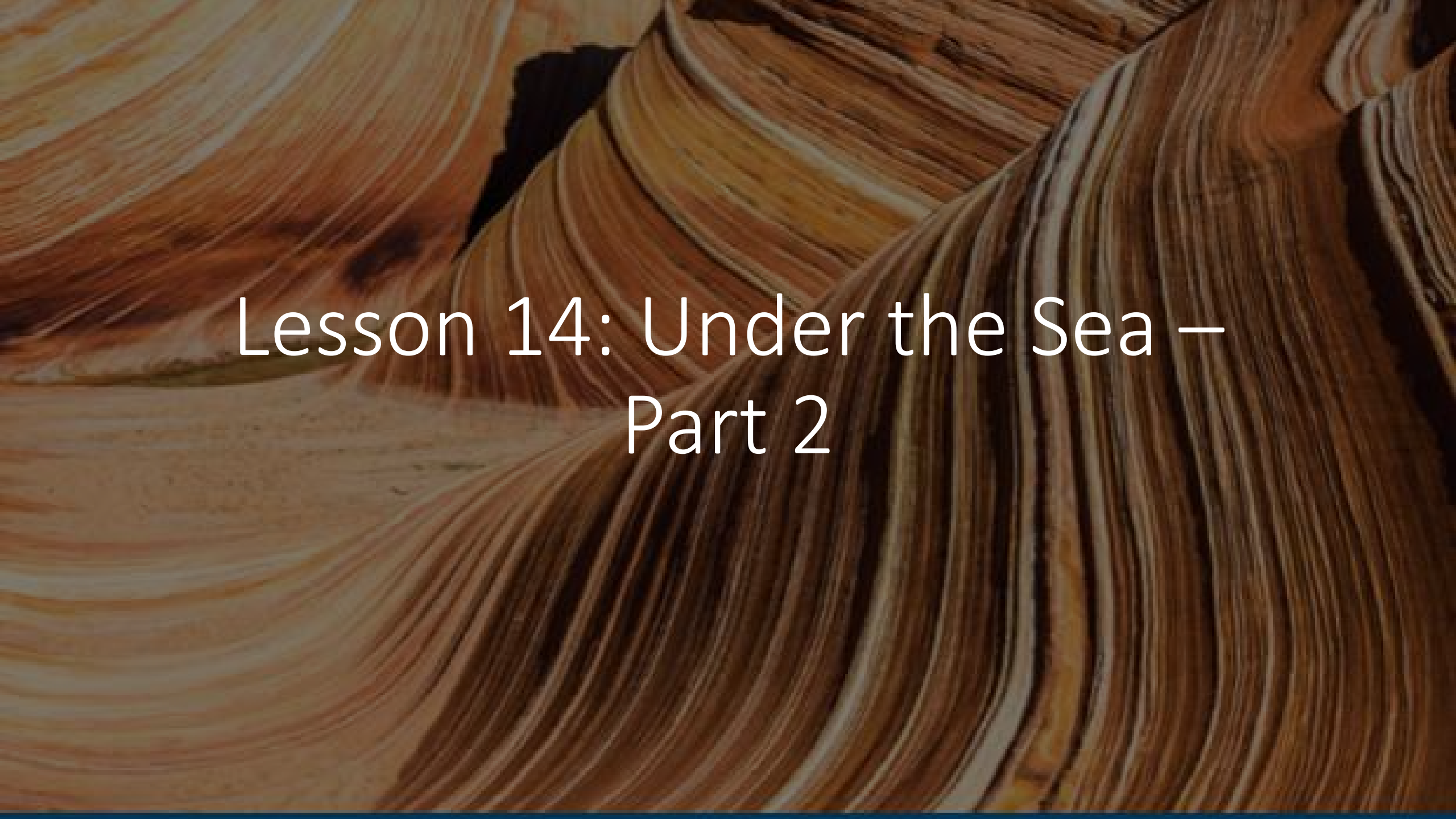


Lesson 14: Under the Sea – Part 2

Chapter 9: Earth's Undersea World

THE BIG QUESTION

How does the movement of tectonic plates shape and change the seafloor?

Activity Page 14.1

Chapter 9

Earth's Undersea World

THE BIG QUESTION
How does the movement of tectonic plates shape and change the seafloor?

Earth's Undersea World

As you and your partner read Chapter 9, "Earth's Undersea World," answer the following questions.

1. Seafloor spreading explains which of the following?
   - A. the presence of mid-ocean ridges on the seafloor
   - B. Wegener's theory of continental drift
   - C. the formation of hydrothermal vents
   - D. All of the above
   - E. A and B only

   Page(s) _____

2. Which phrase describes the Mid-Atlantic Ridge?
   - A. a warm, dark area on the sea floor
   - B. a long, rugged underwater mountain range
   - C. a cluster of seamounts
   - D. a cluster of hydrothermal vents

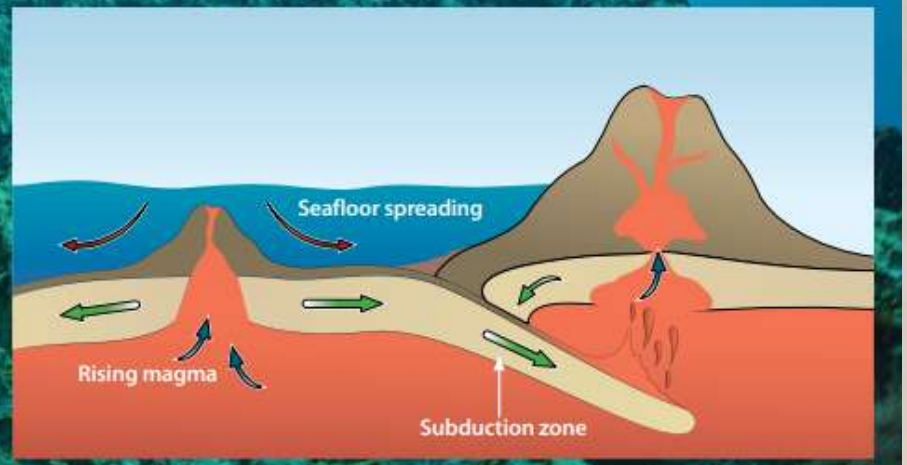
   Page(s) _____

Mountains and Moving Plates

In Chapter 8, you learned some of the ways Earth's slowly moving tectonic plates build mountains. Over millions of years, their movements have created many mountains and mountain ranges on land. Moving plates also build mountains underwater. In fact, there are more mountains on the seafloor than on all of Earth's continents and islands combined.

The Mid-Atlantic Ridge is a long, **rugged** underwater mountain range. It runs for thousands of miles along the boundary between tectonic plates that meet in the center of the Atlantic Ocean. The plates are very slowly moving apart at this boundary.

Remember Alfred Wegener? Wegener proposed the idea of continental drift in the early 1900s. At the time, though, no one knew of any force powerful enough to move continents around on Earth's surface. The theory of seafloor spreading was a big clue to solving the mystery.

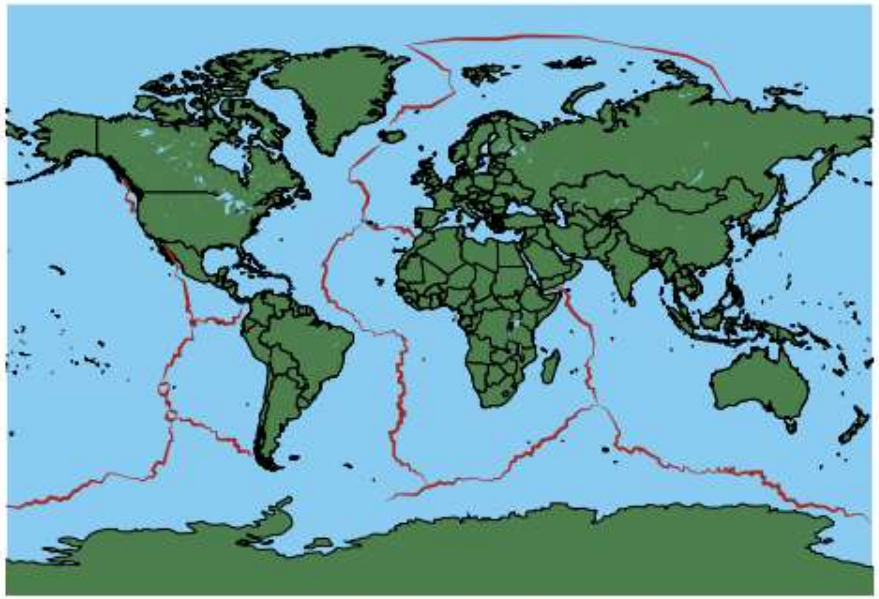


Seafloor spreading was one of several key pieces of geological evidence that led to the theory of plate tectonics. Think of the continents as riding on top of the plates. As the plates move, so do the continents.

It was the study of the Mid-Atlantic Ridge that first made scientists consider the possibility of seafloor spreading. They concluded that, as the seafloor spreads, the continents on either side of the Atlantic are pushed farther apart.

Scientists soon discovered that the Mid-Atlantic Ridge is just one of many mid-ocean ridges. These ridges are found in all the world's oceans, wherever tectonic plates are slowly moving apart. Altogether, mid-ocean ridges form a near-continuous chain of mountains that wraps around the earth like the stitching on a baseball. Spanning 40,389 miles, the chain of mid-ocean ridges is by far the world's longest mountain range. It is also the most volcanically active.

The Mid-Atlantic Ridge is just a part of this gigantic underwater mountain chain. Erupting lava has built up high walls of basalt on either side of the rift. The rift itself is nearly as deep as the Grand Canyon! If you travel along the ridge, you'll soon see more than just high walls of dark rock.



Mid-ocean ridges form a near-continuous chain of underwater mountains.

Hydrothermal Vents

At first glance, it looks like a fire. Black smoke is billowing up from a spot in the ridge. It's not smoke, though. It's searing hot, dark water gushing out of cracks in the rock. It's a **hydrothermal vent**.

Hydrothermal vents are a bit like geysers in Yellowstone National Park. These deep-sea geysers are much, much hotter than anything on land. Hydrothermal vents form as seawater sinks down through cracks in the oceanic crust. As it nears the magma lying below the crust, the water is heated to incredibly high temperatures. It can reach an astonishing 750°F! The water is so hot that it dissolves minerals from the surrounding basalt. The minerals become part of the hot liquid, like salt does when it's stirred into a glass of water.

At a hydrothermal vent, the super-heated, mineral-rich water comes roaring back up through cracks in the crust. It shoots out of the rock with the force of water blasting out of a fire hydrant. When hot vent water meets cold seawater, the dissolved minerals in vent water become solid again. They form tiny particles. The particles make the vent water look like dark smoke.

Hunting for Hydrothermal Vents

Hydrothermal vents

How do scientists find hydrothermal vents? They hunt for them from ships at sea. Hot, mineral-rich vent water moves slowly away from hydrothermal vents. It forms a plume, or cloud, of mineral particles that drifts away from the vent, like smoke from a chimney. If the scientists locate a plume, they send down a robot vehicle. When it locates the vent, the robot sends pictures back to the scientists.

There is more to hydrothermal vents than clouds of hot, black water. Communities of amazing and unusual animals live around many of these deep-sea geysers. Red-topped giant tube worms are the largest animals near vents. Some types of giant tube worms can grow as tall as a person. The vents are also home to ghostly white crabs, football-sized clams, and pale, blind shrimp.

Scientists believe there are tens of thousands of hydrothermal vents along the world's mid-ocean ridges. Scientists, however, have explored only a handful of them. Finding a new one is always exciting. Scientists often discover new types of animals as well.

Giant tube worms near a hydrothermal vent in the Pacific Ocean

Seamounts and Subduction Zones

Seamounts are another type of underwater mountain. Seamounts are underwater volcanoes that come in many shapes and sizes. Some are just a few hundred feet high. Others tower thousands of feet above the seafloor, although their tops are still far beneath the ocean's surface. If a seamount grows high enough to rise above the ocean's surface, it becomes an island.

Seamounts can form wherever magma is erupting through the oceanic crust. Many seamounts form alongside mid-ocean ridges or along subduction zones.

Finally, seamounts can also form over hotspots far from plate boundaries. The islands that make up the Hawaiian Island chain began as seamounts. As you read in Chapter 4, each island formed over a hotspot that **underlies** the center of the Pacific Plate. As a result of repeated volcanic eruptions, each island began as a small seamount that grew over time. Eventually, its top broke the water's surface, making it an island.

Seamount that grew into an island

Scientists estimate that there are at least 100,000 seamounts over 3,000 feet tall in the world's oceans. Since most seamounts are far below the ocean's surface, studying them is a challenge. Scientists have explored a few **firsthand**, traveling down in submersibles. More often, they send robot vehicles down to do the investigating.

No two seamounts are exactly alike. Many are teeming with life, even those that are very deep. Water flowing around these deep-sea volcanoes brings up nutrients from the ocean bottom. Nutrients fuel the growth of tiny, single-celled organisms in the water. These, in turn, become food for larger organisms, including animals that live on and around seamounts. Seamounts are often home to deep-sea corals, sponges, brittle stars, crabs, and anemones. Great **schools** of fish live around seamounts, too.

Deep-sea coral

Brittle star

Into the Trenches

Seamounts aren't the only undersea features that form along subduction zones. Where one plate slides under another, the seafloor dips down to create narrow, extremely deep valleys. These ocean trenches are the deepest places on the planet.

The Mariana Trench in the Pacific Ocean is the deepest ocean trench. It lies just off the Mariana Islands, east of the Philippines. The Mariana Trench is hundreds of miles long, but just 43 miles wide. It is like a deep slash in the ocean bottom. The trench's deepest known point is an area called the Challenger Deep. It is 36,070 feet beneath the ocean's surface, which is almost 7 miles down. By comparison, the average depth of the ocean is about 14,000 feet.

What is it like in the ocean's deepest spot? It is pitch black. The temperature of the water is only a few degrees above freezing. The water pressure is very high—equivalent to having three big SUVs pressing down on every inch of your body!

Only three people have traveled to the bottom of the Mariana Trench. (More people have landed on the moon!) Several robot vehicles have also made the trip. These visits have provided only brief glimpses of this remote and extreme environment.

The Lucky Three

As of 2014, people have traveled to the bottom of the Mariana Trench only twice. The first expedition took place in 1960. The explorers were U.S. Navy Lieutenant Don Walsh and Swiss scientist Jacques Piccard. Their underwater vehicle was *Trieste*. It took *Trieste* almost five hours to descend from the ocean's surface to the bottom of Challenger Deep. Piccard and Walsh peered out a small window onto a part of the planet that humans had not seen before.

Piccard and Walsh in *Trieste*

In 2012, Canadian filmmaker and ocean explorer James Cameron also made the trip. His vessel, *Deepsea Challenger*, was a slim, one-person, underwater vehicle. Cameron's descent took just over two and a half hours. He did something Walsh and Piccard weren't able to do. He filmed the descent and the view he had of the ocean floor at 35,756 feet.

Activity Page 14.1

3. **Part A**: Fill in the following chart to indicate which seafloor feature the animals live around, hydrothermal vents or seamounts.

Animals	Where they live
white crabs	
brittle stars	
schools of fish	
pale, blind shrimp	
sponges	
deep-sea corals	
giant tube worms	
anemones	
football-sized clams	

Page(s) _____

Part B: Why might these animals live near these particular seafloor features?

_____

_____

_____

Activity Page 14.1

4. Match each cause to its effect by writing the correct letter for the effect next to the correct cause.

Causes	Effects
_____ Seamount emerges from the ocean's surface	a. continental drift
_____ One tectonic plate slides under another	b. seafloor spreading
_____ Tectonic plates move apart very slowly	c. islands are formed
_____ Seafloor spreading	d. a trench is formed
_____ Water seeps into the earth's crust and is heated by magma	e. mountains are formed
_____ Tectonic plates collide	f. hydrothermal vents are formed

5. On page 84, the author uses a simile when describing the mountain chain formed by mid-ocean ridges, saying it is *like the stitching on a baseball*. Explain what this simile means.

_____

_____

Word Work: Firsthand

- Scientists have explored a few seasmounts firsthand, traveling down in submersibles.
- Definition
- Only a few astronauts have had the opportunity to explore the surface of the moon firsthand.
- Examples
- Something I have experienced firsthand is _____.
- Part of speech

Word Work: Firsthand

- Firsthand or Not Firsthand?
  - Discovering a new ocean animal while traveling underwater in a submersible
  - Looking at a photo of a newly discovered ocean animal
  - Reading about a car accident in the newspaper
  - Seeing a car hit another car at a traffic light
  - Traveling on a plane to another country
  - Watching a movie about another country

Grammar: Sequencing Adjectives

ADJECTIVES CHART						
Article	**Adjective(s)**					**Noun**
	General → Specific					
	Opinion/ Observation	Physical Description (size, shape, age, color)	Material	Origin	Purpose	

Grammar: Sequencing Adjectives Activity Page 14.2

Sequencing Multiple Adjectives

Complete each sentence by choosing two adjectives from the ones provided and writing them in the correct order in the blanks. Underline the article(s) in each sentence.

Example: **Adjectives**: strong, young, gray, Italian

A strong , gray horse galloped in the field.

1. **Adjectives**: new, Japanese, fast

   The _____, _____ race car zipped around the track.

2. **Adjectives**: hardcover, good, old, science

   She looked at a _____, _____ book about volcanoes.

3. **Adjectives**: canvas, blue, comfortable, walking

   He loves the _____, _____ shoes he tried on.

Grammar: Sequencing Adjectives
Activity Page 14.2

Circle the phrase with the adjectives in the correct order.

Example: a black, large, clever cat
clever, a large black cat
(a clever, large, black cat)

1. the tall, rocky mountain
   the rocky, tall mountain
   rocky, tall, the mountain

2. a sharp, wooden pencil
   wooden, a sharp pencil
   a wooden, sharp, pencil

3. old, an bicycle, orange
   an old, orange bicycle
   an orange, old bicycle

Write a sentence using at least two adjectives. Be sure to order the adjectives correctly and to use proper capitalization and punctuation.

_____

_____

Morphology: Suffixes and Roots

Activity Page 14.3

Practice Suffixes *–ly* and *–y* and Roots *graph* and *rupt*

Write a complete sentence for each of the following words. Be sure to use correct capitalization and punctuation.

1. *interrupt*

2. *messy*

3. *photograph*

4. *busily*

5. *tasty*

Morphology: Suffixes and Roots

Activity Page 14.3

6. *abruptly*

7. *biography*

8. *kindly*

Challenge: *Write a sentence that includes one word with the suffix* –ly *or* –y *and one word with the root* graph *or* rupt.

Spelling and Vocabulary

Worksheet 14.4

Molten	Fault	Geyser
Epicenter	Seismograph	Glacier
Tsunami	Erosion	Conclusion
Tectonic		

1. A giant _____ caused massive damage when it crashed onto the land.

2. Earth's _____ plates have been slowing moving for billions of years.

3. When a _____ erupts, it releases a fountain of steam and hot water.

4. Over a very long period of time, _____ can reshape Earth's surface.

5. Surface waves are first detectable at an earthquake's _____.

6. Inge Lehmann came to the _____ that Earth's core has two parts.

7. The first know _____ was invented by a Chinese scientist.

8. _____ rock moves slowly beneath Earth's surface.

9. If you want to see a _____, travel to the North or South Poles!

10. The San Andreas _____ is one of the most famous faults in the U.S.