Grade 4 | Unit 5

Our Planet: Geology

Take-Home Pages

Amplify CKLA | Core Knowledge®

Grade 4

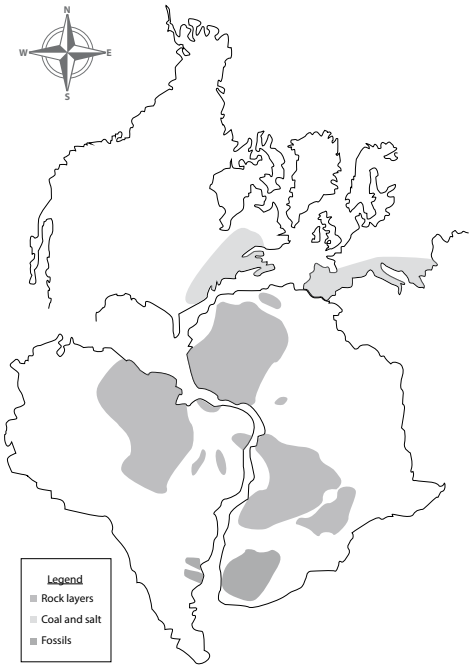
Take-Home Pages

NAME: _____

DATE: _____

Excerpt from "Earth's Changing Surface"

Read the excerpt and complete the chart that follows.



Discoveries of rock layers, as well as coal and salt, indicated that the continents had once been joined.

Search for Clues

So what about the jigsaw-puzzle fit of the continents? During the 1800s and early 1900s, **geologists** studied rock layers on the continents. They made many intriguing discoveries. For example, rock layers along the northern and eastern coasts of South America match rock layers along Africa's western coast. Also, deposits of **coal** and salt in eastern North America are similar to those in southern Europe.

Geologists found fossils of an ancient fern called *Glossopteris* in similar rock layers in Africa, India, Australia, and South America. They found fossils of an ancient reptile, *Lystrosaurus*, in both southern Africa and India. In South America and Africa, fossils of another ancient reptile, *Cynognathus*, turned up directly across the Atlantic Ocean from each other.

These discoveries seemed to indicate that the continents had once been joined—but how? Furthermore, how had they become separated? Several scientists proposed explanations, but they were quite far-fetched. One involved a gigantic eruption from the center of the earth that ripped all the land apart. Another suggested that part of Earth's land broke away to become the moon and what was left became the

continents. Few people paid much attention to these ideas. A better explanation was needed, one with evidence to support it. In the early 1900s, Alfred Wegener provided just that.

Enter Alfred Wegener

Alfred Wegener

Born and educated in Germany, Alfred Wegener was interested in many scientific subjects, including weather, astronomy, and cold, polar regions. Around 1910, Wegener read a scientific paper about similar fossils and rock formations found on different continents. He was intrigued by the mystery of the matching continents and he wanted to solve this mystery.

Wegener gathered evidence. He pulled together discoveries made by many other scientists about rock formations, fossils, and mountain ranges. Polar explorers had recently unearthed fossils of *Glossopteris* in Antarctica. Similar fossils had previously been found in other parts of the world. This seemed to indicate that ice-covered Antarctica might once have been joined to South America, Africa, India, and Australia. It also meant that Antarctica had once had a **climate** warm enough for ferns to grow.

From this evidence, Wegener **concluded** that all the present-day continents had been joined as one huge landmass long ago. He understood, as with any new discovery, that his conclusions might be altered or challenged in the future by more evidence. Nonetheless, he believed that the existing evidence supported his conclusions.

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The following chart contains a statement about Alfred Wegener's continental drift hypothesis. Using information from the excerpt, write five pieces of evidence that support Wegener's hypothesis.

Hypothesis	Long ago, continents were joined as one supercontinent that broke apart and the pieces slowly drifted away from each other.
Evidence	1.
	2.
	3.
	4.
	5.

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Glossary for *The Changing Earth*

Words with an asterisk (*) are important bolded words in this Reader that are not part of the reading lessons.

A

active volcano**, ***n. a type of volcano that has erupted in the past 10,000 years and is likely to erupt again (**active volcanoes**)

aftershock, ***n.*** a smaller, weaker earthquake that often follows a main earthquake event (**aftershocks**)

altar, ***n.*** a platform or table used as a center of worship in religious ceremonies or services (**altars**)

B

basalt, ***n.*** heavy, dense rock formed from cooled, hardened lava

basin, ***n.*** a large area in the earth that is lower than the area around it (**basins**)

bitter, ***adj.*** **1.** resentful and angry because of unfair treatment; **2.** very cold

bulge, ***v.*** to stick out or swell

C

caldera, ***n.*** a crater caused by the collapse of the top of a volcano

canyon, ***n.*** a deep valley with steep sides and often a stream or river flowing through it (**canyons**)

catastrophe, ***n.*** a terrible, sudden event (**catastrophes**)

chemical weathering**, ***n. a process that breaks down rocks by changing the minerals they contain

class, n. group of people or things that are similar in some way

climate, ***n.*** the average weather conditions of a particular area

clustered, ***adj.*** grouped close together

coal**, ***n. a dark, solid substance in the earth formed from plant fossils and used as fuel

collide**, ***v. to crash together with strong force (**colliding**)

compact, ***v.*** to closely pack or press together (**compacts**, **compacting**)

conclude, ***v.*** to decide something or form an opinion based on information you have (**concluded**, ***n.*** **conclusion**)

continental drift, ***n.*** a process in which continents slowly move over time on Earth's surface

contract, ***v.*** to shrink slightly or get smaller

crater, ***n.*** a bowl-shaped opening at the top of a volcano or geyser

crust, ***n.*** Earth's outermost layer, featuring a rocky surface

D

dense, ***adj.*** thick or heavy (**denser**)

deposit, **1.** ***v.*** to put or leave something in a particular place; **2.** ***n.*** material laid down or left by a natural process (***v.*** **deposited**, ***n.*** **deposits**)

descend, ***v.*** to move downward (**descends**)

detective, ***n.*** a person whose job is to find information about someone or something (**detectives**)

dissolved, ***adj.*** mixed with liquid so no solid pieces are visible anymore

distant, ***adj.*** far away in time

dome mountains**, ***n. mountains generally formed when magma pushes upward into Earth's crust from the mantle and cools into igneous rock underground, causing the crust above it to bulge; usually occur as isolated mountains on otherwise flat plains

dormant volcano**, ***n. a type of volcano that is considered active but hasn't erupted for a very long time

drift**, ***v. to slowly move with water, wind, or other natural processes (**drifted**)

durable, ***adj.*** able to last a long time in good condition

dwelling, ***n.*** a place where someone lives (**dwellings**)

E

elder, ***n.*** a person who is older, respected, and often in a position of authority (**elders**)

entomb, ***v.*** to bury (**entombed**)

epicenter**, ***n. the point on Earth's surface directly above an earthquake's focus

erosion**, ***n. any process or force that moves sediments to new locations

erupt, ***v.*** to send out rock, lava, and ash in a sudden explosion (**erupted**, ***n.*** **eruption**)

eruption column, ***n.*** an enormous cloud of ash, bits of rock, and toxic gas produced by a volcanic eruption that can travel hundreds of feet per second

eternal, ***adj.*** lasting forever, with no beginning and no end

evacuate, ***v.*** to remove people from a dangerous place

evidence, ***n.*** proof; information and facts that are helpful in forming a conclusion or supporting an idea

excavation, ***n.*** a hollowed-out place formed by digging or carving (**excavations**)

exert, ***v.*** to cause a force to be felt or have an effect (**exerts**)

expand, ***v.*** to get bigger

expedition, n. a journey taken to explore a place for a specific purpose

experiment, ***n.*** a scientific test to try out something in order to learn about it

extinct volcano**, ***n. a type of volcano that has not erupted for at least 10,000 years (**extinct volcanoes**)

eyewitness, ***n.*** a person who has seen something happen and is able to describe it

F

fault, ***n.*** a crack in Earth's crust (**faults**)

fault-block mountains**, ***n. mountains formed when gigantic blocks of rock move up and down along faults

fine, ***adj.*** very small

firsthand, ***adv.*** coming directly from actually seeing or experiencing something

focus**, ***n. the place in Earth's crust where huge blocks of rock move along a fault, triggering an earthquake

fold mountains**, ***n. mountains formed when rocks are pushed up into huge folds by moving tectonic plates

force**, ***n. strength, power (**forces**)

fossil, ***n.*** the preserved remains of things that lived long ago (**fossils**)

foundation, ***n.*** the basis of something, the support upon which something else is built (**foundations**)

G

geologist, ***n.*** a scientist who studies the makeup of the earth and the forces and processes that shape and change it (**geologists**)

geyser**, ***n. an underground hot spring that periodically erupts, shooting hot water and steam into the air (**geysers**)

granite, ***n.*** a common igneous rock that forms from magma that cooled within Earth's crust

H

heave, ***v.*** **1.** to move up and down over and over; **2.** to lift, pull, push, or throw with a lot of effort

hoodoo, ***n.*** the tallest kind of pinnacle (**hoodoos**)

hotspot, ***n.*** a very hot region deep within Earth's mantle where a huge magma chamber forms (**hotspots**)

hot spring, ***n.*** a naturally flowing source of hot water (**hot springs**)

hydrothermal vent, ***n.*** a deep-sea geyser that forms as seawater sinks down through cracks in the oceanic crust and then releases extremely hot, mineral-rich water back up through cracks in the crust (**hydrothermal vents**)

hypothesis, ***n.*** an idea that has been suggested and may be true but has not yet been proven

I

ice wedging**, ***n. a process in which water alternately freezes and thaws and breaks rocks apart

igneous rock**, ***n. rock that forms when magma cools and solidifies (**igneous rocks**)

inner core**, ***n. Earth's deepest layer, made of very hot, solid metal

L

lava, ***n.*** red-hot melted rock that has erupted above Earth's crust from deep underground

limestone**, ***n. a sedimentary rock often packed with the fossilized skeletons and shells of tiny ocean creatures that is commonly used for building

litter, ***v.*** to scatter in disorder (**littered**)

M

magma, ***n.*** melted rock in Earth's mantle

magnitude, ***n.*** an earthquake's strength

mantle**, ***n. Earth's largest and thickest layer that consists of very hot, very dense rock

metamorphic rock**, ***n. rock that forms when minerals in igneous, sedimentary, or older metamorphic rocks are changed due to extreme heat and pressure (**metamorphic rocks**)

mineral, ***n.*** a solid, nonliving substance found in the earth that makes up rocks (**minerals**)

moai, ***n.*** statues on Easter Island carved from tuff in the shape of partial human figures with large heads, high cheekbones, and heavy brows

O

observation, ***n.*** **1.** the act of paying careful attention to gather information; **2.** a statement based on paying careful attention to something (**observations**)

obsidian, ***n.*** a dark rock or natural glass formed from lava that cooled very quickly

ocean trench, ***n.*** a narrow, extremely deep valley formed when the seafloor dips down as one tectonic plate slides under another (**ocean trenches**)

outer core**, ***n. the layer within Earth between the inner core and the mantle that is made of very hot, liquid metal

outsmart, ***v.*** to trick or defeat someone by being clever

P

panic, ***v.*** to be fearful in a sudden and overpowering way (**panicked**)

pepper, ***v.*** to sprinkle or cover

physical weathering**, ***n. a process that breaks big rocks into smaller rocks without changing the minerals they contain

pinnacle, ***n.*** a slender, soaring rock formation made of tuff (**pinnacles**)

pinpoint, ***v.*** to figure out the exact location of something

plate tectonics, ***n.*** a theory that Earth's crust and the solid top part of the mantle are broken up into sections that fit together but move against each other

plume, ***n.*** a column of magma that rises from the mantle into a chamber beneath Earth's crust

porthole, ***n.*** a small, round window on the side of a ship, submersible, or aircraft (**portholes**)

pressure, ***n.*** the weight or force produced when something presses or pushes against something else

pyroclastic flow, ***n.*** a sort of avalanche of intensely hot ash, rock fragments, and volcanic gas that rolls quickly down the side of a volcano (**pyroclastic flows**)

R

revenge, ***n.*** the act of getting even for a wrongdoing

rock cycle**, ***n. the continuous cycle in which rocks are created, destroyed, and recreated

rugged, ***adj.*** having a rough, uneven surface

S

scald, ***v.*** to burn with very hot water or steam

school, ***n.*** a large number of ocean animals of one type swimming together (**schools**)

sea level, ***n.*** the average height of the ocean's surface

seamount, ***n.*** an underwater volcano that forms wherever magma is erupting through oceanic crust (**seamounts**)

sediment**, ***n. rock, sand, or dirt that has been carried to a place by water, wind, or other natural processes (**sediments**)

sedimentary rock**, ***n. rock that is made of sediments that have been naturally compacted and cemented together (**sedimentary rocks**)

seismic wave, ***n.*** a surge of energy traveling out from an earthquake's source through the earth (**seismic waves**)

*__seismogram__, ***n.*** the record a seismograph makes, showing seismic waves as jagged up-and-down lines

*__seismograph__, ***n.*** an instrument used to track seismic waves traveling through the earth (__seismographs__)

__sensor__, ***n.*** an instrument that detects and measures changes, and then sends information to a controlling device **(sensors**)

__sheer__, ***adj.*** very steep, almost straight up and down

__sheet__, ***n.*** a broad stretch of something (__sheets__)

__silt__, ***n.*** very small sediments deposited by water

__solidify__, ***v.*** to make or become hard or solid (__solidifies__)

__state__, ***n.*** the condition of being a solid, liquid, or gas

__strong-willed__, ***adj.*** determined to do what you want even if other people tell you not to

*__subduction__, ***n.*** a process in which a heavier oceanic plate slides under a lighter continental plate

__subduction zone__, ***n.*** the place where one tectonic plate is sliding beneath another tectonic plate (__subduction zones__)

__submersible__, ***n.*** a small vehicle that can travel deep under water for research (__submersibles__)

__surge__, ***v.*** to move forward quickly, suddenly, and with force (__surges__)

T

__texture__, ***n.*** the size, shape, and sorting of mineral grains in rocks

__theory__, ***n.*** an explanation for why something happens based on evidence

__trigger__, ***v.*** to cause something to start or happen (__triggered__)

__tsunami__, ***n.*** a gigantic wave of seawater caused by an earthquake in oceanic crust (__tsunamis__)

__tuff__, ***n.*** a type of volcanic rock formed from hardened volcanic ash

U

__ultimately__, ***adv.*** finally; at the end of a process

__underlie__, ***v.*** to be located under something (__underlies__)

__undertaking__, ***n.*** something that someone takes on as a task or duty

V

__volcano__, ***n.*** a hill or mountain that forms over a crack in Earth's crust from which lava erupts (__volcanoes__)

W

*__weather__, ***v.*** to break down into smaller pieces (***n.*** __weathering__)

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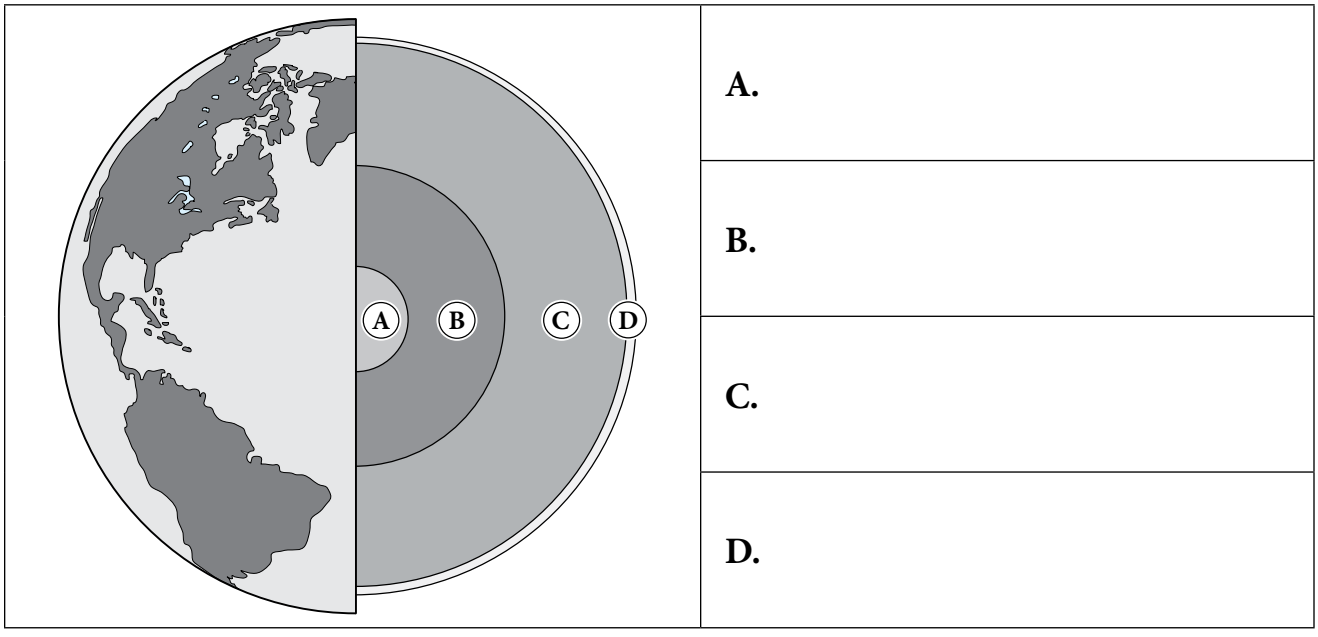
Excerpt from "Earth's Layers and Moving Plates"

Read the following excerpt and use it to label Earth's layers in the diagram that follows.

Earth's deepest layer is a solid inner core of very hot metal. This metal may be nearly as hot as the sun's surface. The outer core is also made of hot metal, but it's liquid, not solid. The mantle surrounds the outer core. The mantle is Earth's largest and thickest layer and consists of very hot, very dense rock. The rock is solid in the lower and upper parts of the mantle. In between, however, is a region where the rock is neither liquid nor solid. The slow movement and behavior of this material, caused by heat and pressure, have an impact on Earth's surface. Above the mantle is Earth's outermost layer, the thin, rocky crust. There are two types of crust: oceanic crust and continental crust. Oceanic crust is covered by ocean water. Most of the continental crust is dry land, but some of the crust around the edges is covered by water. Oceanic crust is thinner but heavier than continental crust.



A.

B.

C.

D.

Read the following excerpt and use it to complete the activity that follows.

Moving Plates

Scientists are still learning about plate tectonics. The theory of plate tectonics states that Earth's crust, together with the solid top of the mantle, is broken up into sections. These huge, rocky slabs are called

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tectonic plates. Tectonic plates fit tightly together. They aren't fixed in place though; they can move. They move because of heat and pressure in the mantle. As the material in the mantle slowly moves, it **exerts** enormous pressure on the overlying plates. All that pressure forces the plates to move as well—very, very slowly.

Earth's tectonic plates have been slowly moving and interacting for billions of years. They interact mostly along their edges, or boundaries. Plate boundaries are where two or more tectonic plates meet.

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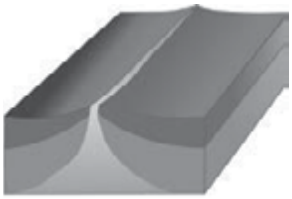
A Matter of Time

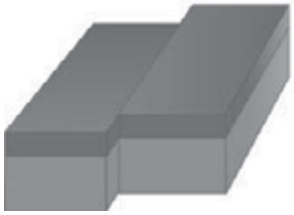

Tectonic plates move apart.

At some boundaries, tectonic plates are moving apart. As the plates separate, molten rock flows up from the mantle into the space between them, creating new crust. Mid-ocean ridges are an example of this type of plate interaction. Tectonic plates along the mid-ocean ridge in the Atlantic Ocean are moving apart at a rate of about 0.8 to 2 inches per year. That may not seem like much, but it adds up. Two hundred million years ago, the landmasses of North America and Europe were joined. So were South America and Africa. Thanks to separating plates, these continents now lie on opposite sides of a vast ocean.


Tectonic plates collide.

At other plate boundaries, tectonic plates are colliding, or crashing together. In some places, colliding plates slowly crash into each other. The crust at their edges gradually crumples and is pushed higher and higher, creating mountains. In other places, one of the colliding plates slides under the other. Two plates are colliding this way along the western coast of South America. A heavier oceanic plate is sliding under a lighter continental plate. Scientists call this process subduction. Subduction has created a deep ocean trench off the coast of Chile and Peru. It has also had a role in creating the towering Andes Mountains along the western edge of South America. Similar plate interactions have formed mountain ranges throughout Earth's long history.

Finally, tectonic plates slide sideways past one another. It's never a smooth process. Plate edges press together hard. They often get stuck while the pressure keeps building. Eventually the pressure gets too great. The stuck edges break free, causing the plates to jerk past each other.


Tectonic plates slide sideways past one another.

Providing the Answers

The theory of plate tectonics answered many questions in geology. It explained how Wegener's Pangaea broke apart. It explained how the continents have been slowly rearranged over millions of years. The movement of the plates also explained mid-ocean ridges, deep ocean trenches, patterns in the locations of mountains, and many other features on Earth's surface. The theory has become the cornerstone of modern geology.

As plates move, interesting things happen. Most of the time, they happen incredibly slowly. Sometimes, though, the effects of plate movements are sudden and dramatic. Think earthquakes and volcanoes!

Core Conclusions

You may never have heard of the Danish scientist Inge Lehmann. Among seismologists, however, she is famous. Around 1900, scientists thought the earth had just three layers: an outer crust, a solid mantle, and a liquid core. Lehmann studied seismograph records of earthquakes. She analyzed how seismic waves changed as they traveled through Earth's interior. Lehmann collected thousands of records organized in boxes—there were no computers back then! She saw patterns in how seismic waves behaved as they moved through Earth. Lehmann concluded that Earth's core has two parts: a liquid outer core and a solid inner core. In 1936, she announced her findings and changed our view of Earth!

Use the correct word from the word bank to fill in each blank in the following paragraphs.

trench	theory	plate	subduction
continental	tectonic	collide	

Sam is excited to tell his family what he is reading and learning about geology at school. His cousins live in the South American country of Chile, and today he learned that there is a deep ocean _____ along Chile's coast. He explained, "There are two _____ plates that meet along the western coast of South America. One is a _____ plate and one is an oceanic plate. The heavier oceanic plate is sliding beneath the lighter continental _____. And, this process has a big name I learned today—it's called _____!"

"I think I know how the Andes Mountains of South America are formed," exclaimed Sam's dad. "When the plates _____ at plate boundaries along the Pacific Coast, I bet the continental crust crumples and gets pushed higher and higher to form the mountains. I learned about the _____ of plate tectonics when I was in school, too."

Sam's dad described an earthquake that the country of Chile had recently experienced. Sam said, "Hmmm . . . I wonder if earthquakes have anything to do with moving tectonic plates?"

What do you think?

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Excerpt from "Earth's Shakes and Quakes"

Read the first full paragraph of the following excerpt aloud to a family member and answer the questions that follow.

objects tumble from shelves, and buildings may even collapse. In 1348 CE, people had no idea what caused earthquakes. Today we know that earthquakes are the result of powerful natural forces at work in Earth's crust and mantle.

As you read in chapter 2, scientists developed the theory of plate tectonics in the 1960s. The theory explains how Earth's surface and interior change over very long periods of time. Some plates are pulling apart at their boundaries, other plates are colliding, and still others are sliding past each other. A lot happens at plate boundaries, including most earthquakes. In fact, one of the easiest ways to locate plate boundaries is to determine where earthquakes are occurring!

Locations of plate boundaries and past earthquake epicenters

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1. According to the excerpt, what does the theory of plate tectonics explain?

2. The last sentence of the excerpt states, "In fact, one of the easiest ways to locate plate boundaries is to determine where earthquakes are occurring!" How does the image on the page support this statement?

NAME: _____

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Spelling Words

The following is a list of spelling words. These words have been covered in morphology lessons and have one of the following roots: arch, graph, *or* rupt.

During Lesson 10, you will be assessed on how to spell these words. Practice spelling the words by doing one or more of the following:

- *spell the words out loud*
- *write sentences using the words*
- *copy the words onto paper*
- *write the words in alphabetical order*

When you practice spelling and writing the words, remember to pronounce and spell each word one syllable at a time.

1. hierarchy
2. matriarch
3. archrival
4. anarchy
5. autograph
6. biographer
7. calligraphy
8. paragraph
9. eruption
10. uninterrupted
11. rupture
12. abrupt

The following chart provides the meanings of the spelling words. You are not expected to know the word meanings for the spelling assessment but it may be helpful to have them as a reference as you practice the spelling words.

Spelling Word	Definition
hierarchy	a system in which people are placed into social classes of different levels of power and importance
matriarch	a woman who controls a family, group, or government
archrival	a chief or main rival or opponent
anarchy	a situation not controlled by rules or laws and without a leader
autograph	a person's handwritten signature
biographer	a person who writes the story of someone's life
calligraphy	the art of beautiful handwriting
paragraph	a piece of writing that includes a few sentences focused on a certain subject in an organized manner
eruption	**1.** the process of sending out rock, lava, and ash in a sudden explosion; **2.** an event in which something breaks or bursts in a sudden and often violent way
uninterrupted	continuing without breaking or being stopped by something
rupture	a break or burst
abrupt	sudden and unexpected; breaking through suddenly

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Practice Spelling Words

Sort the spelling words into categories based on the root in each word.

uninterrupted	matriarch	hierarchy	abrupt
archrival	calligraphy	eruption	paragraph
autograph	rupture	anarchy	biographer

arch	***graph***	***rupt***

List the spelling words in alphabetical order. Remember to pronounce and spell the words syllable by syllable.

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

11.

12.

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7.1 **Take-Home**

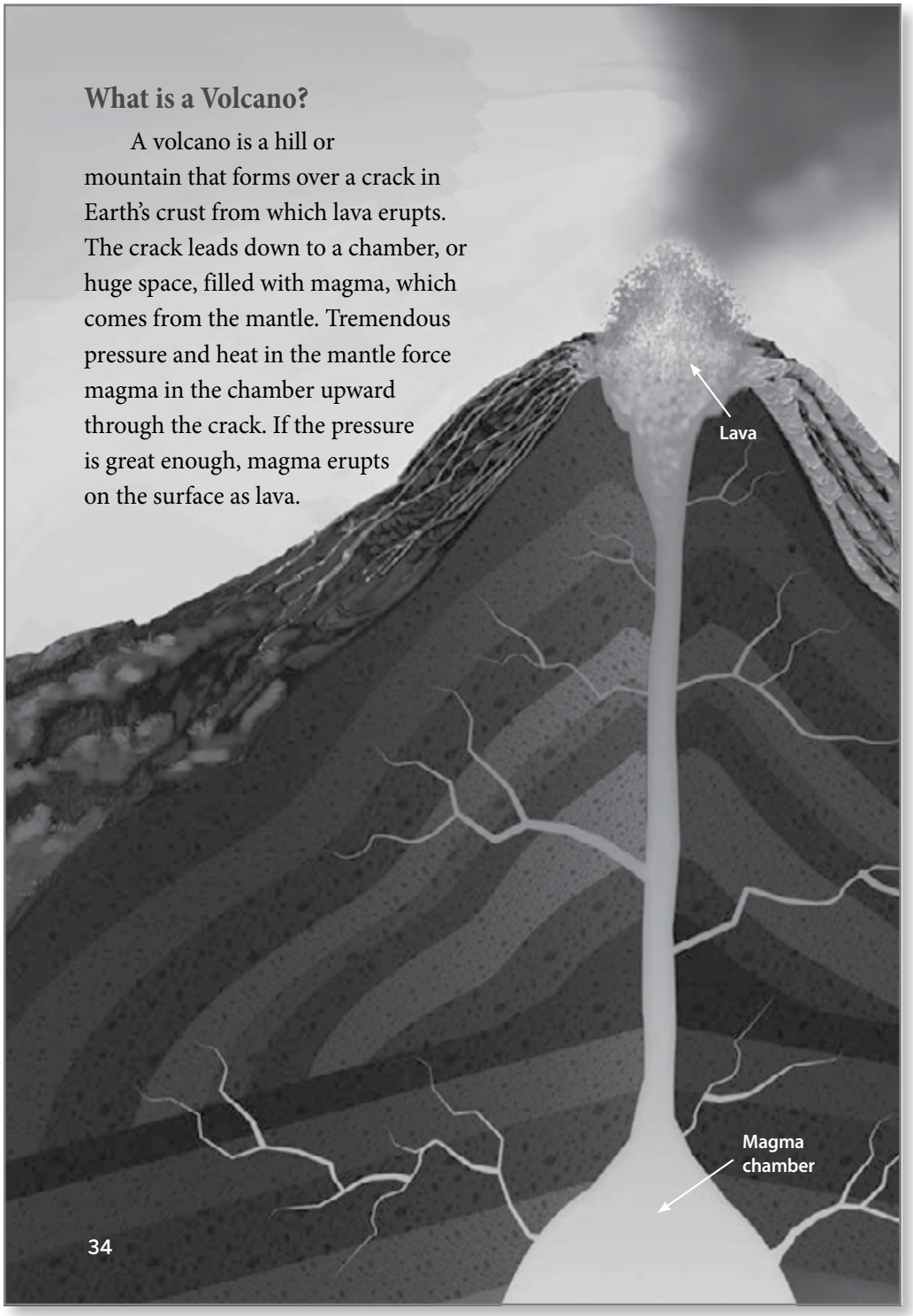
Excerpts from *The Changing Earth*

Read the following excerpts and use them to complete the activity that follows.

Earth's Fiery Volcanoes

What is a Volcano?

A volcano is a hill or mountain that forms over a crack in Earth's crust from which lava erupts. The crack leads down to a chamber, or huge space, filled with magma, which comes from the mantle. Tremendous pressure and heat in the mantle force magma in the chamber upward through the crack. If the pressure is great enough, magma erupts on the surface as lava.



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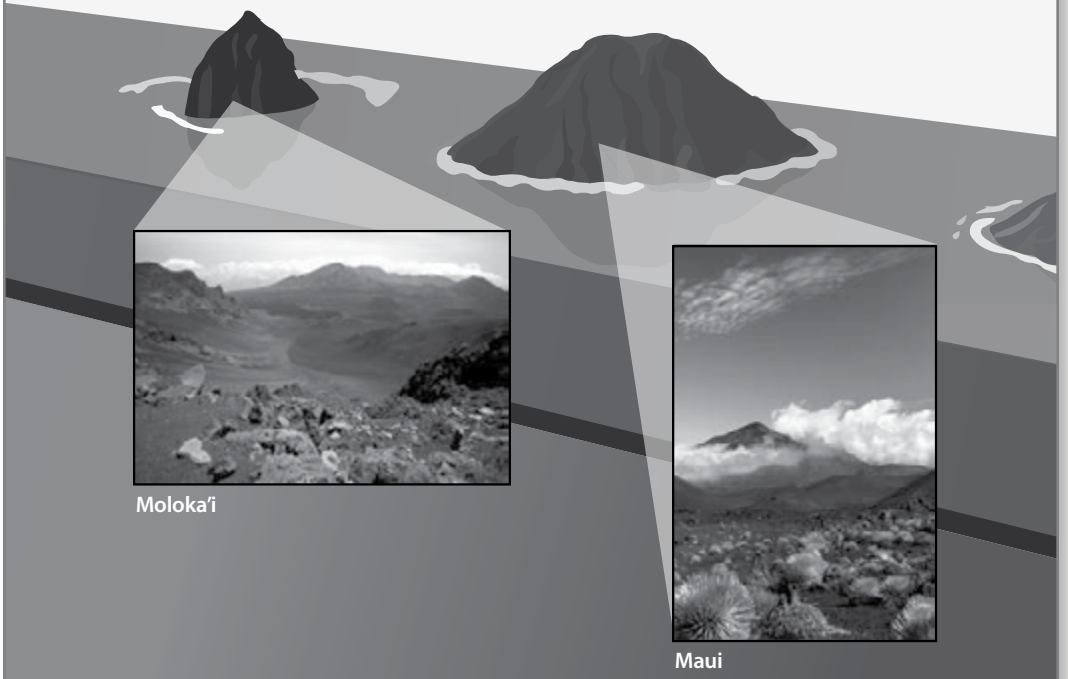
Hotspots

Not all volcanoes form along plate boundaries. Some occur in places that geologists call **hotspots**. A hotspot is a very hot region deep within the mantle. A huge magma chamber forms beneath Earth's crust at a hotspot. Magma periodically erupts from the chamber through cracks in the crust.

Geologists have identified dozens of hotspots worldwide. Some are beneath continental crust. Others are beneath oceanic crust. Hotspots underneath oceanic crust have formed many islands. The process begins when magma erupting from a hotspot forms a volcano on the seafloor. With repeated eruptions, the volcano grows taller and taller over time. Eventually the top of the volcano may rise above the ocean's surface and form an island.



Moloka'i

Maui

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Over a very long period of time, ocean hotspots may form chains of islands. This is because hotspots remain in the same place while tectonic plates slowly keep moving. The Hawaiian Islands, for example, were formed by a hotspot located beneath the middle of the Pacific Plate. The island of Kaua'i formed about 5 million years ago. It began as an undersea volcano that grew tall enough to rise above the water. As the Pacific Plate inched its way northwest, however, Kaua'i moved along with it. At some point, the island was no longer directly above the hotspot. A new underwater volcano began forming on the seafloor. This volcano grew to form the island of O'ahu. Next came the island of Moloka'i, then Maui, and finally the island of Hawai'i. Hawai'i currently lies over the hotspot, which is why it has so many active volcanoes. Eventually, Hawai'i will drift away from the hotspot and a new island will begin to form.

Island of Hawai'i

Several miles to the southeast of Hawai'i, there is an underwater volcano called Kama'ehuakanaloa (previously known as Lō'ihi). Scientists estimate its top will reach the sea surface in tens of thousands of years.

Mythic Volcano Spirits: Hawai'i's Goddess of Fire

Pele had a magic digging stick. When she jabbed the stick into the ground, a crater would open up in which volcanic fires burned. Pele began digging along Kaua'i's rocky coast. Every time she made a crater, seawater mysteriously flooded in and put out the flames. Much to her dismay, Pele discovered that her sister, Na-maka-o-kaha'i, had followed her to Kaua'i. Na-maka-o-kaha'i was trying to ruin Pele's plans to build a home and get married.

Hoping to ***outsmart*** *her hateful sister, Pele fled to O'ahu, the next island in the Hawaiian chain. She took her youngest sister, Hi'iaka, and her brothers with her. Na-maka-o-kaha'i followed them and, once again, she caused seawater to fill every crater Pele dug. So Pele kept moving, traveling to the islands of Moloka'i and then Maui. There, too, Na-maka-o-kaha'i worked her watery magic. Time and again, she turned Pele's craters into cold, wet holes in the ground.*

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Finally, Pele reached Hawai'i, the largest island in the chain. Pele climbed the mountain called Kīlauea and dug a crater at its top. The bright orange flames of volcanic fire flared and did not go out. Pele's crater on Kīlauea was far above the sea, out of the reach of the ocean goddess.

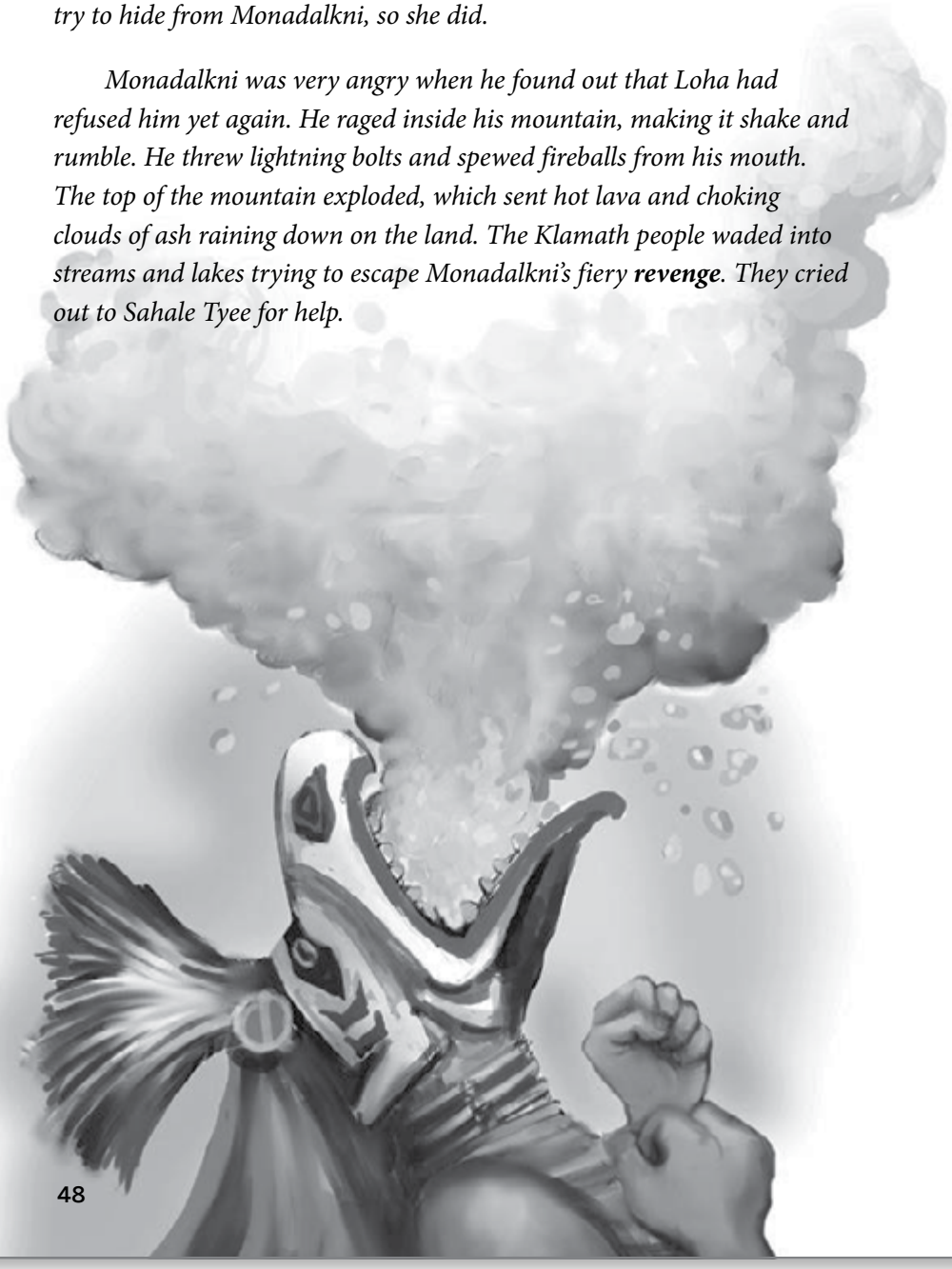
Princess Power

In 1880, Mauna Loa erupted. A large lava flow crept down the mountainside toward the city of Hilo. The Hawaiian princess Ruth Keelikolani traveled to the scene as the lava neared the city. Princess Ruth stood directly in the path of the advancing lava. She recited ancient chants and made offerings to Pele. The next day the lava flow stopped. This helped keep belief in Pele alive.

Mythic Volcano Spirits: The Origin of Crater Lake

*She ran to her father and asked for help. The chief of the Klamath people called the tribal **elders** together. They all agreed that Loha should try to hide from Monadalkni, so she did.*

*Monadalkni was very angry when he found out that Loha had refused him yet again. He raged inside his mountain, making it shake and rumble. He threw lightning bolts and spewed fireballs from his mouth. The top of the mountain exploded, which sent hot lava and choking clouds of ash raining down on the land. The Klamath people waded into streams and lakes trying to escape Monadalkni's fiery **revenge**. They cried out to Sahale Tyee for help.*



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The Chief of the Above World came to the aid of his people. He fought Monadalkni and the two spirits waged a violent, fiery battle. Sahale Tyee eventually gained the upper hand and forced Monadalkni back down into his mountain. Sahale Tyee caused the top of the mountain to collapse, forever shutting off this entrance to the Below World.

The Klamath elders prayed for rain. The rains came and put out the volcanic fires. Rainwater filled the caldera on the mountaintop, creating the high, deep body of water known today as Crater Lake.

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Using information from the excerpts, make notes on how volcanic activity is explained in the excerpts. Shaded cells indicate that no information is needed there.

Volcanic Activity	"Earth's Fiery Volcanoes"	"Mythic Volcano Spirits: Hawai'i's Goddess of Fire"	"Mythic Volcano Spirits: The Origin of Crater Lake"
creation of volcanoes on an island chain			
eruptions			

1. What similarities do you notice across excerpts?

2. What differences do you notice across excerpts?

NAME: _____

DATE: _____

9.1 Take-Home

Excerpts from "Earth's Building Blocks"

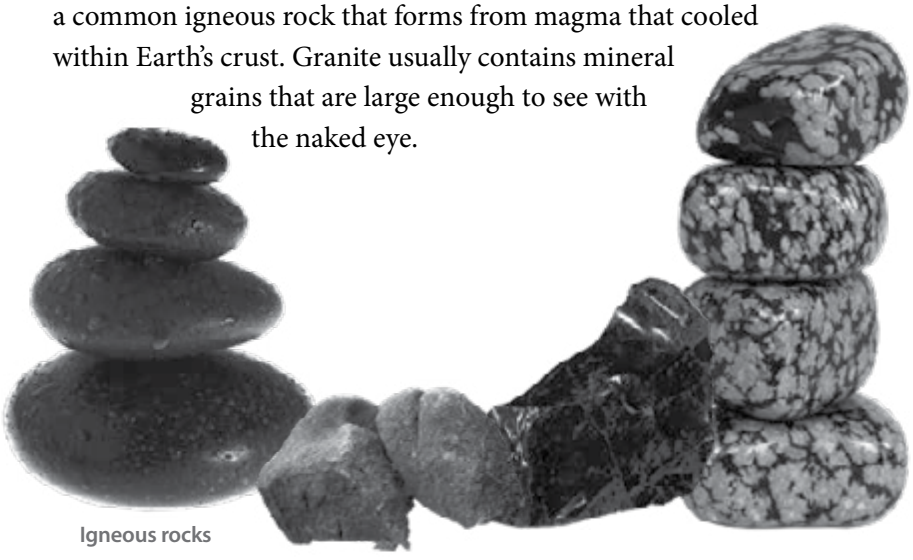
Read the following excerpt and use it to complete the activity that follows.

Born from Magma: Igneous Rock

Let's start with **igneous rocks**, the most abundant class of rocks on the earth. Igneous rocks form when magma cools and **solidifies**. When you think of igneous rocks, think of volcanoes.

There are two basic types of igneous rock. One type forms from magma that erupts onto Earth's surface as lava. The lava cools and hardens into rock. The faster it cools, the smaller the mineral grains will be in the resulting rock. **Obsidian** is an igneous rock formed from lava that cooled very quickly, so quickly, there wasn't time for the minerals to form grains. As a result, obsidian is as smooth and shiny as glass. In fact, it is often called volcanic glass. Basalt is an igneous rock formed from lava that took longer to cool. Basalt is typically a dark-colored rock. It has fairly small mineral grains that give it a fine-grained texture.

The second type of igneous rock forms from magma that solidifies below Earth's surface. Magma cools very slowly when it's deep beneath the surface. Slow cooling leads to igneous rocks with relatively large mineral grains. The slower the cooling, the larger the grains. **Granite** is a common igneous rock that forms from magma that cooled within Earth's crust. Granite usually contains mineral grains that are large enough to see with the naked eye.



Igneous rocks

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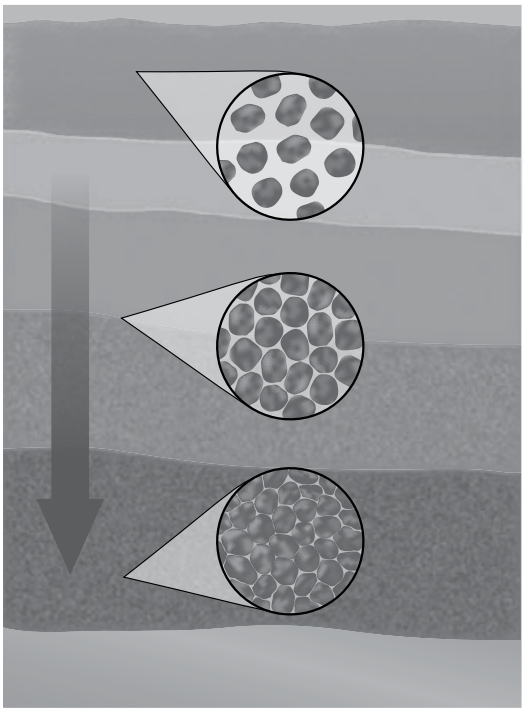
Layer After Layer: Sedimentary Rock

Sedimentary rock is the second major class of rocks. Sedimentary rocks are made of sediments. Sediments are tiny bits of rock and sand combined with fragments of once-living things. Sediments collect in low-lying areas both on land and in bodies of water. They form layers, one on top of another. Over long periods of time, the weight of overlying layers **compacts** the sediments in deeper layers, squeezing them closer together. Sediments also become cemented, or glued, together as **dissolved** minerals fill the spaces between the sediments. As the sediments dry, the dissolved minerals turn into solids, binding the sediments together. Over time, compacting and cementing processes transform sediments into sedimentary rock.



The weight of overlying layers compacts the sediments, squeezing them closer together.

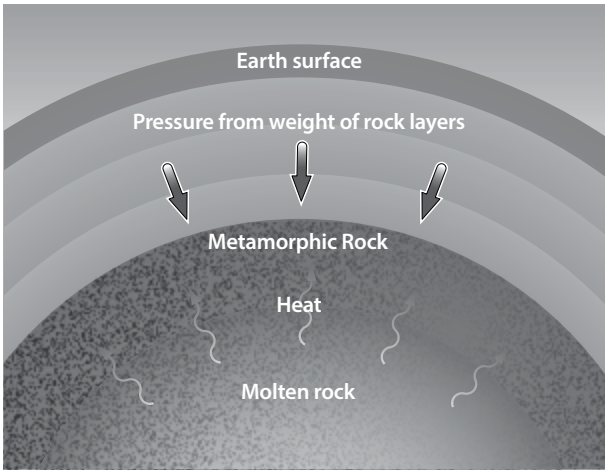
Most sedimentary rocks are more easily broken than most igneous rocks. Hit a sedimentary rock with a hammer, and it will crumble or break apart. Some sedimentary rocks contain fossils. **Limestone** is a sedimentary rock often packed with the fossilized skeletons and shells of tiny ocean creatures. Some sedimentary rocks get their name from their sediments. Sandstone started as grains of sand, whereas mudstone formed from ancient mud.

Changing Form: Metamorphic Rock

The third major class of rocks is **metamorphic rock**. Metamorphic rocks form when igneous or sedimentary rocks are exposed to extreme heat and pressure. They can even form from older metamorphic rocks. High temperatures and crushing pressure alter the minerals in the rocks. Mineral grains may be flattened or rearranged into layers, swirls, or stripes. They may also be changed into completely different minerals!

Remember granite, the igneous rock? When granite is subjected to intense heat and pressure, it becomes a metamorphic rock called gneiss. When the sedimentary rock limestone is squeezed and heated deep below ground, it becomes a metamorphic rock called marble.

Metamorphic rocks tend to form deep within Earth's crust. The pressure from countless tons of overlying rock is tremendous. Equally powerful is the heat rising from hot magma in the mantle beneath the crust. Metamorphic rocks often form where tectonic plates are slowly colliding. They can also form as magma travels up through cracks in Earth's crust and heats the rocks around the cracks. If the heat of the magma completely melts the rock again, then it becomes igneous rock. If the rock is heated just enough to be changed, however, it instead becomes metamorphic rock.



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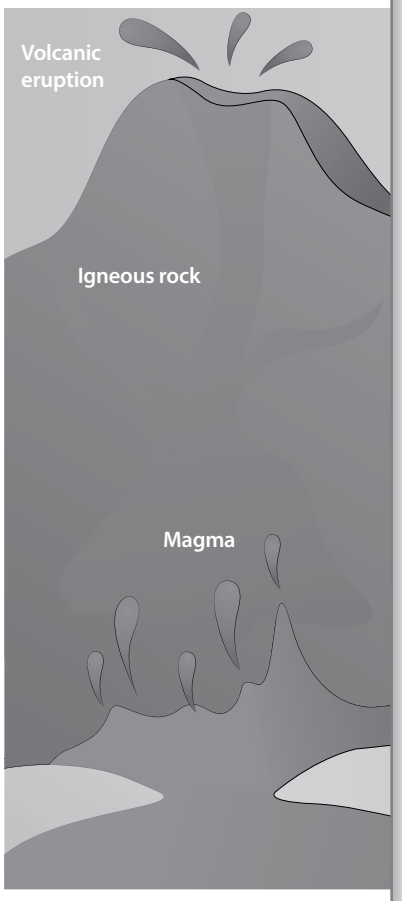
The Rock Cycle

Rocks you see in the world around you might seem like permanent fixtures. Given enough time, however, all rocks change. They are created, destroyed, and recreated in a continuous cycle. Geologists call this ongoing process the **rock cycle**.



The rock cycle has no starting or ending point. You can jump in anywhere to see how it works. Let's begin with magma erupting from a towering volcano. The magma (now lava) cools and hardens into igneous rock. Over the course of thousands of years, sun, wind, rain, and freezing temperatures cause the rock to **weather**, or break down into smaller pieces. The pieces continue to weather, slowly breaking down into sediments. Howling winds, flowing water, and gravity gradually move the sediments down the sides of the volcano and beyond. Movement of sediments from place to place is called **erosion**.

Imagine that the sediments end up in a lake, where they settle to the bottom. Over long periods of time, more layers of sediments are deposited on top of them. Compacting and cementing processes eventually turn the deeply buried sediments into sedimentary rock.

Now imagine that the sedimentary rock is near the edge of a tectonic plate. The plate collides with another plate—very slowly, of course. Tremendous heat and pressure generated by the collision gradually turn the sedimentary rock into metamorphic rock. As the plates continue colliding, their rocky edges crumple. The metamorphic

NAME: _____

DATE: _____

Write the correct word or phrase to complete each sentence. Each of the words/phrases will be used once.

compacted	erosion	magma	igneous	metamorphic
obsidian	rock cycle	sedimentary	solidified	texture

1. Lava flowed down the volcano's side and quickly hardened to form a glassy type of _____ rock.

2. Tiny flakes of _____ fell on the ground as an ancient tool maker worked to create a sharp blade for cutting.

3. The tiny flakes of rock were washed into a nearby stream, where they joined other sediments created by the _____ of rock from the nearby mountains.

4. The sediments formed layers on the stream bed, which _____ over time as the weight of the layers squeezed out the air and water.

5. The sediments cemented together and _____ into rock.

6. _____ rock was buried by even more layers of sediments over millions of years.

7. The heat and pressure from the weight of the overlying rock changed the _____ of the minerals in the rock.

8. New _____ rock formed and lay buried in the earth for millions of years.

9. Heat from _____ below the rock melted it, turning it into igneous rock.

10. As part of its journey through the _____, this piece of rock might someday be found on a beach in Maine or a mountaintop in Tennessee!

NAME: _____

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10.1 **Take-Home**

Earth's Powerful Forces of Change

The following words were used in Chapter 7, "Earth's Powerful Forces of Change." For each word, pick an activity and complete the chart below.

sweep finest accumulate countless deposit massive	**Vocabulary Activities** 1. Write a definition in your own words. 2. Provide a synonym (similar meaning). 3. Provide an antonym (opposite meaning). 4. Use the word in a sentence. 5. Provide another word that the word or phrase makes you think of and explain why. (*Apple* makes me think of bananas because they are both fruits.) 6. Think of an example of the word or phrase and write about it. (An example of *fruit* is cantaloupe. It is a melon that is white on the outside and orange on the inside. They are really tasty in the summer.)

Word	Activity	Activity Response

NAME: _____

DATE: _____

11.1 Take-Home

Spelling Words

The following is a list of spelling words. These words are related to the content of the Reader, The Changing Earth.

During Lesson 15, you will be assessed on how to spell these words. Practice spelling the words by doing one or more of the following:

- *spell the words out loud*
- *write sentences using the words*
- *copy the words onto paper*
- *write the words in alphabetical order*

When you practice spelling and writing the words, remember to pronounce and spell each word one syllable at a time.

1. fault
2. tsunami
3. geyser
4. erosion
5. glacier
6. tectonic
7. molten
8. seismograph
9. epicenter
10. conclusion

The following chart provides the meanings of the spelling words. You are not expected to know the word meanings for the spelling assessment but it may be helpful to have them as a reference as you practice the spelling words.

Spelling Word	Definition
fault	a crack in Earth's crust
tsunami	a gigantic wave of seawater caused by an earthquake in oceanic crust
geyser	an underground hot spring that periodically erupts, shooting hot water and steam into the air
erosion	any process or force that moves sediments to new locations
glacier	an enormous, slow-moving mass of ice found in polar regions and near tops of tall mountains
tectonic	relating to the process of plate movement on Earth's surface
molten	melted
seismograph	an instrument used to track seismic waves traveling through the earth
epicenter	the point on Earth's surface directly above an earthquake's focus
conclusion	a decision or opinion formed based on information you have

NAME: _____

DATE: _____

Practice Spelling Words

Write each spelling word under its definition. Then identify the word's part of speech.

epicenter	tsunami	seismograph	glacier	geyser
conclusion	molten	erosion	fault	tectonic

1. an underground hot spring that periodically erupts, shooting hot water and steam into the air

   Spelling Word: _____

   Part of Speech: _____

2. melted

   Spelling Word: _____

   Part of Speech: _____

3. any process or force that moves sediments to new locations

   Spelling Word: _____

   Part of Speech: _____

4. the point on Earth's surface directly above an earthquake's focus

   Spelling Word: _____

   Part of Speech: _____

5. relating to the process of plate movement on Earth's surface

   Spelling Word: _____

   Part of Speech: _____

6. a crack in Earth's crust

   Spelling Word: _____

   Part of Speech: _____

7. an instrument used to track seismic waves traveling through the earth

   Spelling Word: _____

   Part of Speech: _____

8. an enormous, slow-moving mass of ice found in polar regions or near tops of tall mountains

   Spelling Word: _____

   Part of Speech: _____

9. a decision or opinion formed based on information you have

   Spelling Word: _____

   Part of Speech: _____

10. a gigantic wave of seawater caused by an earthquake in oceanic crust

    Spelling Word: _____

    Part of Speech: _____

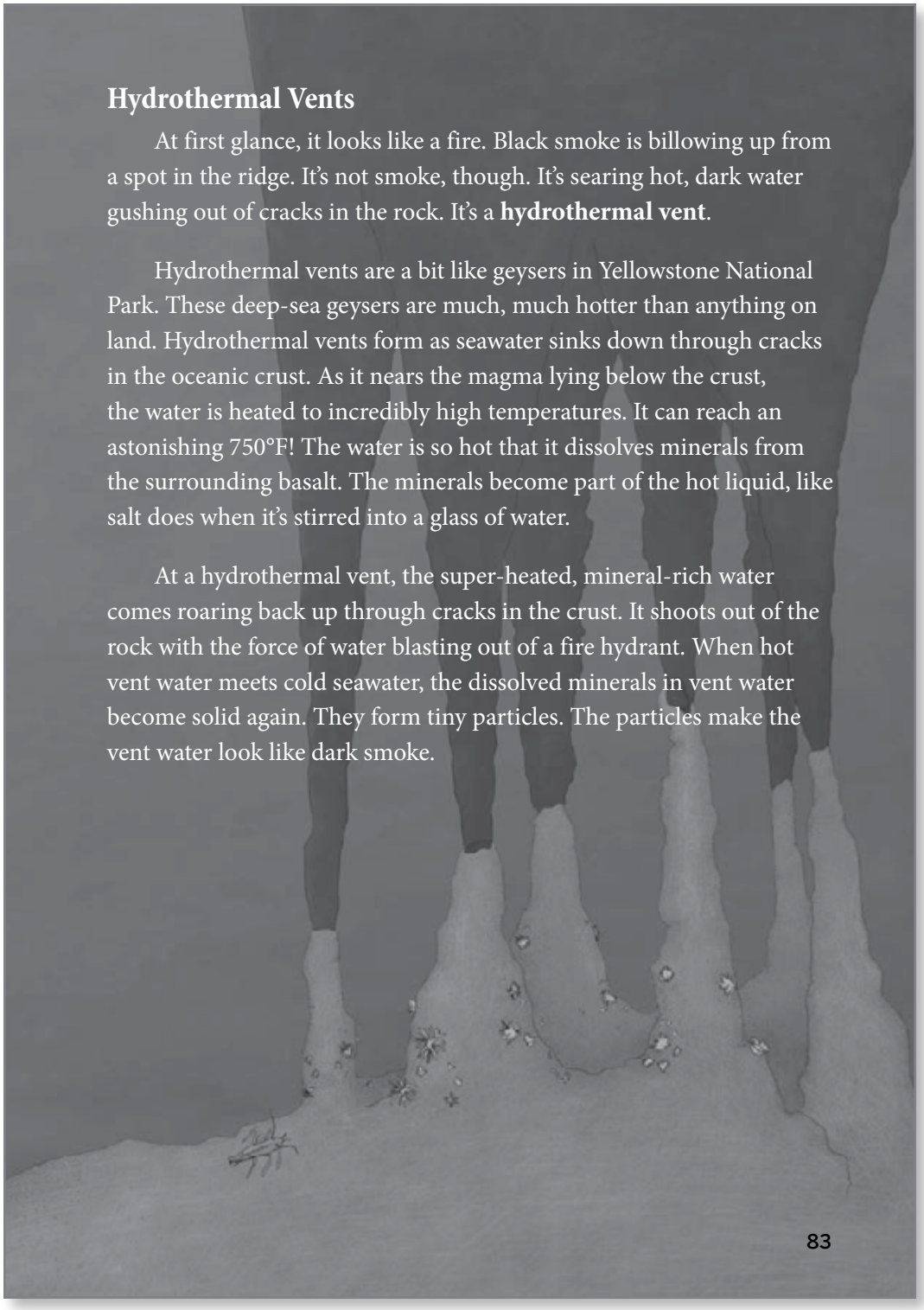
NAME: _____

DATE: _____

13.1 **Take-Home**

Excerpt from "Earth's Undersea World"

Imagine you are a geologist searching for a hydrothermal vent as you read the following excerpt. Answer the questions following the excerpt in complete sentences.



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.

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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

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NAME: _____

DATE: _____

1. What clues tell you that you are close to a vent?

2. How would you get close enough to observe the vent?

3. What would you discover on the seafloor near the vent?

4. Why is it important to conduct your underwater mission?

Grade 4

Answer Key

TAKE-HOME ANSWER KEY

NAME: _____

DATE: _____

1.1 CONTINUED Take-Home

The following chart contains a statement about Alfred Wegener's continental drift hypothesis. Using information from the excerpt, write five pieces of evidence that support Wegener's hypothesis.

Hypothesis	Long ago, continents were joined as one supercontinent that broke apart and the pieces slowly drifted away from each other.
Evidence	1. Rock layers along the northern and eastern coasts of South America match rock layers along Africa's western coast.
	2. Deposits of coal and salt in eastern North America are similar to those in southern Europe.
	3. Fossils of the ancient fern *Glossopteris* found in similar rock layers in Africa, India, Australia, South America, and Antarctica
	4. Fossils of the ancient reptile *Lystrosaurus* found in southern Africa and India
	5. Fossils of the ancient reptile *Cynognathus* found in South America and Africa

NAME: _____

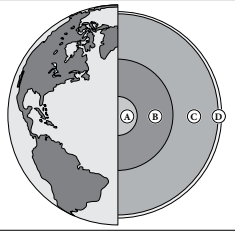
DATE: _____

3.1 Take-Home

Excerpt from "Earth's Layers and Moving Plates"

Read the following excerpt and use it to label Earth's layers in the diagram that follows.

Earth's deepest layer is a solid inner core of very hot metal. This metal may be nearly as hot as the sun's surface. The outer core is also made of hot metal, but it's liquid, not solid. The mantle surrounds the outer core. The mantle is Earth's largest and thickest layer and consists of very hot, very dense rock. The rock is solid in the lower and upper parts of the mantle. In between, however, is a region where the rock is neither liquid nor solid. The slow movement and behavior of this material, caused by heat and pressure, have an impact on Earth's surface. Above the mantle is Earth's outermost layer, the thin, rocky crust. There are two types of crust: oceanic crust and continental crust. Oceanic crust is covered by ocean water. Most of the continental crust is dry land, but some of the crust around the edges is covered by water. Oceanic crust is thinner but heavier than continental crust.



A. inner core

B. outer core

C. mantle

D. crust

Use the correct word from the word bank to fill in each blank in the following paragraphs.

trench	theory	plate	subduction
continental	tectonic	collide	

Sam is excited to tell his family what he is reading and learning about geology at school. His cousins live in the South American country of Chile, and today he learned that there is a deep ocean ___trench___ along Chile's coast. He explained, "There are two ___tectonic___ plates that meet along the western coast of South America. One is a ___continental___ plate and one is an oceanic plate. The heavier oceanic plate is sliding beneath the lighter continental ___plate___. And, this process has a big name I learned today—it's called ___subduction___!"

"I think I know how the Andes Mountains of South America are formed," exclaimed Sam's dad. "When the plates ___collide___ at plate boundaries along the Pacific Coast, I bet the continental crust crumples and gets pushed higher and higher to form the mountains. I learned about the ___theory___ of plate tectonics when I was in school, too."

Sam's dad described an earthquake that the country of Chile had recently experienced. Sam said, "Hmmm . . . I wonder if earthquakes have anything to do with moving tectonic plates?"

What do you think?

1. According to the excerpt, what does the theory of plate tectonics explain?

   The theory explains how Earth's surface and interior change over very long periods of time.

2. The last sentence of the excerpt states, "In fact, one of the easiest ways to locate plate boundaries is to determine where earthquakes are occurring!" How does the image on the page support this statement?

   The dots marking past earthquake epicenters all sit on or near plate boundaries.

NAME: _____

DATE: _____

6.2 Take-Home

Practice Spelling Words

Sort the spelling words into categories based on the root in each word.

uninterrupted	matriarch	hierarchy	abrupt
archrival	calligraphy	eruption	paragraph
autograph	rupture	anarchy	biographer

arch	*graph*	*rupt*
matriarch	calligraphy	uninterrupted
hierarchy	paragraph	abrupt
archrival	autograph	eruption
anarchy	biographer	rupture

List the spelling words in alphabetical order. Remember to pronounce and spell the words syllable by syllable.

1. abrupt
2. anarchy
3. archrival
4. autograph
5. biographer
6. calligraphy
7. eruption
8. hierarchy
9. matriarch
10. paragraph
11. rupture
12. uninterrupted

Using information from the excerpts, make notes on how volcanic activity is explained in the excerpts. Shaded cells indicate that no information is needed there.

Volcanic Activity	"Earth's Fiery Volcanoes"	"Mythic Volcano Spirits: Hawai'i's Goddess of Fire"	"Mythic Volcano Spirits: The Origin of Crater Lake"
creation of volcanoes on an island chain	underwater volcano creates island, plate movement moves island and a new island starts	Pele tried to get away from her sister	
eruptions	pressure in mantle causes magma to erupt as lava	Pele gets mad and sends out lava rivers	Monadalkni was angry Loha refused him

1. What similarities do you notice across excerpts?

Answers may vary.

2. What differences do you notice across excerpts?

Answers may vary.

NAME: _____

DATE: _____

9.1 CONTINUED Take-Home

Write the correct word or phrase to complete each sentence. Each of the words/phrases will be used once.

compacted	erosion	magma	igneous	metamorphic
obsidian	rock cycle	sedimentary	solidified	texture

1. Lava flowed down the volcano's side and quickly hardened to form a glassy type of ___igneous___ rock.
2. Tiny flakes of ___obsidian___ fell on the ground as an ancient tool maker worked to create a sharp blade for cutting.
3. The tiny flakes of rock were washed into a nearby stream, where they joined other sediments created by the ___erosion___ of rock from the nearby mountains.
4. The sediments formed layers on the stream bed, which ___compacted___ over time as the weight of the layers squeezed out the air and water.
5. The sediments cemented together and ___solidified___ into rock.
6. ___Sedimentary___ rock was buried by even more layers of sediments over millions of years.
7. The heat and pressure from the weight of the overlying rock changed the ___texture___ of the minerals in the rock.
8. New ___metamorphic___ rock formed and lay buried in the earth for millions of years.

9. Heat from magma below the rock melted it, turning it into igneous rock.

10. As part of its journey through the rock cycle, this piece of rock might someday be found on a beach in Maine or a mountaintop in Tennessee!

NAME: _____

DATE: _____

11.2 Take-Home

Practice Spelling Words

Write each spelling word under its definition. Then identify the word's part of speech.

epicenter	tsunami	seismograph	glacier	geyser
conclusion	molten	erosion	fault	tectonic

1. an underground hot spring that periodically erupts, shooting hot water and steam into the air
   Spelling Word: geyser
   Part of Speech: noun

2. melted
   Spelling Word: molten
   Part of Speech: adjective

3. any process or force that moves sediments to new locations
   Spelling Word: erosion
   Part of Speech: noun

4. the point on Earth's surface directly above an earthquake's focus
   Spelling Word: epicenter
   Part of Speech: noun

5. relating to the process of plate movement on Earth's surface
   Spelling Word: tectonic
   Part of Speech: adjective

6. a crack in Earth's crust
   Spelling Word: fault
   Part of Speech: noun

7. an instrument used to track seismic waves traveling through the earth
   Spelling Word: seismograph
   Part of Speech: noun

8. an enormous, slow-moving mass of ice found in polar regions or near tops of tall mountains
   Spelling Word: glacier
   Part of Speech: noun

9. a decision or opinion formed based on information you have
   Spelling Word: conclusion
   Part of Speech: noun

10. a gigantic wave of seawater caused by an earthquake in oceanic crust
    Spelling Word: tsunami
    Part of Speech: noun

NAME: _____

DATE: _____

13.1 CONTINUED Take-Home

1. What clues tell you that you are close to a vent?
   A plume of black smoke appears.

2. How would you get close enough to observe the vent?
   A robot vehicle would get closer to the vent and take pictures to send back to scientists.

3. What would you discover on the seafloor near the vent?
   One might discover amazing and unusual sea creatures, like giant tube worms, white crabs, football-sized clams, and blind shrimp.

4. Why is it important to conduct your underwater mission?
   Hydrothermal vents are a great place to discover interesting species as well as to gain understanding of the makeup of the earth.

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