



Earth Science

Interactions of Air, Water, and Land

On Level

Fast Earth- Changing Processes

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Fast Earth-Changing Processes

How do natural events affect our world?

CORE CURRICULUM STATEMENTS

Many of the phenomena that we observe on Earth involve interactions among components of air, water, and land.

Extreme natural events (floods, fires, earthquakes, volcanic eruptions, hurricanes, tornadoes, and other severe storms) may have positive or negative impacts on living things.

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Fast Earth-Changing Processes OL

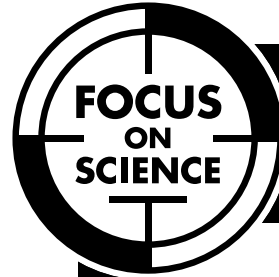
How do natural events
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Many of the phenomena that we observe on Earth involve interactions among components of air, water, and land.

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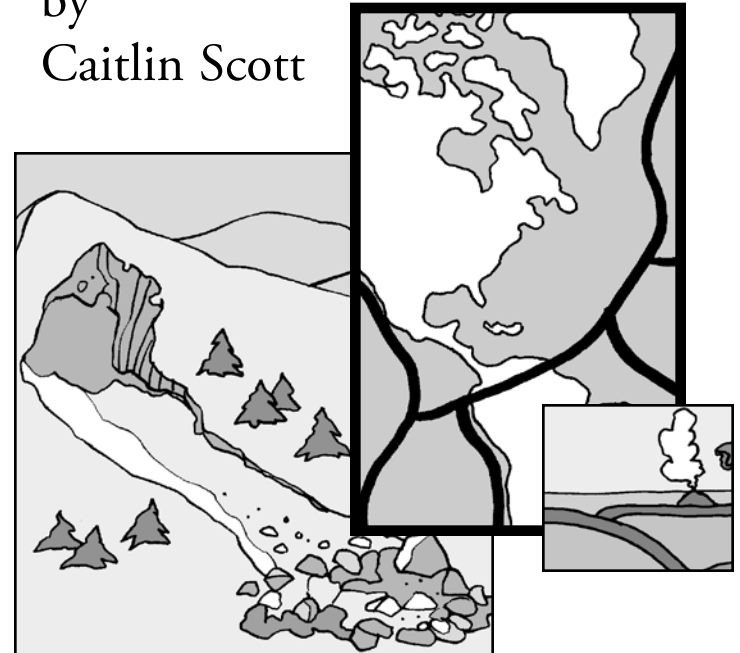


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by
Caitlin Scott





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*– Predict –
What do you think you will
learn from reading this book?*

INTRODUCTION

Earth Is Changing

The surface of Earth is always changing. Most of these changes happen slowly. 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.

But Earth is changing rapidly, too. These fast changes are very **dramatic**. They can harm plants and animals. Sometimes, they even bring down buildings and put people in danger. Fast Earth-changing events include:

- earthquakes
- volcanoes
- tsunamis
- landslides
- avalanches
- forest fires

dramatic: very noticeable

Why do these changes happen? Can we predict when they will happen? What can we do to protect ourselves and the land?

These are all questions that scientists can answer by studying Earth. Often, by observing small changes, scientists can predict large changes such as earthquakes. These scientists are called geologists.

There are about 28,000 geologists in the United States. Are you interested in a **career** studying changes on Earth? If so, you should study science and math in school. You will also need to get a college **degree**.

– Conclude –

Why are geologists important?

Talk about it with a friend.

career: the work or a series of jobs a person has

degree: a rank given to a student for completing a course of study

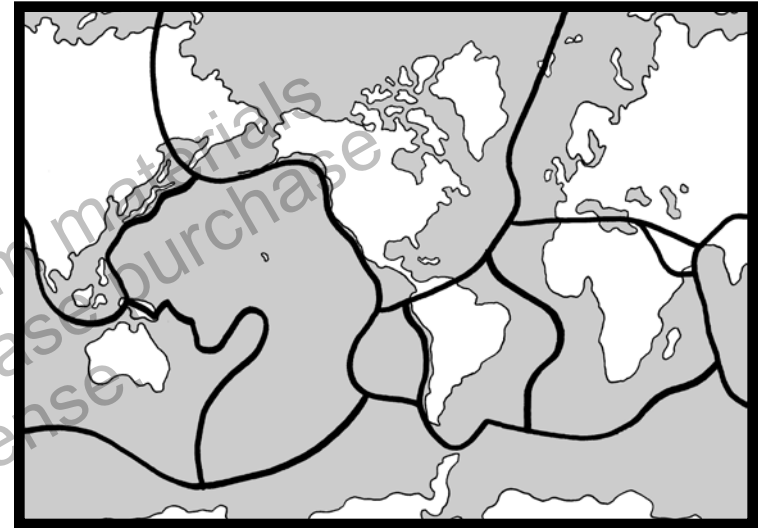
Shifting Plates

Look at a map of Earth. You might notice the land is like a puzzle. South America and Africa could fit together. That's because long ago, they once did.

Earth is made of layers. The crust is the layer we walk on. It breaks easily. The mantle is below the crust. It is softer, like a thick liquid. The crust floats on the mantle in big pieces called plates. Look at the map on the next page to see where these plates are located.

About 300 million years ago, heat inside Earth began pushing the plates apart. That is why South America and Africa are now apart.

Earth's Major Plates

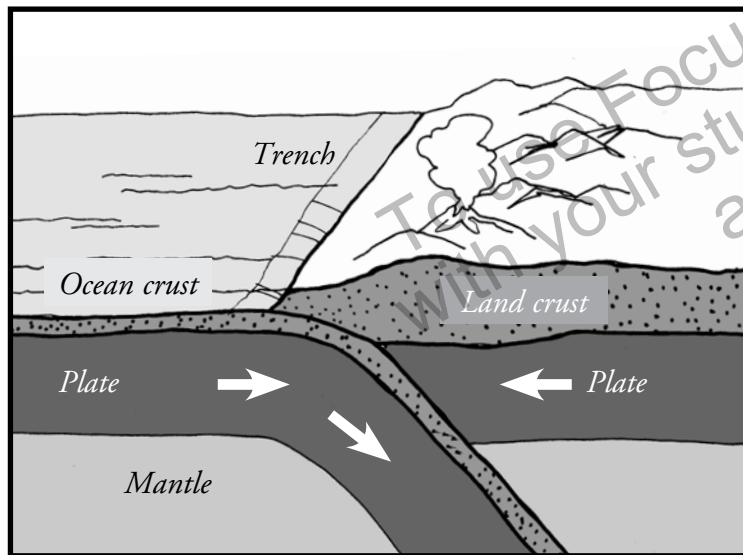


The dark lines on this map show the edges of Earth's major plates. Plates are large pieces of Earth's crust that are always moving.

Earthquakes

Most of the time, plates on Earth move very slowly. But sometimes two plates move past each other and get stuck together. Pressure builds up. Then, suddenly the plates move, usually one under the other. This causes an earthquake.

Sometimes, earthquakes cause gentle shaking. Other times earthquakes bring down entire buildings.



Along fault lines, one plate moves under another. This causes earthquakes.

Places where earthquakes happen a lot are called fault lines. On the map on page 7, you can see a dark line down the west coast of North America. This is a fault line.

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.

People who live near fault lines should know 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.

Volcanoes

Volcanoes also happen along fault lines and where one plate moves under another. Look at the diagram on the next page. 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.

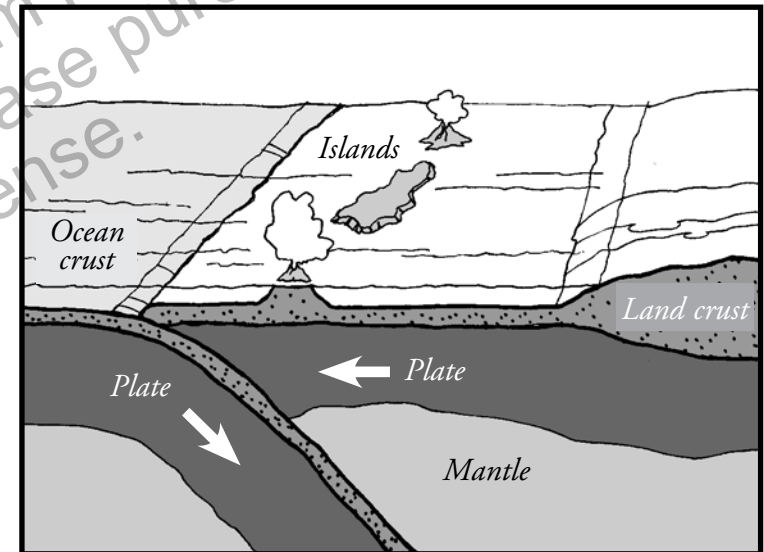
Volcanoes are very dangerous. The ground shakes when they **erupt**. Hot rocks, **lava**, ash, and mud fly up from the top of the mountain. The trees and buildings for miles around can be knocked down.

But, scientists are learning how to predict when a volcano will erupt. People usually have time to get away. If you live near a volcano and hear that it might erupt, listen to the news. Scientists will tell people how far away they need to get.

erupt: to explode with great force

lava: molten rock that flows or bursts from a volcano

Some volcanoes are under the ocean. The volcanoes erupt under water. Then, they break through to the surface. When this happens, islands form. 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 causes rock to melt. The lava is pushed up, forming a volcano. This is how undersea volcanoes form islands.

Tsunamis

You know that there are fault lines all around Earth. Many are under the ocean. What happens when there is an earthquake underwater? It can be deadly!

When you throw a rock in water, ripples move out in all directions. The same thing happens in an underwater earthquake.

But, the ripples from earthquakes are huge waves. As these waves move toward land, they can be 100 feet tall. They can travel more than 400 miles per hour.

In the United States, Hawaii is at the greatest risk for tsunamis. They get about one big wave each year. California, Oregon, and Washington State get big waves about once every 28 years.

Tsunamis cause a lot of damage. The big waves tip over boats and knock down buildings. The flood waters cause problems in coastal towns, too.

Fortunately, there are tsunami warning centers in Hawaii and Alaska. Scientists usually know when a tsunami is coming. People can do some simple things to stay safe in a tsunami.

First, if you are near the ocean and feel an earthquake, listen to the news. It will tell you if there is a tsunami coming. Next, if you are told to evacuate, leave the area. Get to higher ground. If you live near the ocean, you should have a plan for escape in advance. Finally, do not go back to the ocean after the first big wave. A tsunami usually has several large waves.

Gravity

Most of the time, gravity causes slow changes in Earth. It makes broken rocks fall from a mountain top. It sends sand rolling downhill.

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

Landslides

Landslides make mud, dirt, and rocks slide downhill. This can bury buildings. Landslides happen in all 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. They can follow an earthquake or flood. They can also follow human actions. Sometimes digging on a hill causes a landslide.

How can you stay safe during landslides? The first thing to do is avoid them. People should not build houses or other buildings on steep hills. If these hills could flood or have earthquakes, the danger is even greater.

Second, notice if the land is shifting. If trees or fence posts seem to be leaning over, there might be a landslide. If you are in a landslide, try to get away. If you can't get away, get under something heavy like a table.

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

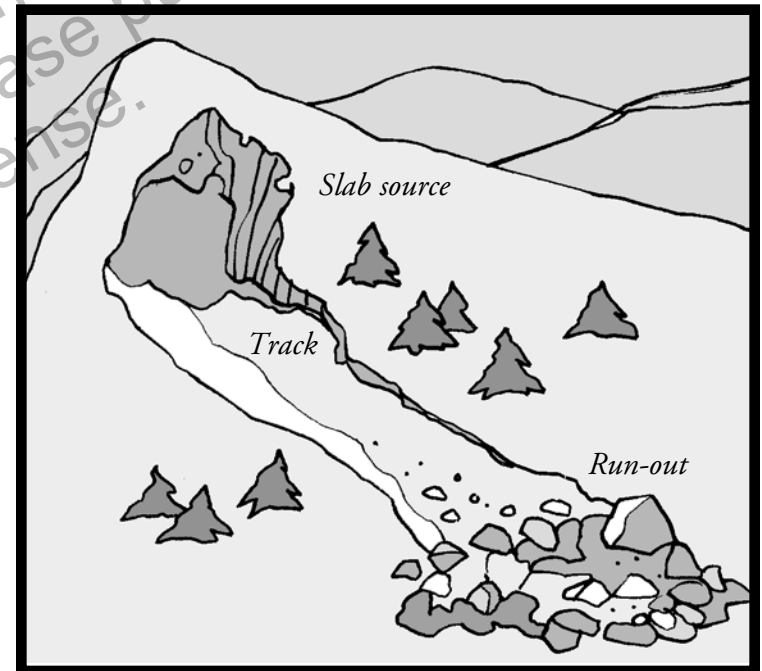
Avalanches

Avalanches are similar to landslides. They are both caused, in part, by gravity. But, landslides are slides of mud and rock. Avalanches are slides of snow, ice, and rock.

On mountains snow piles up in layers. There might be ice or even pockets of air between the layers, due to melting and freezing snow. The larger the spaces between the layers, the more likely gravity will make the layers slide away from each other. This causes an avalanche. Some avalanches are just loose snow. Others are huge slabs of snow and ice that can bury people.

Most avalanches happen very high in snowy mountains. Skiers and mountain climbers are in the most danger of being caught in an avalanche.

Most ski resorts have avalanche warnings. Don't go out when there is avalanche danger. If you do get caught in an avalanche, try to stay above the snow. If you get buried, put one hand in front of your face to keep a pocket of air in front of you, so you can breathe. Wait for rescue.



This slab avalanche will cause the entire slab of snow and ice to race downhill. This is the most dangerous type of avalanche.

Fire

Shifting plates and gravity can cause both fast and slow changes on Earth. Fire causes only one type of change—a fast change.

Forest Fires

You might think that forest fires are bad for the environment. However, some forest fires are natural and good for forests. Certain plants need fire to make seeds. In addition, bigger plants and trees need fire to clear out smaller plants and make room for new growth. These fires often start because of lightning or extreme heat on dry leaves.

Other fires are unnatural and can be damaging. Some occur in the wrong places. Some burn too hot. These fires can be dangerous to land and people. Sometimes these fires are started by people, like a camper who does not put out a campfire. Lightning may also cause these fires.

Firefighters and park rangers have to work hard to stop a forest fire. One strategy is to dig long **trenches**. These dirt trenches will not burn, so they help keep the fire from spreading. Another strategy is to dump dirt, sand, or water on the fire. People do this by flying airplanes over the site of the fire.

If you are in the path of a forest fire, you need to get away quickly. Listen to the news to find the best way to escape. This is not something you can plan ahead, because you never know which way the fire will turn.

trench: a long, narrow ditch

Let It Burn?

Hikers spot smoke on a wooded hillside. A park ranger flies over. Sure enough, it's the beginning of a forest fire. Should people put out the blaze or let it burn? The answer is not so easy. Scientists have to consider several questions such as these:

- What kinds of plants are in the forest?
- How rapidly will the forest burn?
- Has there been a fire in the area recently? Do some plants need this fire to survive?
- What is the weather likely to be in the coming days? How quickly will the fire spread?
- How close will the fire come to people and buildings? Can these people get to safety?

– Analyze –

What data would you collect to answer these questions? What other questions would you ask? How would you go about designing an investigation to answer the questions?

Scientists who study forest fires spend years gathering **data** about forests and fires, so that they can make good decisions when a fire starts.

If scientists decide to let this fire burn, some people will not be happy. These people may think all forest fires are bad. They may be afraid the fire will reach their homes and burn them down. What could scientists tell people to convince them that this burn is a good thing for the land?

– Summarize –

Describe how we know that the surface of Earth undergoes fast changes.

data: information; facts

Glossary

career—the work or a series of jobs a person has

data—information; facts

degree—a rank given to a student for completing a course of study

dramatic—very noticeable

erupt—to explode with great force

lava—molten rock that flows or bursts from a volcano

trench—a long, narrow ditch

To Find Out More . . .

Want to learn more about fast Earth-changing processes?

Try these books

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

Forest Fires by Luke Thompson. Children's Press, 2000.

Access these Web sites

U.S. Department of Labor Occupational Outlook Handbook: Geoscientists
<http://www.bls.gov/oco/ocos288.htm>

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

USDA Forest Service
<http://www.fs.fed.us/>

Write for more information

USDA Forest Service
1400 Independence Ave., SW
Washington, D.C. 20250-0003

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Assessments

Fast Earth-Changing Processes

Print pages 20–22 of this PDF for the assessments.

Check Understanding

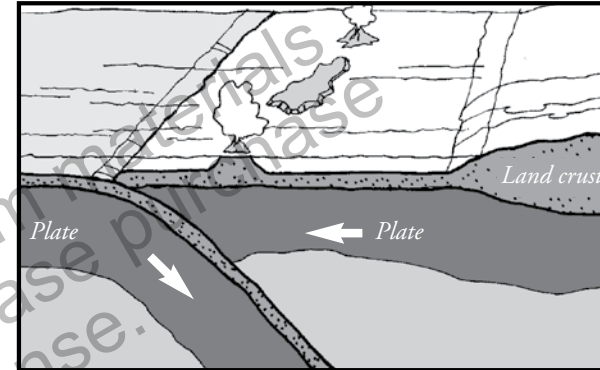
Shade the circle next to the correct answer or write your answer on the lines provided.

1. Some processes that change Earth are slow while others are fast. How can shifting plates change Earth quickly?
 A They can start forest fires.
 B They can push continents apart.
 C They can produce heat and melt rock.
 D They can cause rocks and mud to slide downhill.

Note that question 2 has only three choices.

2. Which two fast Earth-changing processes are caused, in part, by gravity?
 A earthquakes and tsunamis
 B landslides and avalanches
 C earthquakes and volcanoes

3. The following diagram shows an underwater volcano.



Identify the landform produced by underwater volcanoes.

Explain how this landform is created.

Check Understanding

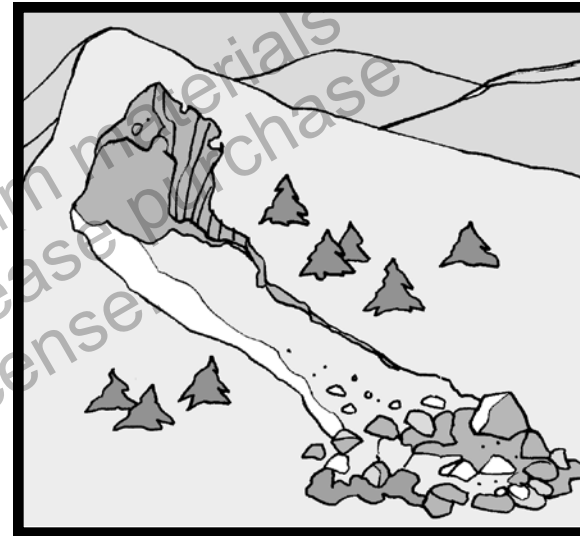
Shade the circle next to the correct answer or write your answer on the lines provided.

4. When a camper failed to put out his campfire, a forest fire started. It burned for days before firefighters could extinguish it. This fire caused a lot of damage. However, not all forest fires are bad for the environment. Identify two ways that forest fires can start naturally.

- 1) _____
- 2) _____

Explain two reasons that forest fires can be good for the environment.

5. The diagram below shows an area of land that changed rapidly.



Which force cause this change?

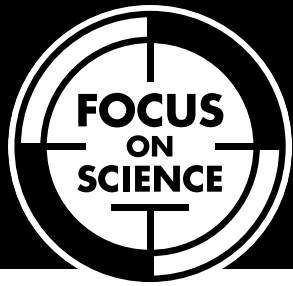
- (A) wind
- (B) evaporation
- (C) gravity
- (D) condensation

Assessment Scoring Guidelines

1. Answer C is correct.
2. Answer B is correct.
3. Island
When a volcano erupts under water, melted rock overflows and breaks through to the surface.
4. Lightning
Extreme heat

Forest fires can make room for new plant growth.
Forest fires can help certain plants produce seeds.
5. Answer C is correct.

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English Language Arts Activities

Fast Earth-Changing Processes

Print pages 24–28 of this PDF for the reading activities.

Draw Conclusions

TRY THE SKILL

When you read, think about what you read in order to draw conclusions. Facts from the book should support these conclusions.

Here is a paragraph from *Fast Earth-Changing Processes*. The graphic organizer shows one conclusion you might draw, as well as the facts that support this conclusion.

When two plates move suddenly, they can cause an earthquake on land. The earthquake happens along the line where the plates were stuck together. Sometimes, earthquakes cause gentle shaking that might knock a book off a table. Other times earthquakes bring down whole buildings.

Conclusion	Facts
Moving plates cause earthquakes.	<ul style="list-style-type: none">• The earthquake happens along the line where the plates were stuck together.• Sometimes, earthquakes cause gentle shaking that might knock a book off a table.• Other times earthquakes bring down whole buildings.

Read this paragraph from *Fast Earth-Changing Processes*.

People who live near fault lines should know 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.

Now complete this graphic.

Conclusion	Facts

Compare and Contrast

TRY THE SKILL

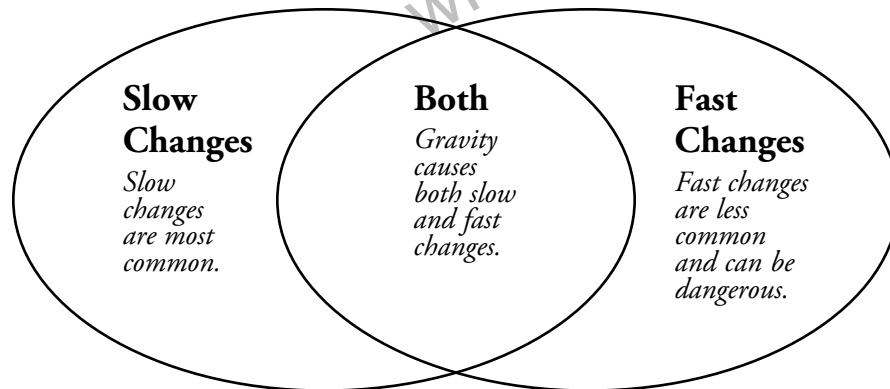
Comparing and contrasting can help you understand what you read.

- Comparing tells how things are alike.
- Contrasting tells how things are different.

Read these paragraphs from *Fast Earth-Changing Processes*. Then, study the graphic that compares and contrasts.

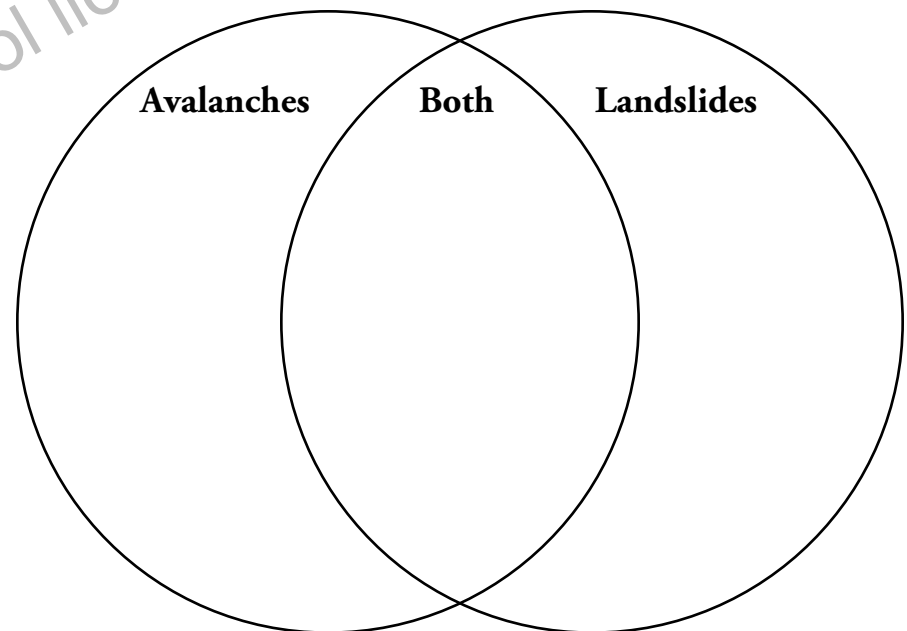
Most of the time, gravity causes slow changes in Earth. It makes broken rocks fall from a mountain top. It sends sand rolling downhill.

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



Read the paragraphs. Think about comparing and contrasting. Then complete the Venn diagram.

Avalanches are similar to landslides. They are both caused, in part, by gravity. But, landslides are slides of mud and rock. Avalanches are slides of snow, ice, and rock.



Prefixes

TRY THE SKILL

Prefixes are short syllables at the beginning of words that change the meaning of the word. Knowing prefixes can help you learn new words.

The prefix *sub-* means *below* or *under*. Knowing what *sub-* means can help you understand the new word. Read this passage and find the word that begins with *sub-*.

Where do the world's biggest earthquakes occur? Big earthquakes happen along subduction zones. This is where one plate is moving under another.

What word begins with *sub-*?

subduction

Use what you know about the prefix *sub-* to determine the meaning of *subduction*.

Subduction means that one plate moved under another.

Here are some more words that use the prefix *sub-*. Use what you know about this prefix to match the words with their definitions.

Word

1. submarine _____
2. subway _____
3. subsoil _____
4. subalpine _____
5. substandard _____

Definition

- A. the layer of soil below the topsoil
- B. something that is below the standard in quality
- C. an area on a mountain that is below the alpine forest
- D. a boat that goes under the ocean
- E. a train that goes under the street

Predict

TRY THE SKILL

You can use facts in informational writing to make predictions. *Fast Earth-Changing Processes* contains many facts about Earth that would help you predict fast changes.

Read this paragraph from *Fast Earth-Changing Processes*.

Earth is made up of layers. The crust, or the layer we walk on, breaks easily. Below the crust, the mantle is softer and warmer. The crust floats on the mantle in big pieces called plates. Heat inside Earth began pushing the plates apart 300 million years ago.

Most of the time, this happens very slowly, but sometimes two plates moving past each other get stuck together. The pressure builds up. Then, suddenly the plates move. This causes problems.

What is likely to happen next?

There is likely to be an earthquake.

Read the paragraphs. Shade the circle next to the correct answer.

On mountains snow piles up in layers. There might be ice or even pockets of air between the layers, due to melting and freezing snow. The larger the spaces between the layers, the more likely gravity will make the layers slide away from each other.

1. What kind of disaster will happen next?

- A an earthquake
- B a landslide
- C an avalanche

“Are we going skiing this weekend?” Maria asked her mom. All week the weather had been changeable. “I’m not sure,” her mother answered. “The upper part of the mountain might be dangerous.”

2. How should Maria and her mother decide whether to go skiing?

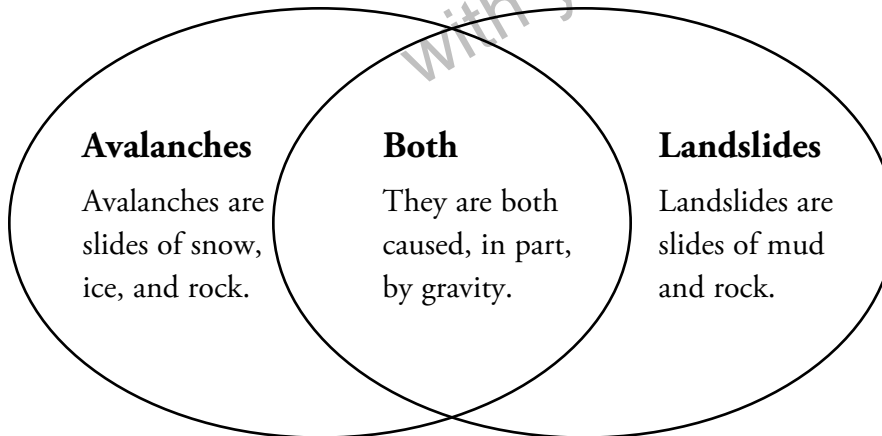
- A They should watch the weather report.
- B They should make sure it will be a warm day.
- C They should check for avalanche warnings.

Answer Key

Draw Conclusions

Conclusion	Facts
People can protect themselves in earthquakes.	<ul style="list-style-type: none">• They should know what to do in an earthquake.• They should also make sure the buildings they live and work in can withstand earthquakes.• They should live in buildings that sway instead of fall down.

Compare and Contrast



Prefixes

1. D
2. E
3. A
4. C
5. B

Predict

1. C
2. C