



SCIENCE • GRADE 4

Science Content Standards

Earth Sciences: 5.A

Earth Sciences: 5.B

Earth Sciences: 5.C

Above Level

Our Changing Earth

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Arts Activities

Our Changing Earth

California's Content Standards Met

GRADE 4 SCIENCE

- EARTH SCIENCES: 5**—Waves, wind, water, and ice shape and reshape Earth's land surface. As a basis for understanding this concept:
- Students know how some changes in the earth are due to slow processes, such as erosion, and some changes are due to rapid processes, such as landslides, volcanic eruptions, and earthquakes.
 - Students know natural processes, including freezing and thawing and the growth of roots cause rocks to break down into smaller pieces.
 - Students know moving water erodes landforms, reshaping the land by taking it away from some places and depositing it as pebbles, sand, silt, and mud in other places (weathering, transport, and deposition).

GRADE 4 ENGLISH LANGUAGE ARTS

2.0 READING COMPREHENSION

Structural Features of Informational Materials 2.1—Identify structural patterns found in informational text (e.g., compare and contrast, cause and effect, sequential or chronological order, proposition and support) to strengthen comprehension.

Comprehension and Analysis of Grade-Level-Appropriate Text 2.2—Use appropriate strategies when reading for different purposes (e.g., full comprehension, location of information, personal enjoyment).

Comprehension and Analysis of Grade-Level-Appropriate Text 2.3—Make and confirm predictions about text by using prior knowledge and ideas presented in the text itself, including illustrations, titles, topic sentences, important words, and foreshadowing clues.

Comprehension and Analysis of Grade-Level-Appropriate Text 2.6—Distinguish between cause and effect and between fact and opinion in expository text.



SCIENCE • GRADE 4

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Earth Sciences: 5.A

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Above Level

Student Book

Our Changing Earth

Print pages 5 – 18 of this PDF for the student book.

How to Make the Student Book

- The student book is contained on pages 5–18 of this PDF. It begins on the next page.
- To make one student book, or a two-sided master copy that can be photocopied, you will print on both sides of seven sheets of 8.5" x 11" paper.
- Do a test printout of one book first to familiarize yourself with the procedure.
- Follow these instructions carefully.

First—Select the Paper

Since you will be printing on both sides of the sheets of paper, select a good quality white paper. We recommend using at least a 22lb sheet.

Second—Check Printer Settings

Be sure you have the correct page setup settings for your computer and printer. You will print these pages in landscape format.

Third—Print EVEN Pages

Open the PDF of the book you want to print. Select print from your file menu. In your printer's dialogue box enter pages 5–18 to print. Then select EVEN pages only. It is important to print only the EVEN pages first. Click "Print" to print the even pages. (**Important note:** The first page that prints will be blank. DO NOT discard this page. It will be needed to print the cover in the next step.)

Forth—Print ODD Pages

When the even pages have printed, flip the stack of pages over to print the odd pages. Place the stack back in your printer. Select print from the file menu again. In your printer's dialogue box, select ODD pages. Click "Print" to print the odd the pages.

Fifth—Fold the Book

You now have a complete book. Check to be sure the pages are in the correct order with the book's cover as the top page. Then fold the stack of paper in half.

Sixth—Staple the Book

Use an extended-length stapler to staple the pages together. Place three staples in the spine of the book.

Please note that printers vary in how they output pages. Do a test printing with one book and adjust the procedure as necessary.

If you want to make a one-sided master copy, print ALL pages 5–18 at once. Then select "one-sided to two-sided" on the copy machine.

Our Changing Earth

California's Content Standards Met

AL

GRADE 4 SCIENCE

EARTH SCIENCES: 5—Waves, wind, water, and ice shape and reshape Earth's land surface. As a basis for understanding this concept:

- a. Students know how some changes in the earth are due to slow processes, such as erosion, and some changes are due to rapid processes, such as landslides, volcanic eruptions, and earthquakes.
- b. Students know natural processes, including freezing and thawing and the growth of roots cause rocks to break down into smaller pieces.
- c. Students know moving water erodes landforms, reshaping the land by taking it away from some places and depositing it as pebbles, sand, silt, and mud in other places (weathering, transport, and deposition).

GRADE 4 ENGLISH LANGUAGE ARTS

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SCIENCE • GRADE 4

Science Content Standards

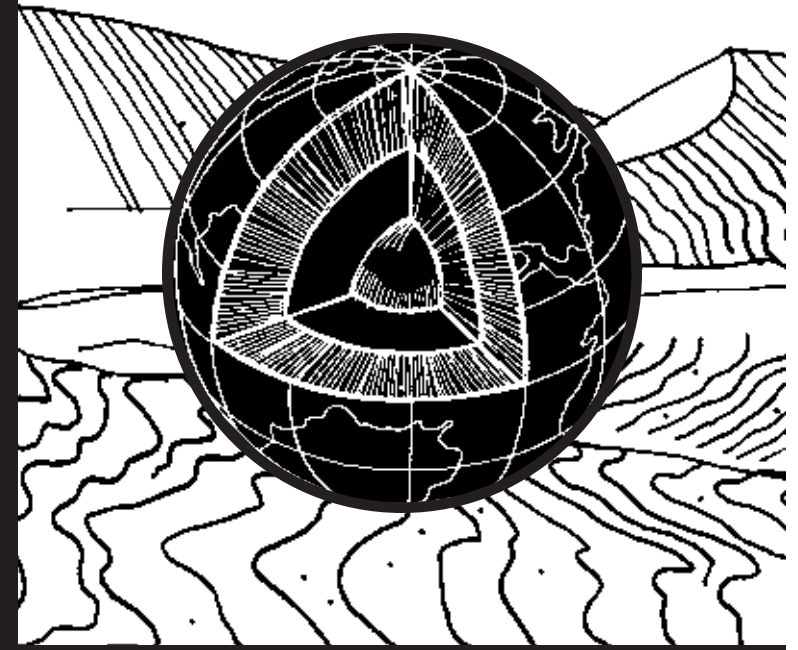
Earth Sciences: 5.A

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Our Changing Earth

by Caitlin Scott





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INTRODUCTION

Earth Is Changing

The surface of Earth is constantly changing. Most of these changes happen gradually. For example, on sandy beaches everywhere on Earth, the wind is blowing sand into large piles called sand dunes. All the rivers of Earth are slowly washing dirt and small rocks downstream to the ocean. These slow changes are gentle and do not disrupt plant and animal life.

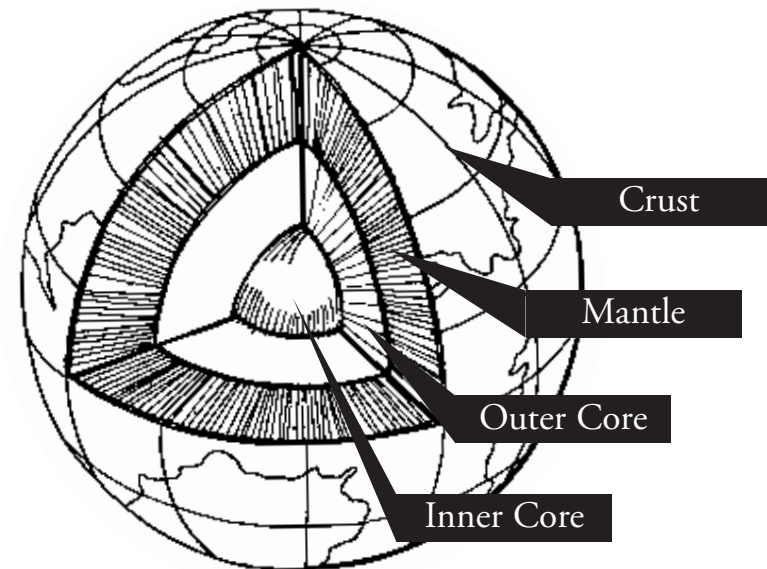
However, Earth is changing rapidly, too. These fast changes can be extremely dramatic. They can kill plants and animals. Sometimes, they even bring down buildings and put people in danger. Fast Earth-changing processes include:

- earthquakes
- volcanoes
- landslides

CHAPTER 1

Causes of Slow Changes

The planet Earth is made up of four different layers. Most slowly occurring changes take place on the crust which is thinner and more **brittle** than the other layers. There are several different **natural** processes that cause these slow changes.



brittle: easily broken

natural: not made by man

Wind

Have you ever seen a dirt devil or a dust storm? In a dust storm, the wind might blow dust across a road or field. Sometimes this dust forms a rotating funnel, which people call a dirt devil. Wind carrying dirt away is a type of **erosion**. On a beach, wind erosion can move sand several miles.

Water

Like wind, water can also change the surface of Earth. Water can transport soil and rocks to other places. Most of the time this happens very slowly.

For example, rain on a rocky cliff can wear down the rock over thousands of years, or a river can slowly carve out the riverbanks. This creates twists and turns in the river. Sometimes these twists break off and create small ponds or lakes called oxbows beside the river.

Flooding can carry soil and rocks away more quickly. This can be quite dangerous.

erosion: the process of slowly wearing away; a type of weathering

Ice

Ice doesn't move dirt and rocks in quite the same way as water and wind do. You might not think ice could cause changes to Earth, but it can. Like wind and water, ice changes Earth slowly and depends on the seasons.

Water freezes at 0 degrees Celsius or 32 degrees Fahrenheit. When water freezes, it **expands** rapidly. Have you ever left a soda can in the freezer by accident? If so, you know that the soda can swells, pushing out the top and bottom of the can. It almost looks as if the soda is about to break out of the aluminum can.

The same thing happens when water freezes inside the ground or inside a crack in a rock. The ice expands and breaks Earth's crust apart. Sometimes ice can even break a rock apart.

Describe how wind, water, and ice reshape Earth's land surface.

expands: gets bigger

Slow Change Processes

Most of Earth's slow changes are natural, but some changes are harmful to the plants and animals that live on Earth. It is important to learn about these changes and stop the harmful ones. There are two basic types of slow earth-changing processes.

Erosion—when wind, water, ice, or human activities wear away parts of Earth's crust.

Deposition—when weathered material is carried away to create land structures such as sand dunes on a beach.

*Think of all the ways erosion changes Earth.
Brainstorm a list with a friend.*

Erosion

Erosion is the breakdown of rocks and minerals. This breakdown can be caused by physical and chemical processes.

Physical Erosion

Physical erosion, also known as mechanical weathering, is the breakdown of large pieces of earth material into smaller ones through forces such as changes in heat, water movement, ice formation, and pressure.

For example, water can seep into cracks in rock. When the water freezes, it expands and causes stress, or pressure, in the crack. As the stress increases, the crevice widens and breaks the rock or mineral apart.

Plants also can physically weather rocks and minerals in a similar way. Plant roots grow into cracks and slowly wedge the rock apart as they grow larger.

*Describe how plant growth and
freezing water causes erosion.*

Chemical Erosion

Physical erosion does not change the material that is being broken down. Chemical erosion does change the property of the material.

Chemical erosion is the process by which earth materials are **decomposed**, dissolved, or loosened by chemical processes which leads to a breakdown of the material. The internal structure of the material is altered by the addition or removal of chemical elements.

For example, when oxygen is added to material with iron, the iron forms rust. The surface of the iron has changed from a solid, hard surface to a loose, crumbly surface. The properties of the material has changed. It is not iron any more. It is now rust or iron oxide.

Both physical and chemical erosion lead to the deposition of rocks and minerals.

decompose: to break down into separate, basic parts

Deposition

Erosion is the process by which soil and weathered rock particles, such as gravel, sand, silt, and clay, are transported, or moved from one place to another. What happens to all that eroded dirt and rock when it is deposited someplace else? It doesn't disappear. The eroded material creates new landforms. This process is called deposition.

Deposition also changes the earth. For example, wind and waves erode the sand on a beach. Then, the sand piles up to form huge sand dunes.



If you look closely at a sand dune, you can often see a pattern on the surface of the dune. This shows how the wind is slowly moving the sand.

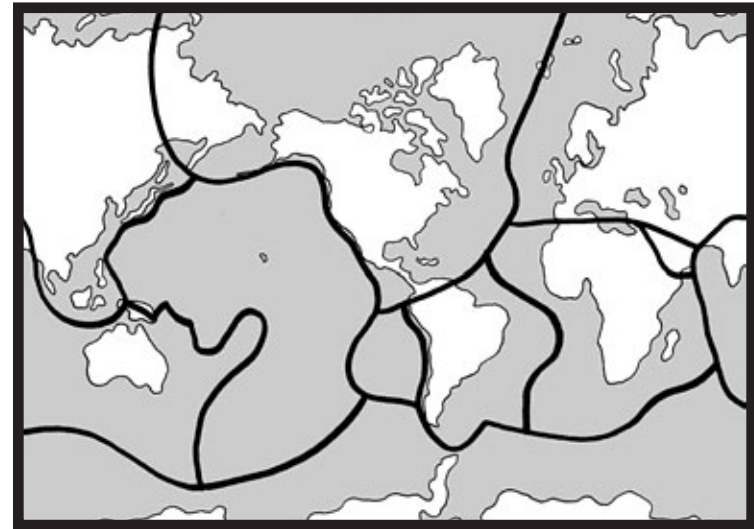
Fast Change Processes

When you look at a map of Earth, you might notice that the land could be fitted together like a puzzle. For example, South America and Africa look as if they could be puzzle pieces that fit together. That's because long ago, these continents were once side by side.

Earth is composed of layers. The crust, which is the layer we walk on as well as the layer right under the oceans, breaks easily. Below the crust, the mantle is much softer and very hot. The crust floats on the mantle in big pieces called plates. Approximately 300 million years ago, heat inside Earth began pushing the continents on the plates apart.

Most of the time, the plates move extremely slowly, but sometimes two plates moving past each other get stuck together. The pressure builds up; then, suddenly the plates move. This causes problems.

Earth's Major Plates



The dark lines on this map show the edges of Earth's major plates. These plates are always moving.

Earthquakes

When two of Earth's plates get stuck and then move suddenly, they can cause an earthquake on land. This earthquake occurs along the line where the plates were stuck together, shaking the land, buildings, and roads along the line. Sometimes, earthquakes cause gentle shaking that you might not even notice or that might be strong enough to knock a book off a table. Other times, earthquakes bring down entire buildings and rip roads in half.

Places where earthquakes occur frequently are called fault lines. On the map, you can see a dark fault line running down the west coast of North America. This is why the state of California gets a lot of earthquakes.



Where do the world's most damaging earthquakes occur? The strongest earthquakes occur along subduction zones, where one of Earth's plates is moving under another.

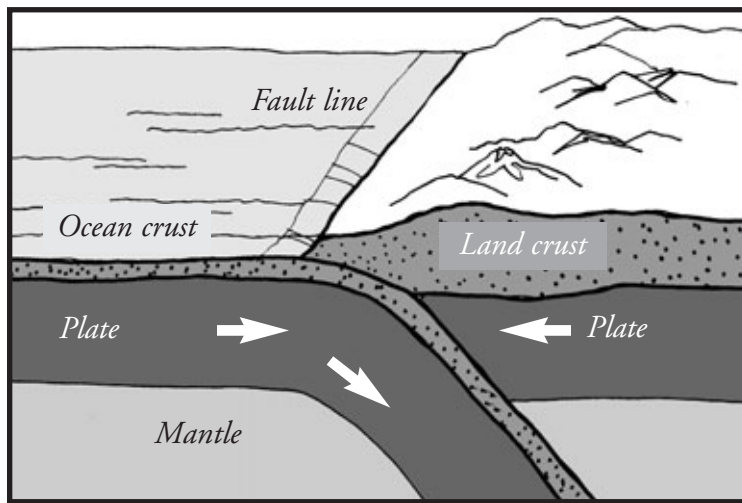
People who live in subduction zones should make a special effort to learn what to do in an earthquake. They should also make sure the buildings they live and work in can withstand earthquakes. In recent years, scientists have found ways to build buildings that will sway in an earthquake rather than fall down.

How can you protect yourself in an earthquake? The best thing to do is:

- drop to the ground.
- take cover by getting under something heavy like a desk or a doorway.
- hold on and wait for the ground to stop shaking.

Volcanoes

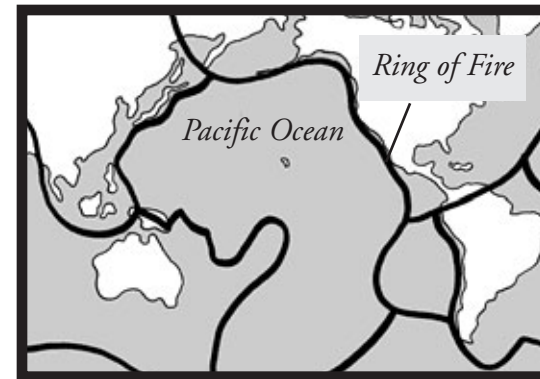
Volcanoes also happen along subduction zones, where one plate moves under another. Look at the diagram below. One plate is moving under another. When this happens heat is generated. This heat melts some of the rock. If the melted rock is pushed toward the crust, a volcano forms.



Along fault lines, one plate moves under another. This causes earthquakes. It can also form a volcano.

Volcanoes are very dangerous. The ground shakes when they **erupt**. Hot rocks, **lava**, ash, and mud fly up from the top of the mountain. The trees and buildings for miles around can be knocked down.

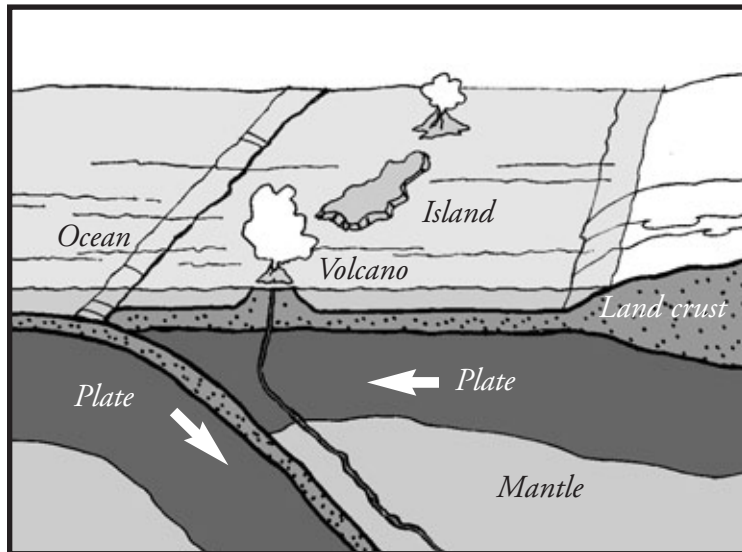
More than half of Earth's volcanoes form a ring around the Pacific Ocean. This is called the "Ring of Fire."



Fortunately, scientists are pretty good about predicting when a volcano will erupt. People usually have time to evacuate. If you live near a volcano and hear that it might erupt, listen to the news. Scientists will tell people when the volcano is likely to erupt and how to get away.

erupt: to explode with great force
lava: molten rock that flows or bursts from a volcano

Some subduction zones are underneath the ocean. The movement of the plates causes volcanoes to erupt under water. Eventually, the dirt, lava, mud, and rocks from the eruption break through to the surface, forming islands. This is how the Hawaiian Islands were formed. The volcanoes on the big island of Hawaii are still active.



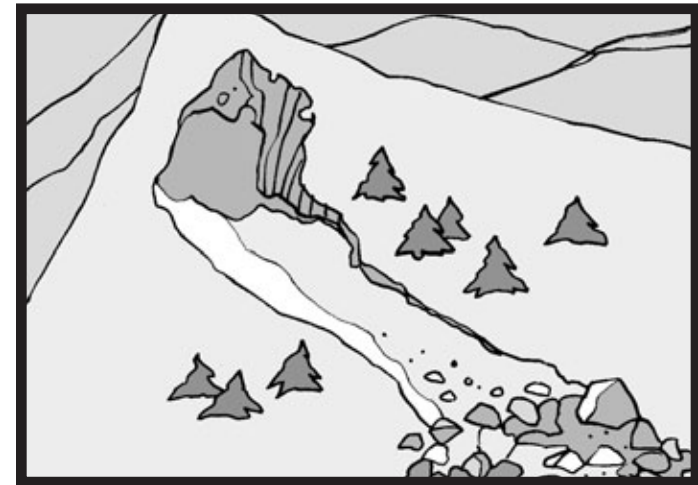
Heat from the two plates rubbing against each other cause rock to melt. The lava is pushed up, forming a volcano. This is how undersea volcanoes form islands.

Landslides

Most of the time, gravity causes slow changes on Earth's surface. For example, gravity can make broken rocks fall from a mountain top and send sand rolling downhill.

However, gravity also causes sudden changes. These changes are less common and can be extremely dangerous. Both landslides and avalanches are caused, in part, by gravity.

In a landslide, gravity makes mud and rocks suddenly slide downhill, burying buildings and destroying roads. These landslides can occur in any one of the 50 states. In the United States, landslides cause about \$2 to \$3 billion worth of damage a year.



Landslides often happen at the same time as other disasters. For example, when earthquakes or floods loosen dirt and rocks, gravity can cause a landslide. Human activities can also cause landslides. For example, sometimes digging on a steep hill causes a slide. Cutting down a lot of trees on a hill can also cause a slide, because the tree roots are no longer there to hold the land in place.

What can people do to protect themselves from landslides? The first thing to do is avoid building houses or other buildings on steep hills. This is especially important if the hills are along a fault line or if the hills flood frequently.

Second, people should be aware of shifts in the land. If trees or fence posts appear to be leaning over, there might be a landslide soon. If you are in a landslide, try to get away. If you can't get away, get under something heavy like a table and wait to be rescued.

Finally, after the landslide, you still need to be careful. Do not go into the landslide area, because the land may still be shifting.

CHAPTER 4

Wangari Maathai

Wangari Maathai was born in Nyeri, Kenya in 1940. She went to school to study biology. Afterward, Wangari decided to help people in Kenya. She noticed that many, many trees were being cut down all over the country, but very few trees were being replanted.



Without trees, the land eroded rapidly. The rain and wind carried the good, rich topsoil away. Soon, many small animals couldn't find enough to eat. Eventually, people began to have trouble farming and finding enough firewood to cook with and heat their homes.

To help solve these problems, Wangari formed the Green Belt Movement. She got Kenyan women to plant trees. The people cutting the trees didn't like this, but Wangari stuck with it.

Through Green Belt, Kenyan women have planted more than 20 million trees and much of the land has been restored. As a result of her work, Wangari won the Nobel Prize in 2004.

Glossary

brittle—easily broken

decompose—to break down into separate, basic parts

expands—gets bigger

erosion—the process of slowly wearing away; a type of weathering

erupt—to explode with great force

lava—molten rock that flows or bursts from a volcano

natural—not made by man

To Find Out More . . .

Want to learn more about how Earth changes?

Try these books

Erosion by Joelle Riley. Lerner Publications, 2006.

Volcanoes and Earthquakes by Andres Llamas Ruiz. Sterling Publishing Company, Inc., 1997.

Access these Web sites

U.S. Environmental Protection Agency
Land Revitalization Office

<http://www.epa.gov/oswer/landrevitalization/lrso.htm>

The Nature Conservancy
<http://www.nature.org/>

FEMA for Kids: Federal Emergency
Management Agency
<http://www.fema.gov/kids/>

Write for more information

The Nature Conservancy
4245 North Fairfax Drive, Suite 100
Arlington, VA 22203-1606

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ENGLISH-LANGUAGE ARTS • GRADE 4

California Content Standards

Structural Features of Informational Materials: 2.1

Comprehension and Analysis of Grade-Level-Appropriate Text: 2.2

Comprehension and Analysis of Grade-Level-Appropriate Text: 2.3

Comprehension and Analysis of Grade-Level-Appropriate Text: 2.6

Above Level

English-language Arts Activities

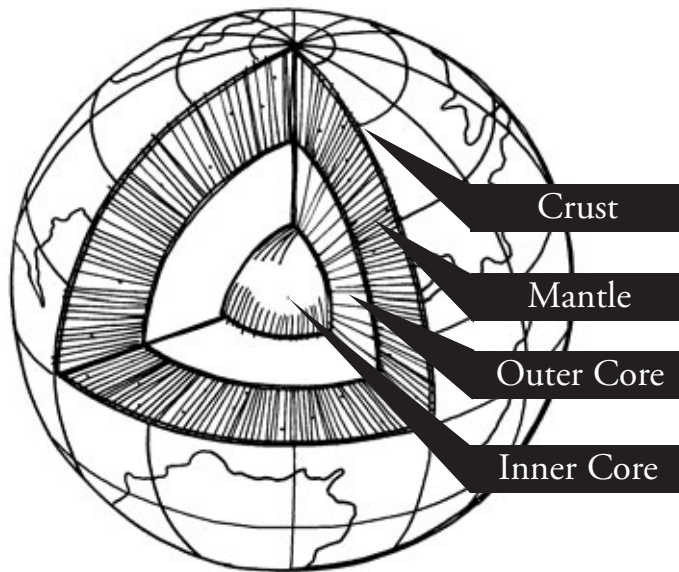
Our Changing Earth

Print pages 20–24 of this PDF for the reading activities.

Using Graphics to Predict

TRY THE SKILL

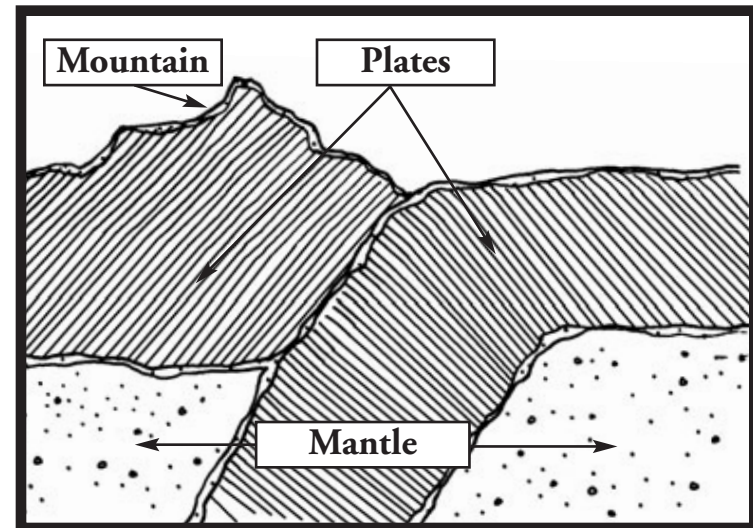
Graphics can give you information quickly and help you make predictions about the world. Look at this graphic showing the layers of Earth.



What does this graphic show you about the layers of Earth? Here is some information you get from the graphic.

- The crust is on the surface of Earth. It's very thin.
- The mantle is under the crust. It's thicker.
- The outer core is under the mantle.
- The inner core is under the outer core.

Study this graphic. What does it tell you about where earthquakes might occur? Write about it.



Proposition and Supporting Details

TRY THE SKILL

In some paragraphs, the author will begin with a statement or proposition. The sentences that follow will support or further explain the proposition.

Here is a paragraph from *Our Changing Earth*. The graphic organizer shows the proposition and supporting details.

Volcanoes are very dangerous. The ground shakes when they erupt. Hot rocks, lava, ash, and mud fly up from the top of the mountain. The trees and buildings for miles around can be knocked down.

Proposition

Volcanoes are very dangerous.

Supporting Details

- The whole ground shakes when they erupt.
- Hot rocks, lava, ash, and mud fly up from the top of the mountain.
- The trees and buildings for miles around can be knocked down.

Read this paragraph from the *Our Changing Earth*.

Landslides often happen at the same time as other disasters. For example, when earthquakes or floods loosen dirt and rocks, gravity can cause a landslide. Human activities can also cause landslides. For example, sometimes digging on a steep hill causes a slide.

Now complete this graphic.

Proposition

Supporting Details

Cause and Effect

TRY THE SKILL

A cause is why something happens. An effect is what happens as a result. Sometimes the cause is stated first, but sometimes the effect is first. Words such as *if*, *because*, *as*, and *when* are often used to state cause and effect.

Read this sentence.

When weathered material is carried away, new land structures, such as sand dunes, are created.

Which part of the sentence is the effect?

New land structures, such as sand dunes, are created.

This phrase tells *what* happens. Which part of the sentence is the cause?

When weathered material is carried away,

This phrase tells *why* new land structures are created.

Read these sentences. Then underline the cause and circle the effect.

1. When Earth's crust cracks, large pieces break off and start to float and move on the more liquid mantle.
2. As the stress increases, the crevice widens and breaks the rock or mineral apart.
3. The deforested land erodes quickly, because the trees are not there to help hold the land in place.
4. If a farmer plants crops in the same place too many times, plants use up the nutrients in the soil.
5. Natural erosion occurs when earth material is worn away.
6. When the water freezes, it expands and causes stress, or pressure, in the crack.
7. Cutting down a lot of trees on a hill can also cause a slide, because the tree roots are no longer there to hold the soil.
8. Perhaps because it is so thin, it is light and breaks easily.

Locating Information

TRY THE SKILL

Chapter headings in a table of contents tell what a chapter is going to be about. Subheadings tell more about the information within a chapter.

Read the beginning of the table of contents from another book about changes in Earth.

Introduction:

Earth Is Changing 4

Chapter 1:

Shifting Plates 6

Earthquakes 8

 Volcanoes 10

 Tsunamis 12

Chapter 2:

Gravity 14

 Landslides 14

 Avalanches 16

What page and chapter would give you information about Earth's plates?

The table of contents says this information is on page 6 in Chapter 1.

What might be another good title for Chapter 1?

Instead of "Shifting Plates" this chapter could be called "Plate Movement" because this has the same meaning.

Read the table of contents again. Answer the questions.

1. What page and chapter would give information about gravity?

2. What page and chapter would give information about volcanoes?

3. What page and chapter would give information about huge waves?

4. What would be another good title for Chapter 2?

- Ⓐ Natural Disasters
- Ⓑ Downhill Slides
- Ⓒ Geology

Answer Key

Using Graphics to Predict

Answers will vary but should include places along fault lines.

Proposition and Supporting Details Proposition

Landslides often happen at the same time as other disasters.

Supporting Details

- When earthquakes or floods loosen dirt and rocks, gravity can cause a landslide.
- Human activities can also cause landslides.
- Sometimes digging on a steep hill causes a slide.

Locating Information

1. Page 14, Chapter 2
2. Page 10, Chapter 1
3. Page 12, Chapter 1
4. B

Cause and Effect

1. When Earth's crust cracks, large pieces break off and start to float and move on the more liquid mantle.
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