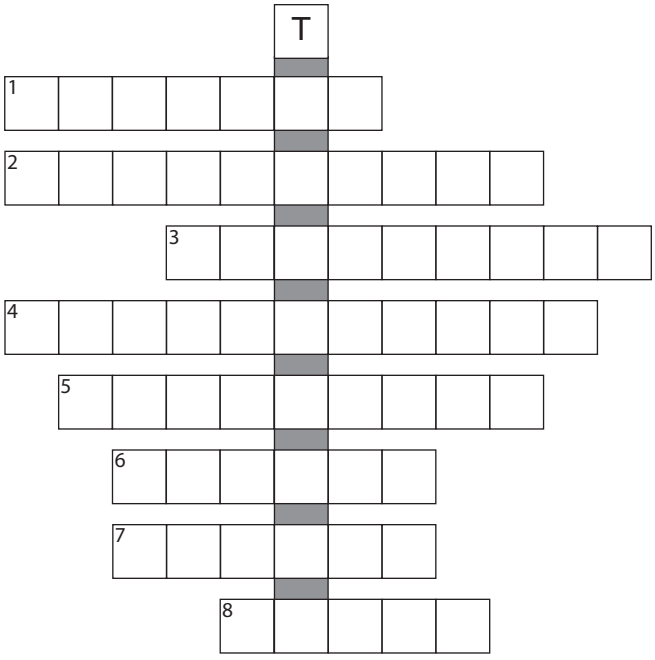
Satisface las necesidades individuales

Lectura dirigida para Dominio del contenidio

Términos claves
Tectónica de las placas

Instrucciones: *Usa los siguientes términos para completar el crucigrama. Las letras en la caja vertical oscura contestan la pregunta 9.*

Pangaea	**manto**	**expansión**	**litosfera**
convección	**placas**	**deriva**	**astenosfera**



1. Todos los continentes estuvieron conectados una vez formando una gran masa de tierra llamada _____.
2. Ciclo de calentamiento, elevación, enfriamiento y hundimiento se llama corriente de _____.
3. La corteza y la parte superior del manto se conocen como _____.
4. Las placas continentales se mueven sobre una capa viscosa bajo la superficie de Tierra llamada _____.
5. El magma caliente que sube en las dorsales mediooceánicas produce _____ del suelo marino.
6. La hipótesis de que los continentes se mueven lentamente se llama _____ continental.
7. Las secciones de la corteza y el manto superior de la Tierra se llaman _____.
8. Justo debajo de la corteza terrestre está ubicada la _____.
9. La teoría de que la corteza y el manto superior de la Tierra están divididos en secciones que se mueven se llama _____ de placas.

Satisface las necesidades individuales

Name Date Class

SECTION 1 Reinforcement

Continental Drift

Directions: *Match the descriptions in Column I with the terms in Column II. Write the letter of the correct term in the blank at the left.*

Column I	Column II
_____ **1.** reptile fossil found in South America and Africa	**a.** Pangaea
_____ **2.** fossil plant found in Africa, Australia, India, South America, and Antarctica	**b.** Appalachians
_____ **3.** clues that support continental drift	**c.** continental drift
_____ **4.** mountains similar to those in Greenland and western Europe	**d.** glacial deposits
_____ **5.** Wegener's name for one large landmass	**e.** *Glossopteris*
_____ **6.** slow movement of continents	**f.** *Mesosaurus*
_____ **7.** evidence that Africa was once cold	**g.** fossil, climate, and rock

Directions: *Answer the following questions on the lines provided.*

8. How did the discovery of *Glossopteris* support Wegener's continental drift hypothesis?

9. Why was Wegener's hypothesis of continental drift not widely accepted at the time it was proposed? What do scientists now think might be a possible cause of continental drift?

Meeting Individual Needs

Name Date Class

SECTION 2 Reinforcement

Seafloor Spreading

Directions: *Find the mistakes in the statements below. Rewrite each statement correctly on the lines provided.*

1. During the 1940s and 1950s, scientists began using radar on moving ships to map large areas of the ocean floor in detail.

2. The youngest rocks are found far from the mid-ocean ridges.

3. The scientist Henry Hess invented echo-sounding devices for mapping the ocean floor.

4. As the seafloor spreads apart, hot saltwater moves upward and flows from the cracks.

5. As the new seafloor moves away from the ridge and becomes hotter, it moves upward and forms still higher ridges.

6. The research ship *Glomar Challenger* was equipped with a drilling rig that records magnetic data.

7. Rocks on the seafloor are much older than many continental rocks.

8. When plates collide, the denser plate will ride over the less-dense plate.

9. Earth's magnetic field has always run from the north pole to the south pole.

10. The magnetic alignment in rocks on the ocean floor always runs from the north pole to the south pole.

Name Date Class

SECTION 3 Reinforcement

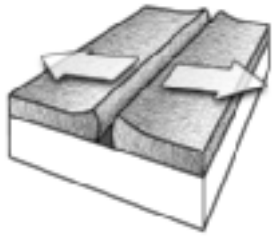
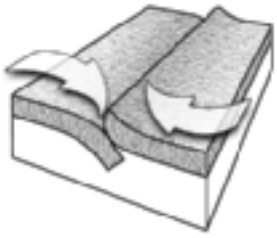
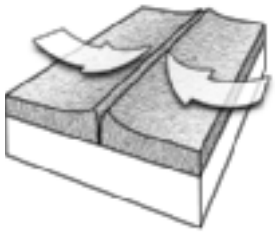
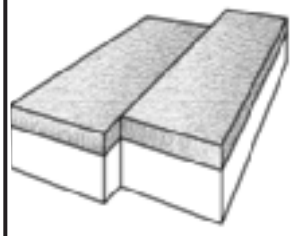
Theory of Plate Tectonics

Directions: *Use the following words to fill in the blanks below.*

asthenosphere **lithosphere** **plate tectonics**
convection **plates**

1. The theory of _____ states that Earth's crust and upper mantle are broken into sections.
2. These sections, called _____, are composed of the crust and a part of the upper mantle.
3. The crust and upper mantle together are called the _____.
4. Beneath this layer is the plasticlike _____.
5. Scientists suggest that differences in density cause hot, plasticlike rock to be forced upward toward the surface, cool, and sink. This cycle is called a _____ current.

Directions: *Four diagrams are shown in the table below. Label and describe each diagram in the space provided in order to complete the table.*

Diagram	Type of boundary and motion at boundary	Diagram	Type of boundary and motion at boundary
6. 		8. 	
7. 		9. 	

Meeting Individual Needs

SECTION 1 Enrichment

Studying Seafloor Spreading on Land

You know from your textbook how seafloor spreading changes the ocean floor. You know that magma rises at the mid-ocean ridge and flows away from the ridge. In general, this activity is hidden beneath the ocean's water. But there is a place where seafloor spreading can be seen on land.

Figure 1

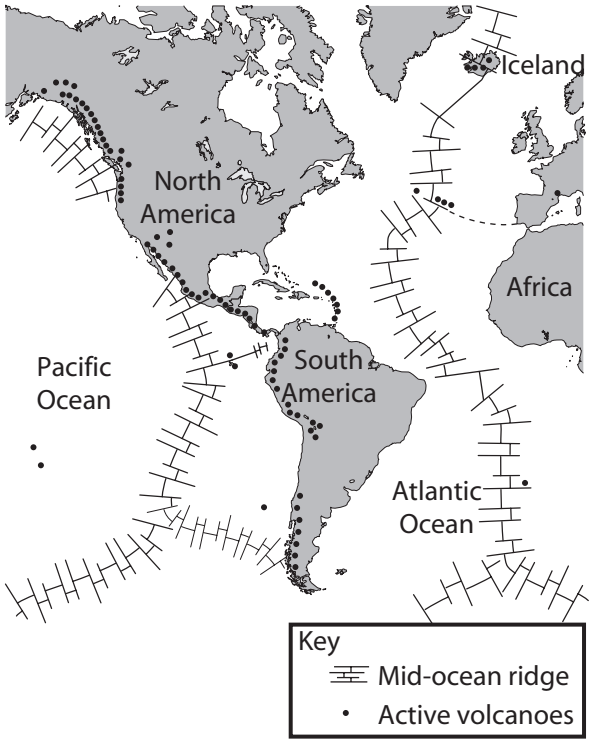
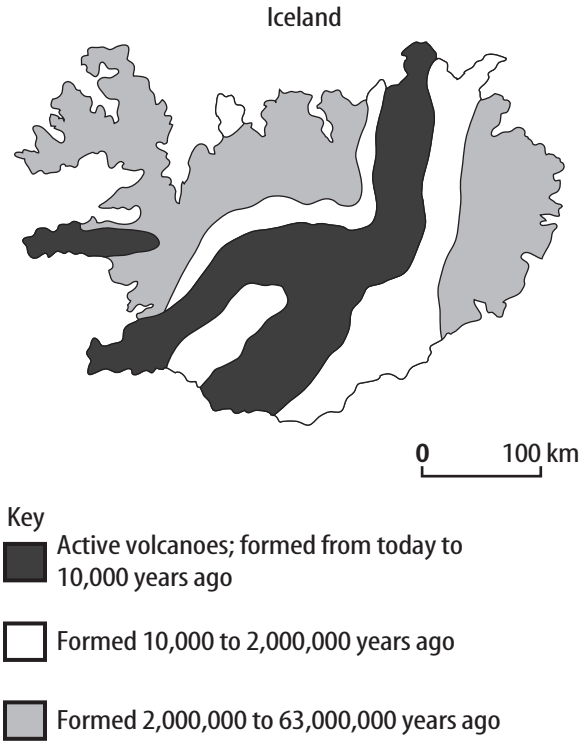


Figure 2



1. What is the name of the landmass through which the mid-ocean ridge in the Atlantic Ocean passes?

2. How do the land structures of Iceland help confirm seafloor spreading?

3. Why do you think geologists might find Iceland a useful place to conduct research on seafloor spreading?

Meeting Individual Needs

SECTION 2 Enrichment

Axial Volcano—Evidence for Seafloor Spreading

What happens when a volcano erupts under water? Ocean scientists got the opportunity to find out in January 1988 when Axial erupted. Axial is an underwater volcano, or seamount, located about 480 km west of Oregon's coast. It looms the largest of all the underwater structures on the Juan de Fuca ridge.

Quakes Along the Seafloor

Underwater listening instruments called hydrophones, which are used by the Navy to hear submarines, first picked up rumblings from Axial on January 25. Scientists recorded nearly 7,000 earthquakes during the first four days alone. Scientists hypothesized that these quakes resulted from hot magma moving and cracking rock, uncapping the top of Axial. The earthquakes followed a line in the seafloor where the Juan de Fuca oceanic plate is moving eastward, away from the Pacific oceanic plate. East of the shoreline, the Juan de Fuca plate is being pushed under the North American continental plate.

Creating New Seafloor

The scientists discovered that when Axial erupted, boiling-hot water shot up out of the volcano, followed by a great amount of superhot lava. Much of this lava filled part of the gap between the Pacific Ocean plate and the Juan de Fuca plate, creating new seafloor. Having lost so much magma, Axial caved in somewhat—by about 3.2 m in the center.

Megaplumes

Around the same time, another group of scientists was on a 52 m research ship, the *Wecoma,* on the ocean's surface about a mile above. They fought stormy conditions to gather data such as water temperature, water current flow, and samples of chemicals from the eruption. In 1986 scientists had learned that underwater volcanoes can cause underwater "hurricanes," called megaplumes, which shoot hot water loaded with minerals and lifeforms some 305 m up from the bottom. Only seven megaplumes in the world had been observed previously.

Hydrothermal Vents

At Axial's summit sits a rectangular caldera (roughly 20 km^2 in area) between two rift zones. In the dark caldera, hydrothermal vents furnish heat and "food" such as hydrogen sulfide—poisonous to most creatures—to communities of bacteria and tube worms comfortable in temperatures hotter than the boiling point of water.

Axial provides scientists with a model for the rest of Earth's 64,000 km or so of mid-ocean ridges. Various groups of scientists are conducting long-term studies of Axial and other areas along the Juan de Fuca ridge, focusing on various aspects of seafloor exploration.

1. Describe how seafloor spreading occurs along the Juan de Fuca ridge.

_____

_____

2. Using a physical map of Oregon, identify the geographical feature where the Juan de Fuca plate is pushing under the North American plate. _____

3. Do you think that the rocks near Axial are younger or older than the rocks in Oregon? Explain.

_____

_____

Meeting Individual Needs

Name Date Class

SECTION 3 Enrichment

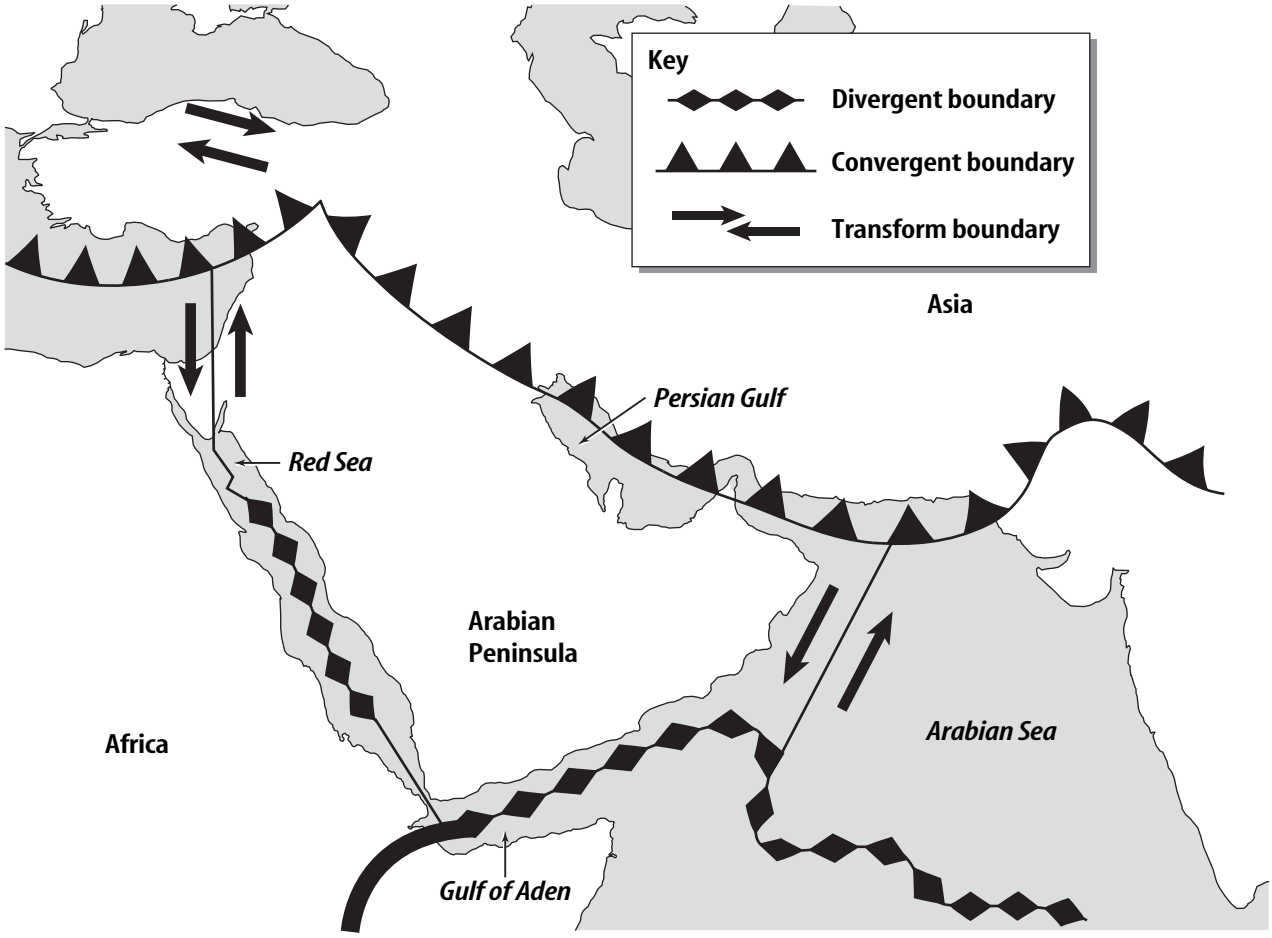
Predicting Plate Movement

The word tectonics comes from the same Greek base word as "architect." Both words refer to building. An architect designs structures. Tectonics is a process by which Earth's structures are built and changed.

1. Cut the map along the boundaries. Move the pieces to show how the plates will move in the next million years, according to the types of boundaries. Tape the pieces in place.
2. In which place(s) did you have to crumple your paper to account for the various plate movements?

3. Compare your new map with those of your classmates. Discuss similarities and account for any differences.

4. Research another area in the world where plates meet. Share your findings with the class.



Meeting Individual Needs

Name Date Class

Note-taking Worksheet

Plate Tectonics

Section 1 Continental Drift

A. The **continental drift** hypothesis—continents have moved slowly to their current locations.

1. All continents were once connected as one large landmass now called _____.

2. The land mass broke apart, and the _____ drifted to their present positions.

3. Evidence for continental drift

a. _____ fit of the continents

b. Similar _____ have been found on different continents.

c. Remains of warm-weather plants in _____ areas and glacial deposits in _____areas suggest that continents have moved.

d. Similar _____ structures are found on different continents.

B. At first, continental drift was not accepted because no one could explain _____ or _____continents had moved.

Section 2 Seafloor Spreading

A. Using _____ waves, scientists discovered a system of underwater mountain ranges called the mid-ocean ridges in many oceans.

B. In the 1960s, Harry Hess suggested the theory of _____ to explain the ridges.

1. Hot, less dense material below Earth's _____ rises upward to the surface at the mid-ocean ridges.

2. Then, it flows sideways, carrying the _____ away from the ridge.

3. As the seafloor spreads apart, _____ moves up and flows from the cracks, cools, and forms new seafloor.

C. Evidence for seafloor spreading

1. _____ rocks are located at mid-ocean ridges.

2. Reversals of Earth's _____ field are recorded by rocks in strips parallel to ridges.

Meeting Individual Needs

Note-taking Worksheet (continued)

Section 3 Theory of Plate Tectonics

A. Plate movements

1. Earth's _____ and upper mantle are broken into sections.

2. The sections, called _____, move on a plasticlike layer of the mantle.

3. The plates and upper mantle form the _____.

4. The plasticlike layer below the lithosphere is called the _____.

B. Plate boundaries

1. Plates moving _____—divergent boundaries

2. Plates moving _____—convergent boundaries

a. Denser plates sink under less _____ plates.

b. Newly formed hot _____ forced upward forms volcanic mountains.

3. Plates collide

a. Plates crumple up to form _____ ranges.

b. _____ are common.

4. Plates slide past—called _____ boundaries; sudden movement can cause earthquakes

C. Convection inside Earth—the cycle of heating, rising, cooling, and sinking of material inside Earth is thought to be the _____ behind plate tectonics.

D. Features caused by plate tectonics

1. Faults and _____ valleys

2. Mountains and _____

3. Strike-slip faults—cause of _____

E. Testing for plate tectonics—scientists can measure _____ as little as 1 cm per year.

Assessment

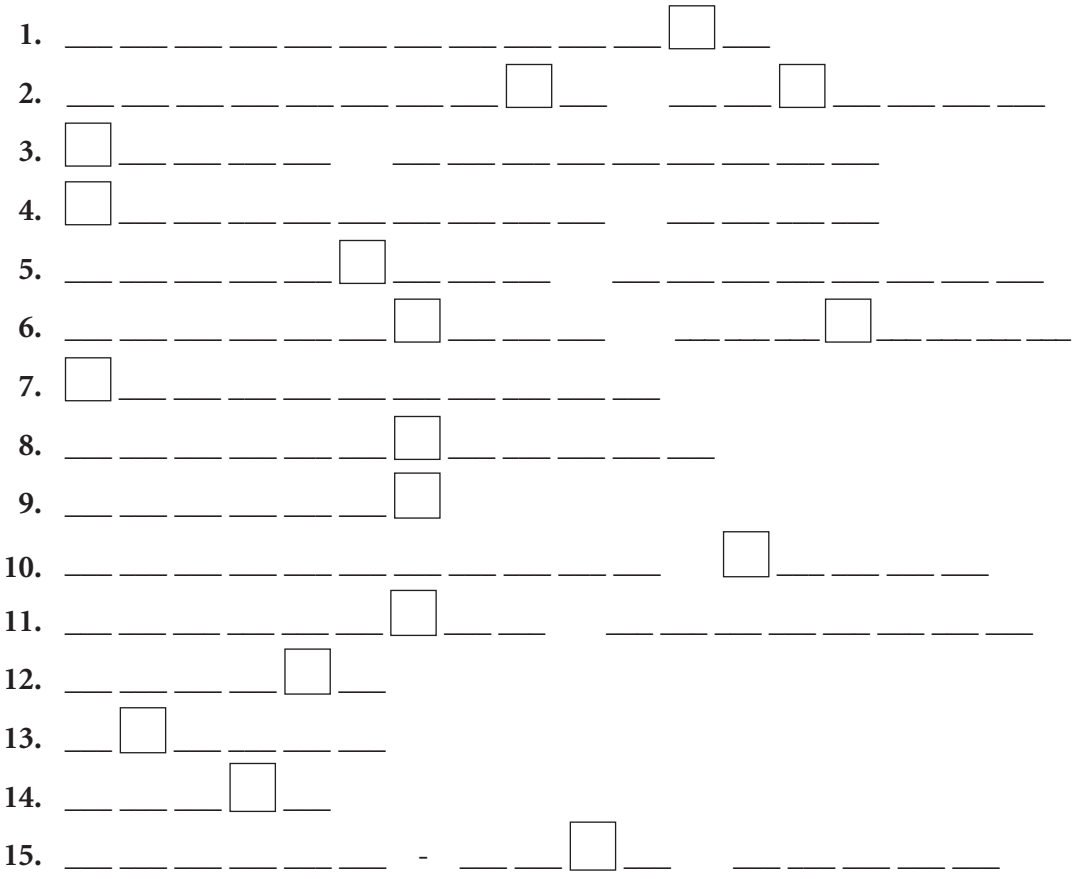
Name Date Class

Chapter Review

Plate Tectonics

Part A. Vocabulary Review

Directions: *Write the term that matches each description below in the spaces provided. Then unscramble the letters in the boxes to reveal the mystery phrase.*



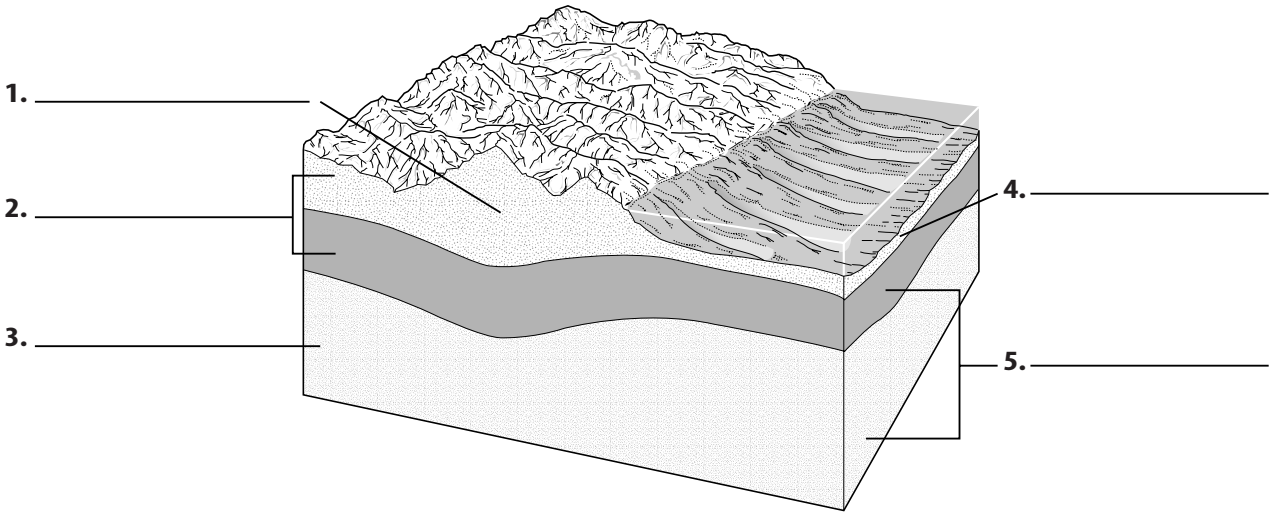
1. plasticlike layer of Earth's surface below the lithosphere
2. cycle of heating, rising, cooling, and sinking
3. theory that states that Earth's crust and upper mantle are broken into sections, which move around on a special layer of the mantle
4. area where an oceanic plate goes down into the mantle
5. plate boundary that occurs when two plates slide past one another
6. place where two plates move together
7. rigid layer of Earth's surface made up of the crust and a part of the upper mantle
8. sensing device that detects magnetic fields, helping to confirm seafloor spreading
9. one large landmass hypothesized to have broken apart about 200 million years ago into continents
10. hypothesis that the continents have moved slowly to their current locations
11. boundary between two plates that are moving apart
12. sections of Earth's crust and upper mantle
13. largest layer of Earth's surface, composed mostly of silicon, oxygen, magnesium, and iron
14. outermost layer of Earth's surface
15. where rocks on opposite sides of a fault move in opposite directions or in the same direction at different rates
16. Mystery phrase:

_____

Chapter Review (continued)

Part B. Concept Review

Directions: *Study the following diagram. Then label the parts of Earth's surface.*



Directions: *Answer the following questions using complete sentences.*

6. Compare and contrast divergent, convergent, and transform plate boundaries.

7. Describe how convection currents might be the cause of plate tectonics.

8. Why are new ideas often rejected, and what is needed before new ideas should be accepted?

Name Date Class

Chapter Test

Plate Tectonics

I. Testing Concepts

Directions: *For each of the following, write the letter of the term or phrase that best completes the sentence.*

_____ **1.** The seafloor spreading theory was proposed by _____
a. Alfred Wegener. **c.** Abraham Ortelius.
b. Harry Hess. **d.** Carl Sagan.

_____ **2.** As Earth's plates move apart at some boundaries, they collide at others, forming _____
a. mountains and volcanoes. **c.** strike-slip faults.
b. ocean basins. **d.** both a and b.

_____ **3.** The youngest rocks in the ocean floor are located at the mid-ocean _____
a. volcanoes. **b.** basins. **c.** trenches. **d.** ridges.

_____ **4.** The results of plate movement can be seen at _____
a. rift valleys. **c.** plate centers.
b. plate boundaries. **d.** both a and b.

_____ **5.** The _____ are forming where the Indo-Australian plate collides into the Eurasian plate.
a. Andes mountain range **c.** Himalayas
b. Rocky Mountains **d.** Appalachian Mountains

_____ **6.** The presence of the same _____ on several continents supports the idea of continental drift.
a. fossils **b.** rocks **c.** neither a nor b **d.** both a and b

_____ **7.** Continental drift occurs because of _____
a. seafloor spreading. **c.** magnetic reversal.
b. Pangaea. **d.** earthquakes.

_____ **8.** The cycle of heating, rising, cooling, and sinking is called a _____
a. subduction zone. **c.** convection current.
b. convergent boundary. **d.** conduction current.

_____ **9.** Oceanic plates are pushed down into the upper mantle in _____
a. convection currents. **c.** strike-slip faults.
b. subduction zones. **d.** divergent boundaries.

_____ **10.** The hypothesis that continents have moved slowly to their current locations is called _____
a. continental drift. **c.** magnetism.
b. continental slope. **d.** convection.

_____ **11.** Plates move apart at _____ boundaries.
a. convergent **b.** transform **c.** divergent **d.** magnetic

_____ **12.** Ocean floor rocks are _____ continental rocks.
a. more eroded than **c.** younger than
b. older than **d.** the same age as

Chapter Test (continued)

_____ **13.** The alignment of iron-bearing minerals in rocks when they formed reflects the fact that Earth's _____ has reversed itself several times in its past.
a. magnetic field **b.** core **c.** asthenosphere **d.** gravity

_____ **14.** The lack of an explanation for continental drift prevented many scientists from believing a single supercontinent called _____ once existed.
a. *Glomar* **b.** *Glossopteris* **c.** *Pangaea* **d.** *Mesosaurus*

_____ **15.** Scientists aboard the *Glomar Challenger* added to the evidence for the theory of seafloor spreading by providing _____
a. high altitude photos of existing continents.
b. samples of plant life from different locations.
c. samples of rock from different locations.
d. direct measurements of the movement of continents.

_____ **16.** Where plates slide past one another, _____ occur.
a. volcanoes **b.** earthquakes **c.** island arcs **d.** ocean trenches

_____ **17.** The places between plates moving together are called _____
a. divergent boundaries. **c.** strike-slip faults.
b. convergent boundaries. **d.** lithospheres.

_____ **18.** Seafloor spreading occurs because _____
a. new material is being added to the asthenosphere.
b. earthquakes break apart the ocean floor.
c. sediments accumulate on the ocean floor.
d. hot, less-dense material below Earth's crust is forced upward toward the surface.

_____ **19.** Studying the ocean floor, scientists found rocks showing magnetic _____
a. weakening. **b.** reversal. **c.** bonds. **d.** poles.

Directions: *Complete the following sentences using the correct terms.*

20. The theory that describes Earth's crust and upper mantle as being broken into sections is called _____.

21. The theory of _____ was shown to be correct by age evidence and magnetic clues.

22. _____, occurring in the mantle, are thought to be the force behind plate tectonics.

23. Earth's plasticlike layer is the _____.

24. Earth's _____ move around on a special layer of the mantle.

25. The main lines of evidence for _____ are fossil, rock, and climate clues, and the theory of seafloor spreading.

26. The rigid part of the plates of the _____ are made of oceanic crust or continental crust and upper mantle.

27. The name _____ means "all land."

Chapter Test (continued)

II. Understanding Concepts

Directions: *Answer the following questions on the lines provided.*

1. What is the difference between a convergent and a divergent plate boundary?

2. What happens to warmer material in a convection current?

3. What observation led Alfred Wegener to develop the hypothesis of continental drift?

4. Which part of Earth's structure is about 100 km thick?

5. How were the Andes mountain range, the Himalayas, and the islands of Japan formed alike?

6. How were the Andes mountain range, the Himalayas, and the islands of Japan formed differently?

Skill: Recognizing Cause and Effect

7. What causes new material to form at a mid-ocean ridge on the ocean floor?

Chapter Test (continued)

III. Applying Concepts

Directions: *Answer the following questions on the lines provided.*

1. Why are there few volcanoes in the Himalayas?

2. Glacial deposits often form at a high latitude near the poles. Explain why glacial deposits have been found in Africa.

3. Why would the fossil of an ocean fish found on two different continents **NOT** be good evidence of continental drift?

IV. Writing Skills

Directions: *Answer the following questions using complete sentences.*

1. Explain how research from the G*lomar Challenger* helped scientists support the theory of seafloor spreading.

2. Since new crust is constantly being added, why does Earth's surface not keep expanding?

Assessment

Transparency Activities

Name Date Class

SECTION 1 Section Focus Transparency Activity

A Cold Dig

If you were interested in the fossils of an animal that liked warm weather, would you think of digging in Antarctica? Archaeologists have found many interesting fossils there, including parts of a hadrosaur, a dinosaur previously found only in the Americas.

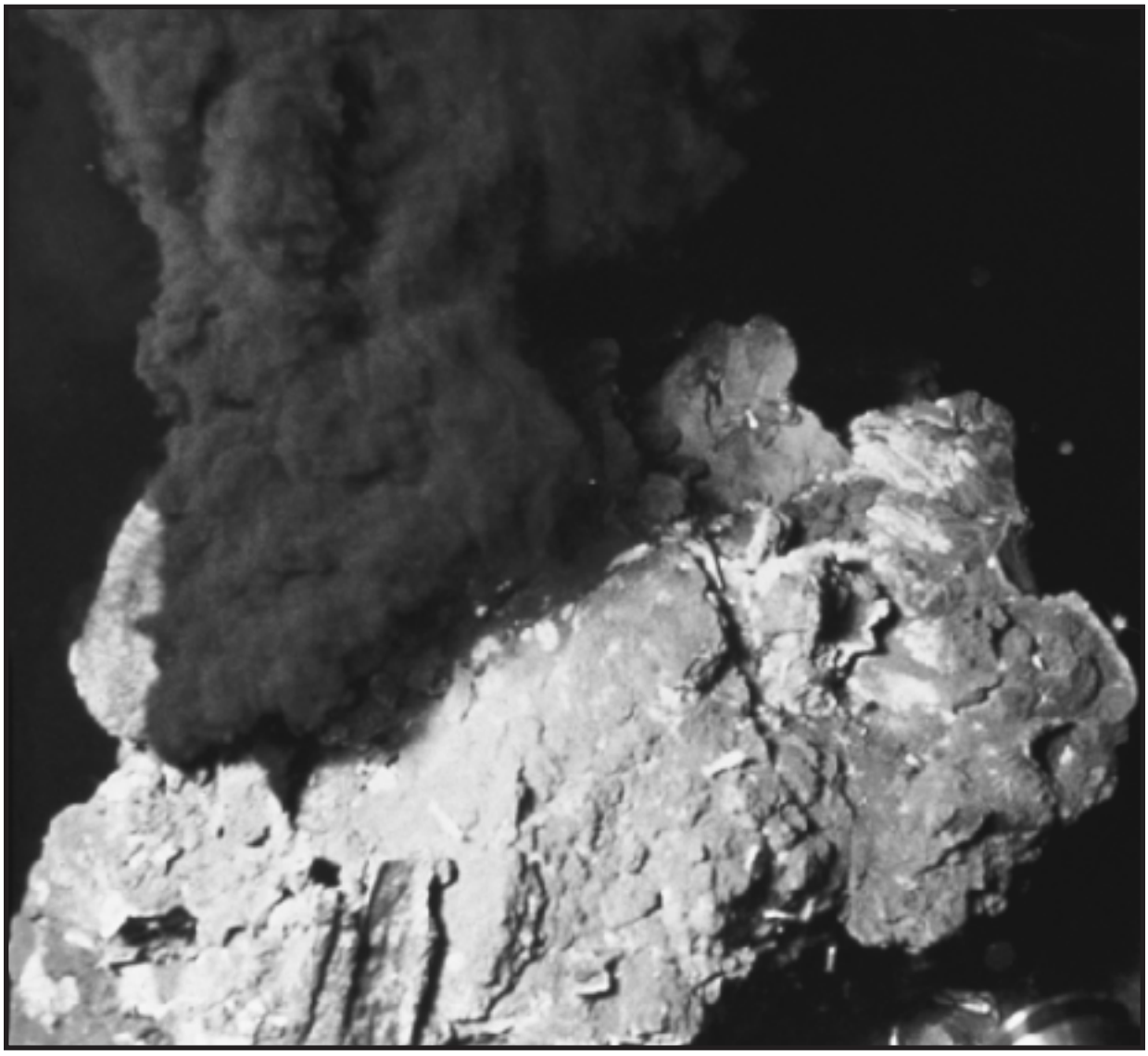
1. **Antarctica has a very inhospitable climate. Why might fossils of warm-weather animals be found there?**
2. **What are some reasons that the climate of Antarctica might change in the future?**

Name Date Class

SECTION 2 Section Focus Transparency Activity

The Main Event

Until recently, the bottom of the sea was impossible to see. New technology has improved the view, and today we have a better idea of what is going on there. This photo shows one feature of the ocean floor—a deep-sea vent.



1. **What is occurring in the photograph?**
2. **What features on land are similar to this deep-sea vent?**
3. **Judging from the photo, what do you think conditions around this vent are like?**

Name Date Class

SECTION 3 Section Focus Transparency Activity

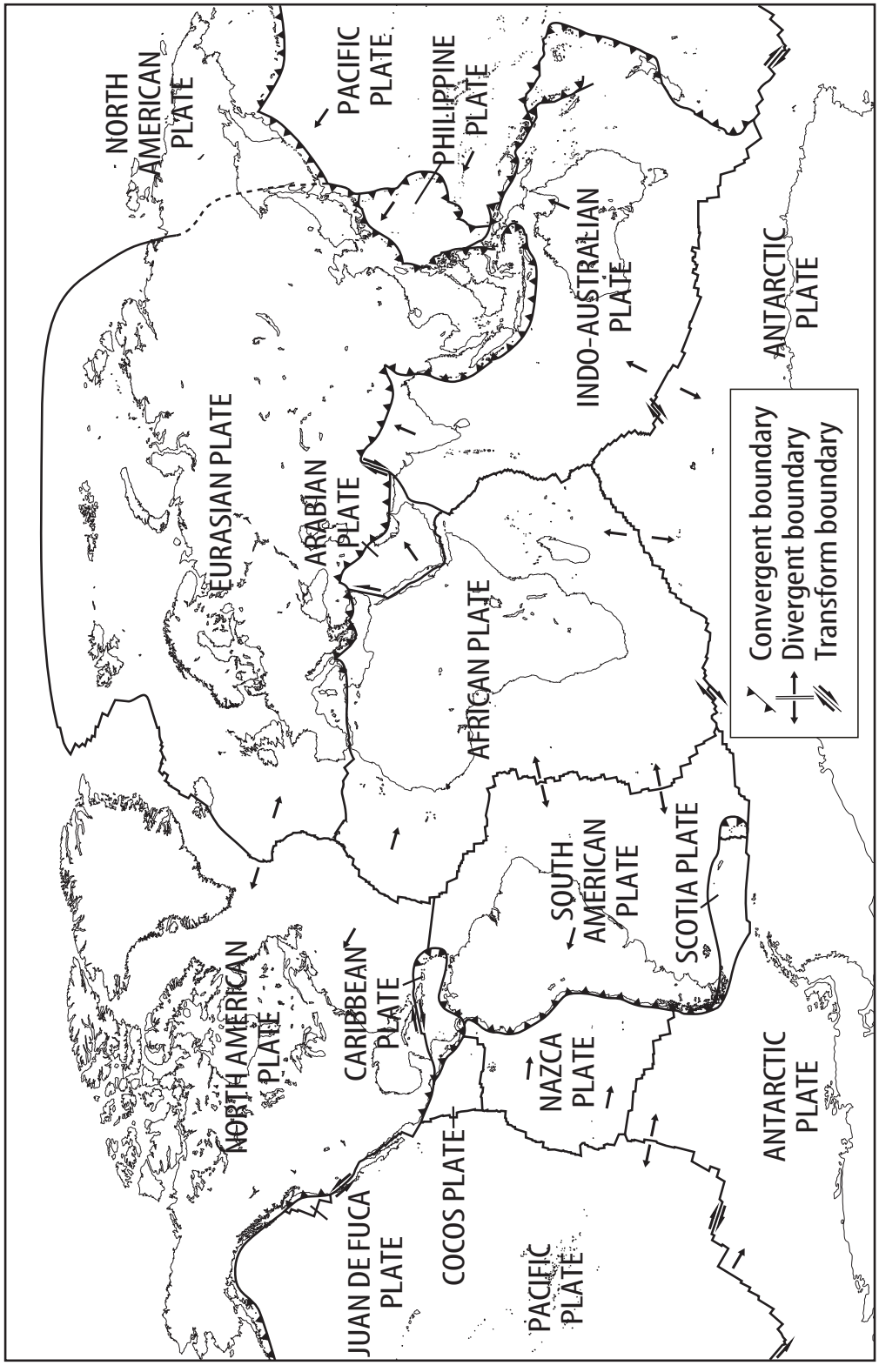
Valley of Ten Thousand Smokes

One of the most massive volcanic eruptions ever investigated occurred in a valley in southern Alaska in 1912. The eruption covered over forty square miles with ash as deep as 210 meters and left thousands of vents (called fumaroles) in the valley spewing steam and gas.

1. **How did this valley get its name, the Valley of Ten Thousand Smokes?**
2. **Why don't you see any smoke in the photograph?**
3. **Name some other places where there are volcanoes.**

SECTION 3 Teaching Transparency Activity

Plates of the Lithosphere



Teaching Transparency Activity (continued)

1. What makes up the lithosphere?

2. What is a convergent boundary?

3. What type of boundary is on the western coast of South America?

4. Which plate is covering most of two continents? What two continents?

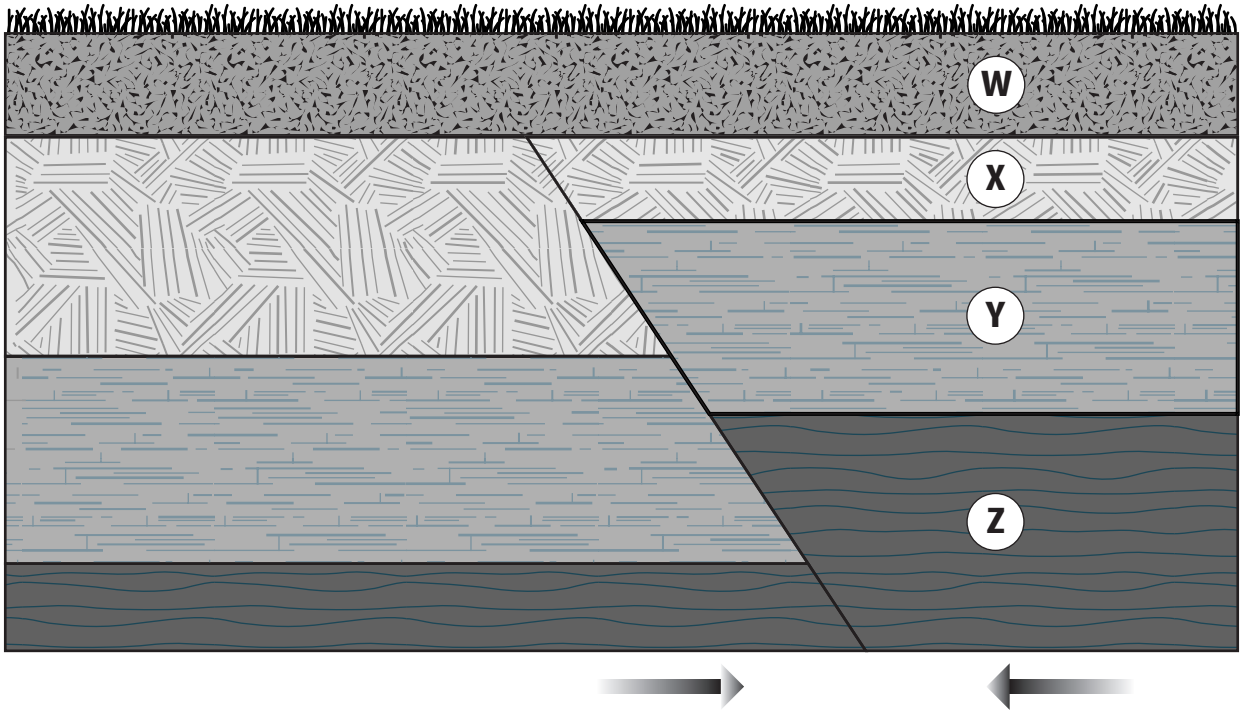
5. What kind of boundary forms the Mid-Atlantic Ridge?

6. What two plates form the boundary on the western coast of Canada?

Assessment Transparency Activity

Plate Tectonics

Directions: *Carefully review the diagram and answer the following questions.*



1. Which is the oldest rock layer in the picture?

A W
B X
C Y
D Z

2. The arrows indicate the directions the two plates are moving. What is this type of boundary called?

F convergent boundary
G divergent boundary
H transform boundary
J moving boundary

3. Which of the following is the danger most likely posed by the rock formation shown in the diagram?

A flooding
B earthquake
C tornado
D forest fire