Table of Contents

Chapter Preview Questions

1. Breaks in Earth's crust where rocks have slipped past each other are called

a. boundaries.

b. plates.

c. trenches.

d. faults.

Chapter Preview Questions

1. Breaks in Earth's crust where rocks have slipped past each other are called

a. boundaries.

b. plates.

c. trenches.

✓ faults.

Chapter Preview Questions

2. What occurs when rock and soil slide rapidly down a steep slope?

a. creep

b. landslide

c. slump

d. mudflow

Chapter Preview Questions

2. What occurs when rock and soil slide rapidly down a steep slope?

a. creep

landslide

c. slump

d. mudflow

Chapter Preview Questions

3. To find distance on a map, you would use a map's
   a. symbols.
   b. scale.
   c. contour lines.
   d. contour interval.

Chapter Preview Questions

3. To find distance on a map, you would use a map's

a. symbols.

scale.

c. contour lines.

d. contour interval.

Chapter Preview Questions

4.A place where two plates slide past each other moving in opposite directions is a

a. sliding boundary.

b. colliding boundary.

c. spreading boundary.

d. mid-ocean ridge.

Chapter Preview Questions

4.A place where two plates slide past each other moving in opposite directions is a

a. sliding boundary.

b. colliding boundary.

c. spreading boundary.

d. mid-ocean ridge.

Focus on the BIG Idea

How do plate motions affect Earth's crust?

Imagine grasping a paper towel in both hands and slowly pulling your hands apart. At first, you see the paper towel stretch. Then, suddenly, it tears! How is the tearing paper towel similar to an earthquake? How is it different?

Build Science Vocabulary

High-Use Academic Words

Word	Meaning	Examples
category	*n*. A class or group of things	The books on the shelf are separated into two categories—math and science.

Build Science Vocabulary

High-Use Academic Words

Word	Meaning	Examples
construct	*v.* To build	The goal was to construct a building that would stand up during an earthquake.

Build Science Vocabulary

High-Use Academic Words

Word	Meaning	Examples
expand	*v.* To spread out	The experiment expanded into a long-term scientific investigation.

Build Science Vocabulary

High-Use Academic Words

Word	Meaning	Examples
method	*n*. A way or system of doing things	Writing a letter and sending an e-mail are two methods of sharing information.

Build Science Vocabulary

Apply It!

From the list above, choose the word that best completes the sentence.

1. A balloon will _____ until it breaks.

expand

2. The work crew will _____ the bridge to be safe during an earthquake.

construct

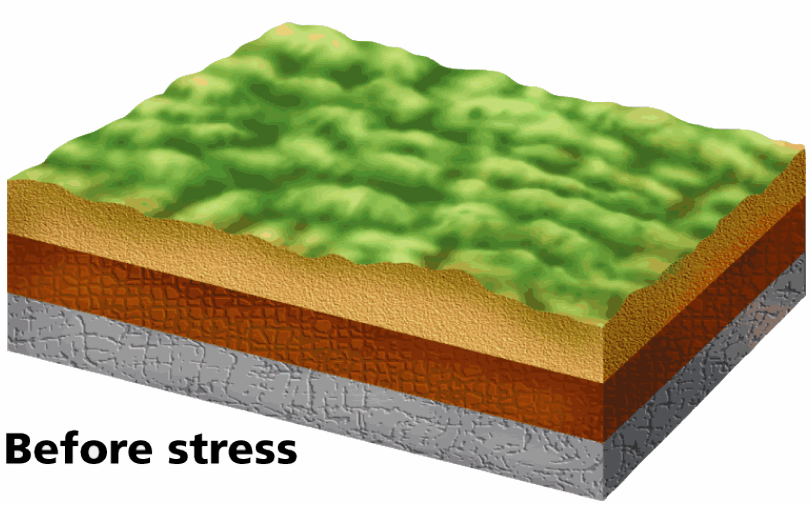
End of Chapter Preview

Section 1: Forces in Earth's Crust

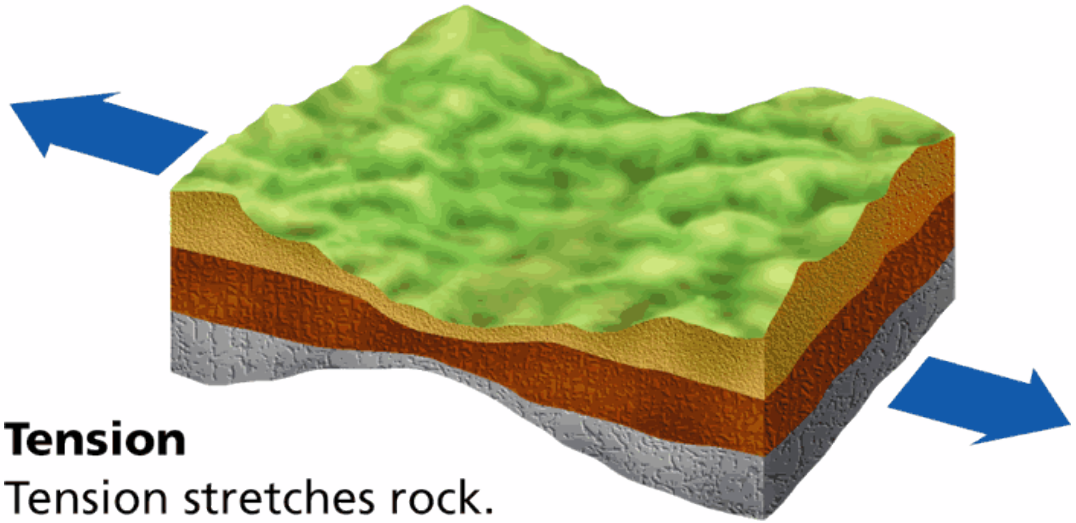
- How does stress in the crust change Earth's surface?
- Where are faults usually found, and why do they form?
- What land features result from the forces of plate movement?

Types of Stress

The stress force called *tension* pulls on the crust, stretching rock so that it becomes thinner in the middle.



Before stress

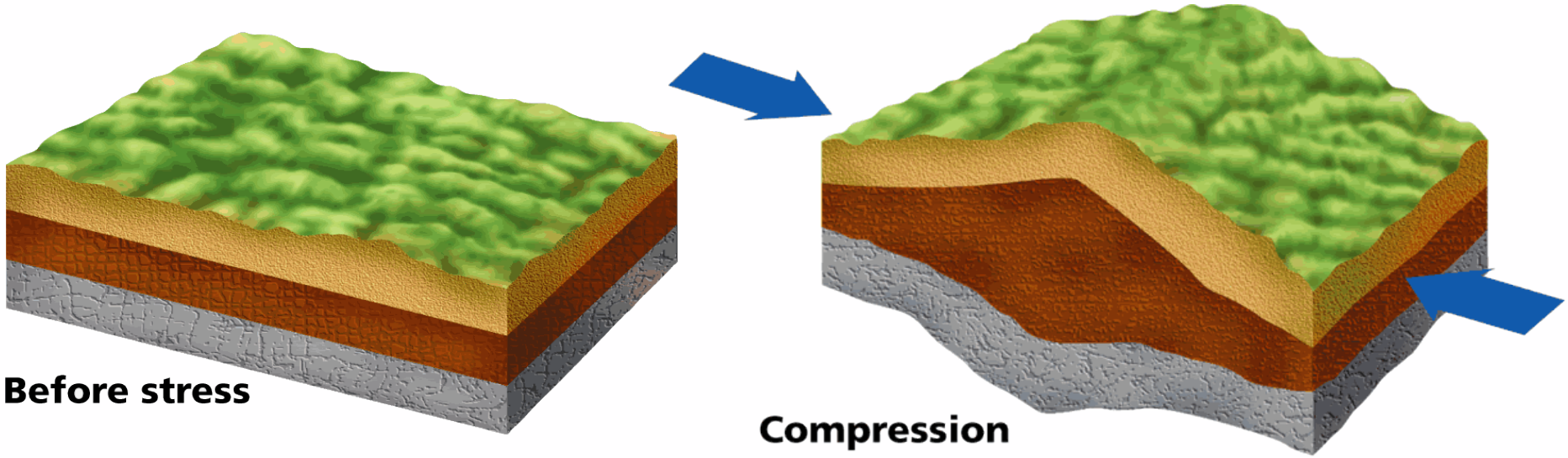


Tension

Tension stretches rock.

Types of Stress

The stress force called *compression* squeezes rock until it folds or breaks.

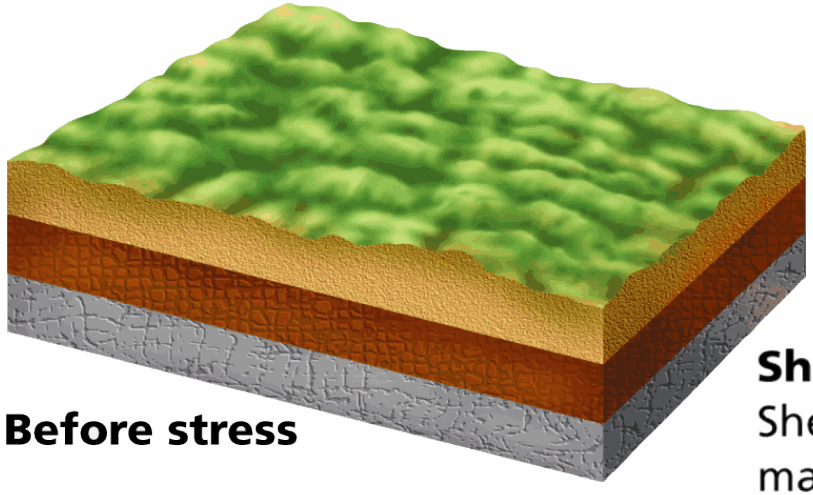


Before stress

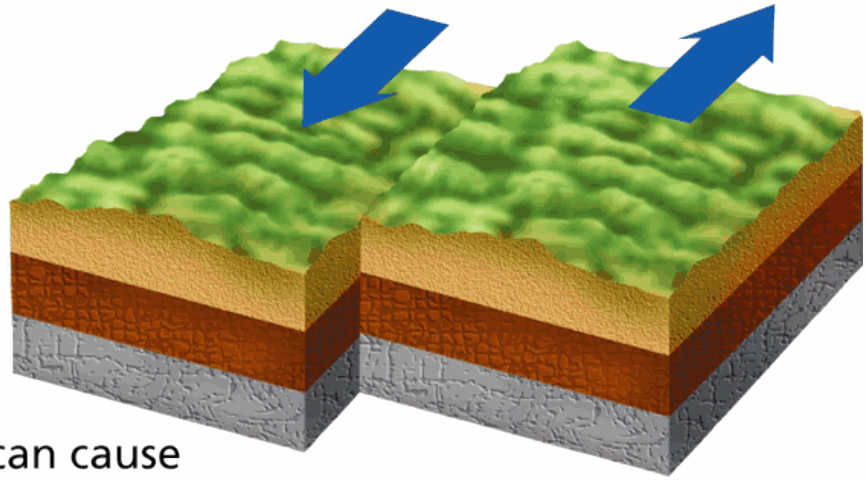
Compression
Compression pushes rock together.

Types of Stress

Stress that pushes a mass of rock in two opposite directions is called *shearing*.



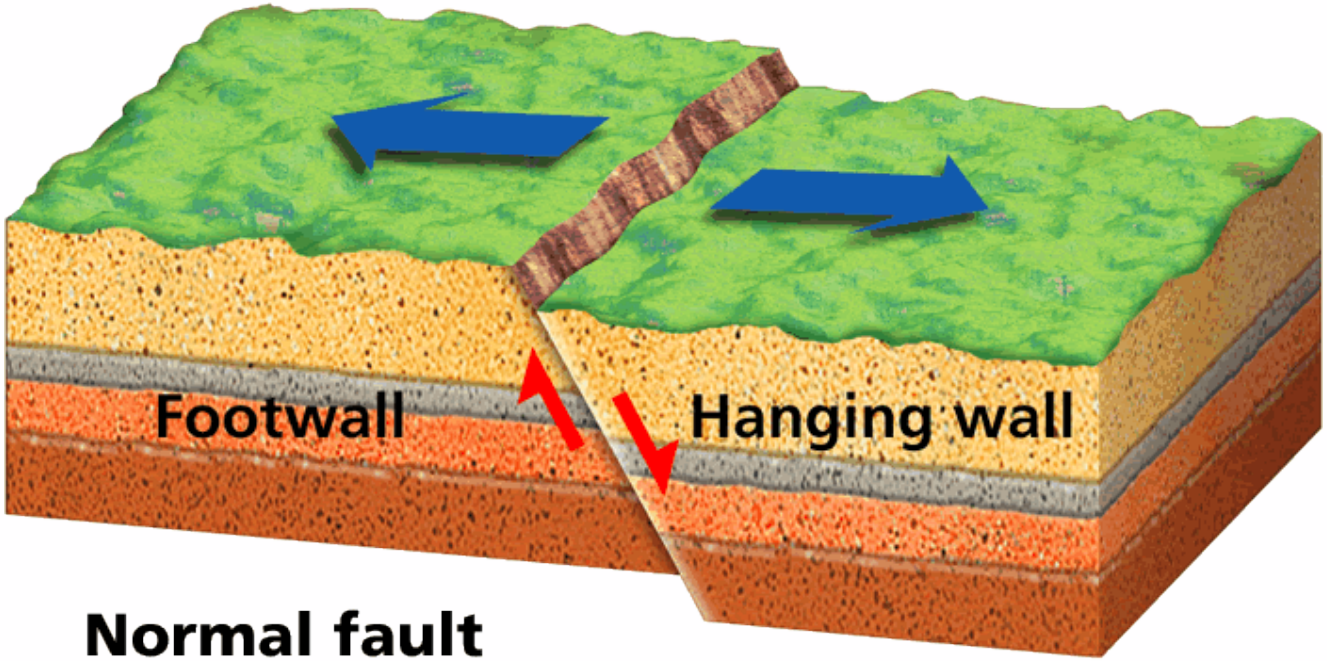
Before stress



Shearing
Shearing can cause masses of rock to slip.

Kinds of Faults

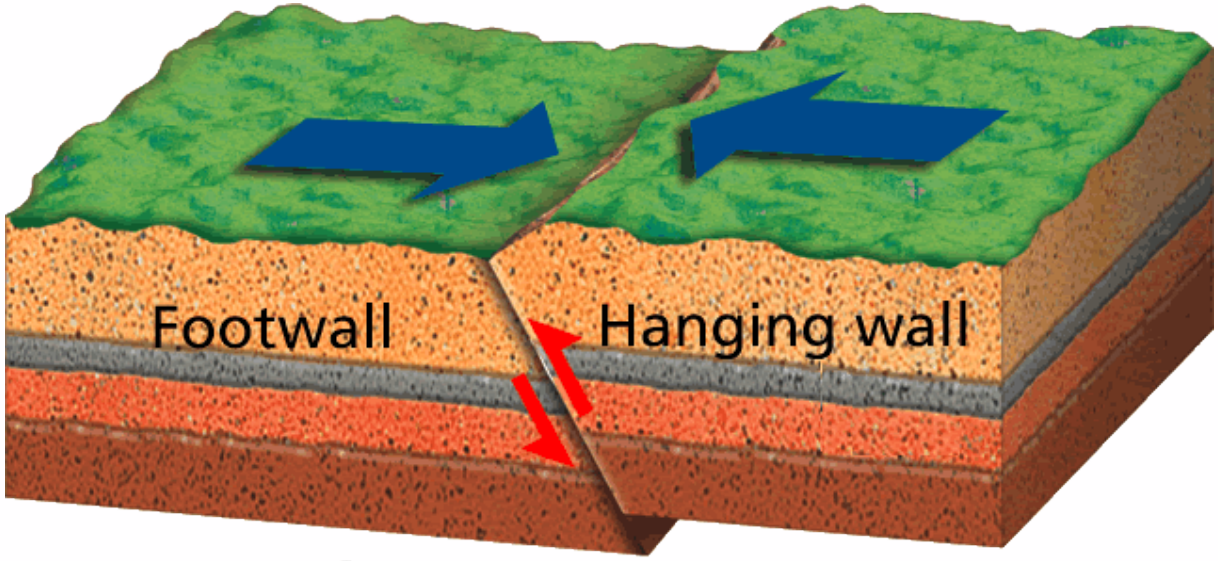
Tension in Earth's crust pulls rock apart, causing normal faults.



Normal fault
In a normal fault, the hanging wall slips down relative to the footwall.

Kinds of Faults

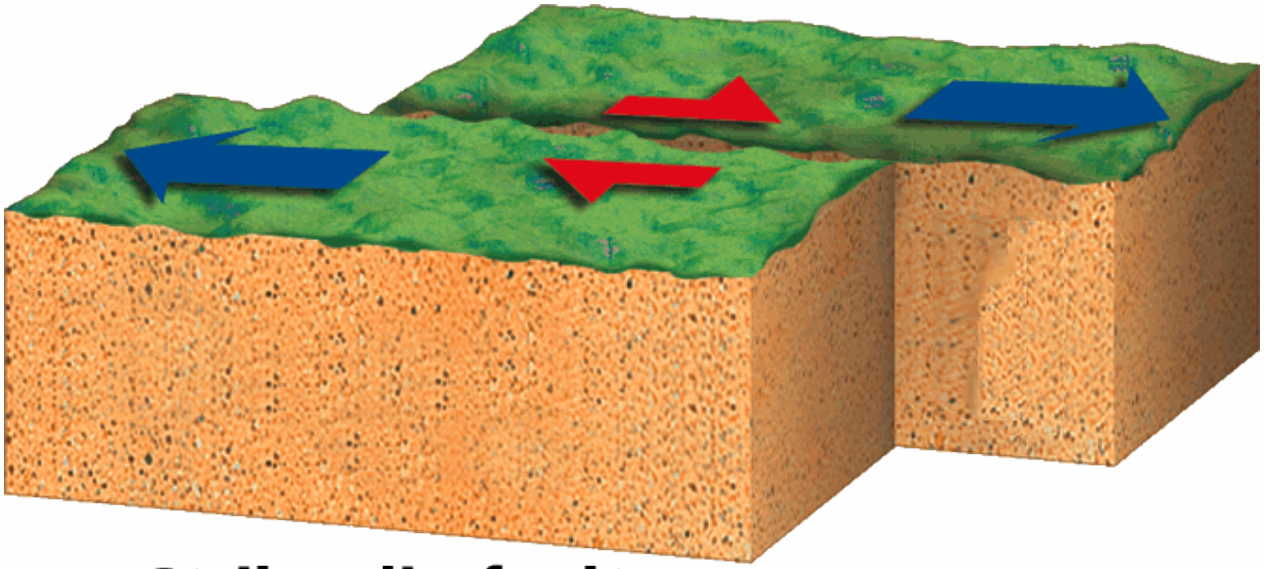
A reverse fault has the same structure as a normal fault, but the blocks move in the opposite direction.



Reverse fault
In a reverse fault, the hanging wall moves up relative to the footwall.

Kinds of Faults

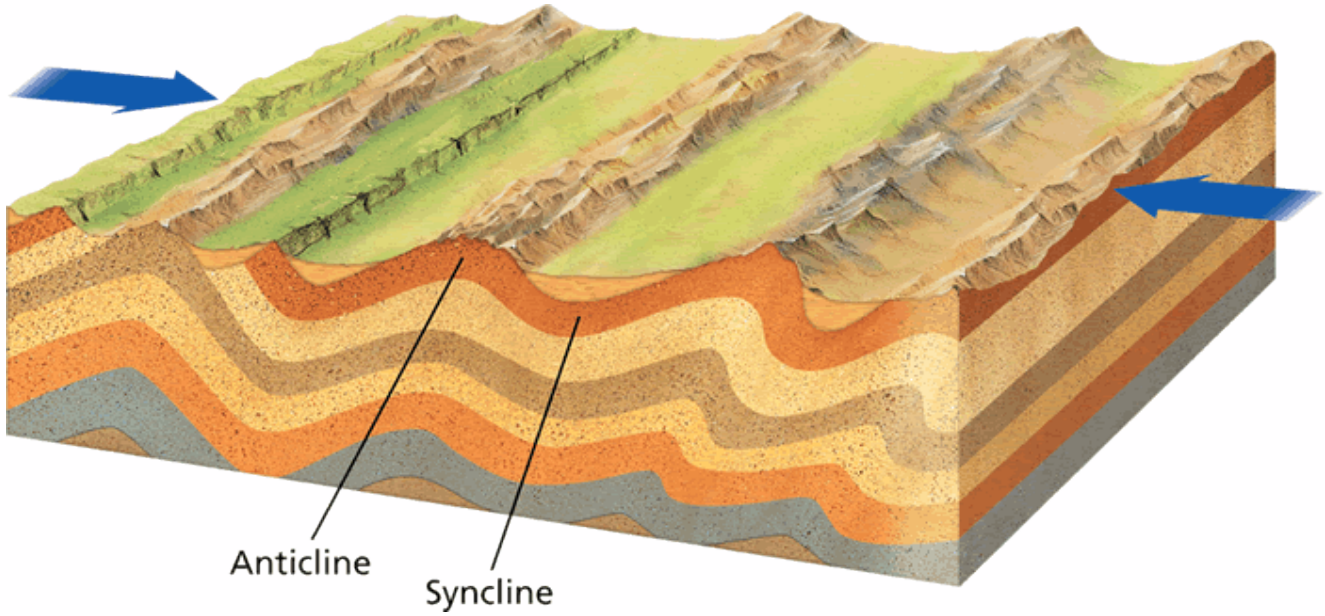
In a strike-slip fault, the rocks on either side of the fault slip past each other sideways, with little up and down motion.



Strike-slip fault
Rocks on either side of a strike-slip fault slip past each other.

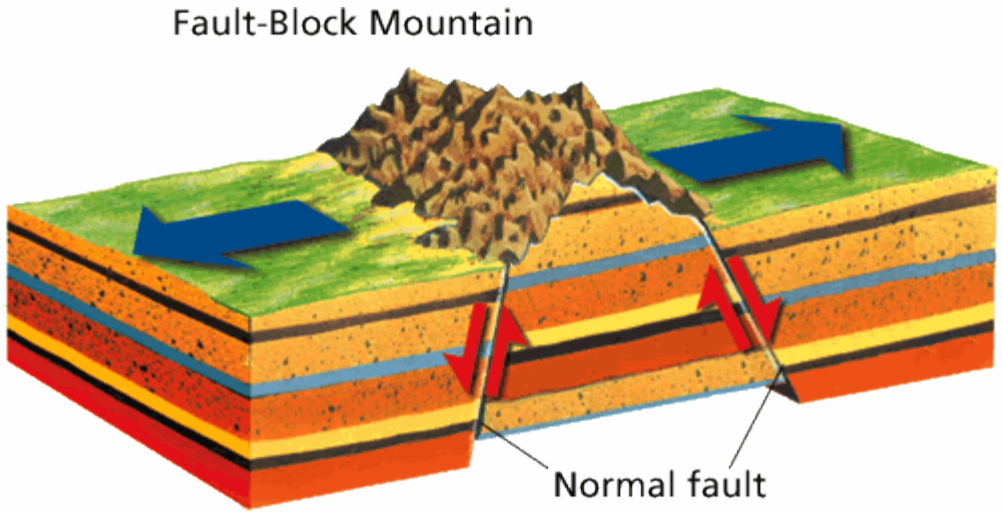
Changing Earth's Surface

Over millions of years, the forces of plate movement can change a flat plain into landforms such as anticlines and synclines, folded mountains, fault-block mountains, and plateaus.



Changing Earth's Surface

As tension forces pull the crust apart, two parallel normal faults can form a range of fault-block mountains.



Links on Faults

Click the SciLinks button for links on faults.

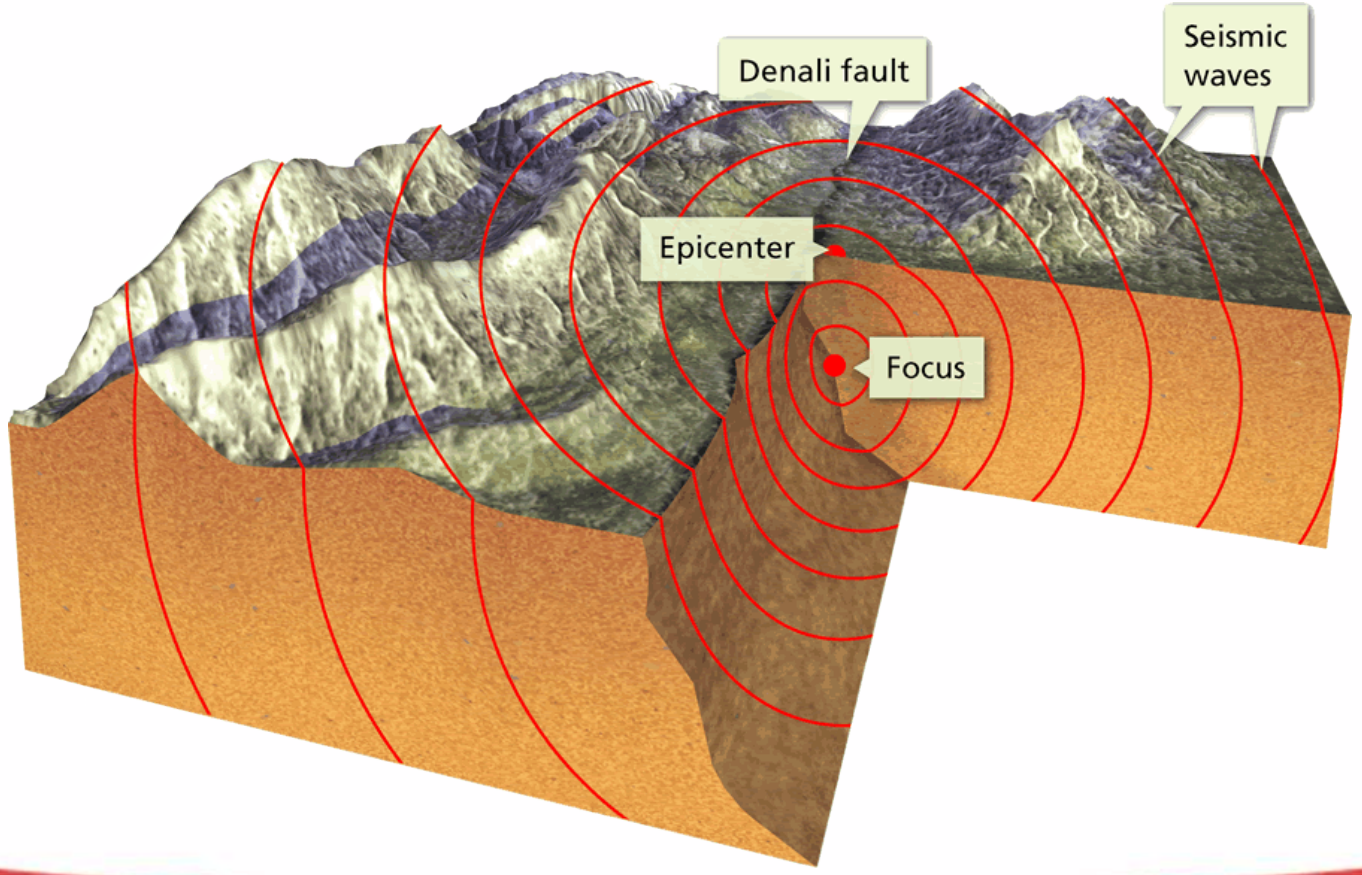
End of Section: Forces in Earth's Crust

Section 2: Earthquakes and Seismic Waves

- How does the energy of an earthquake travel through Earth?
- What are the scales used to measure the strength of an earthquake?
- How do scientist locate the epicenter of an earthquake?

Types of Seismic Waves

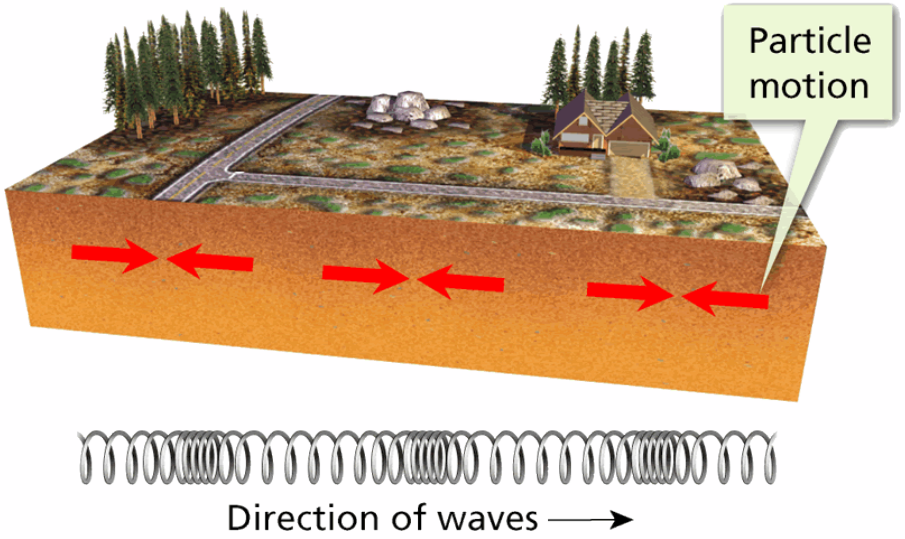
Seismic waves carry energy from an earthquake away from the focus, through Earth's interior, and across the surface.



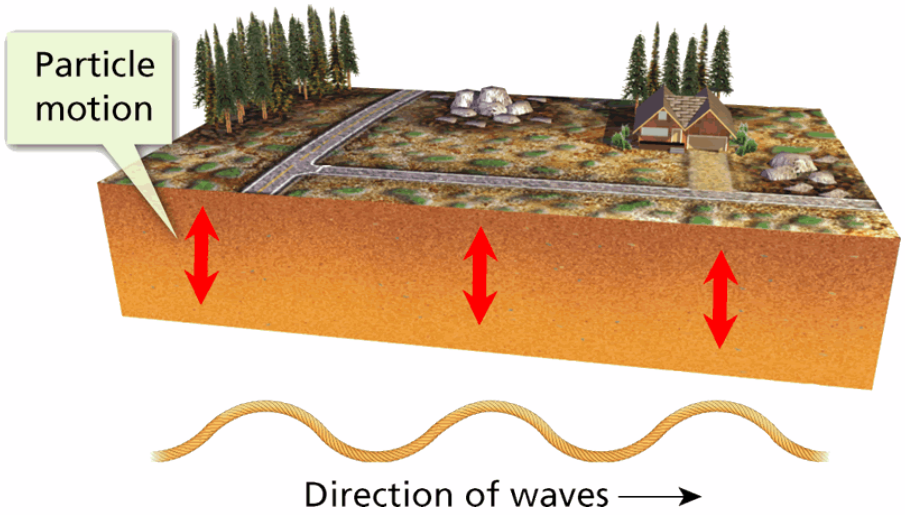
Types of Seismic Waves

P waves are seismic waves that compress and expand the ground like an accordion. S waves are seismic waves that vibrate from side to side as well as up and down.

P waves
The crust vibrates forward and back along the path of the wave.



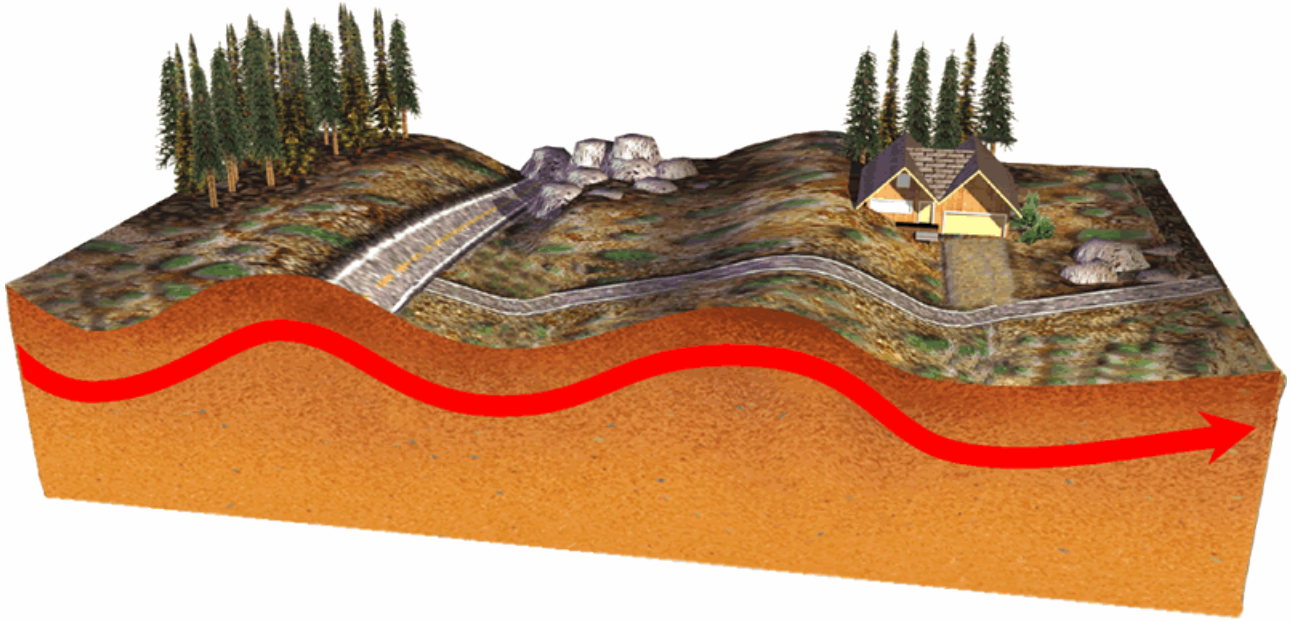
S waves
The crust vibrates from side to side and up and down.



Types of Seismic Waves

Surface waves move more slowly than P waves and S waves, but they produce the most severe ground movements.

Surface waves
The ground surface rolls with a wavelike motion.

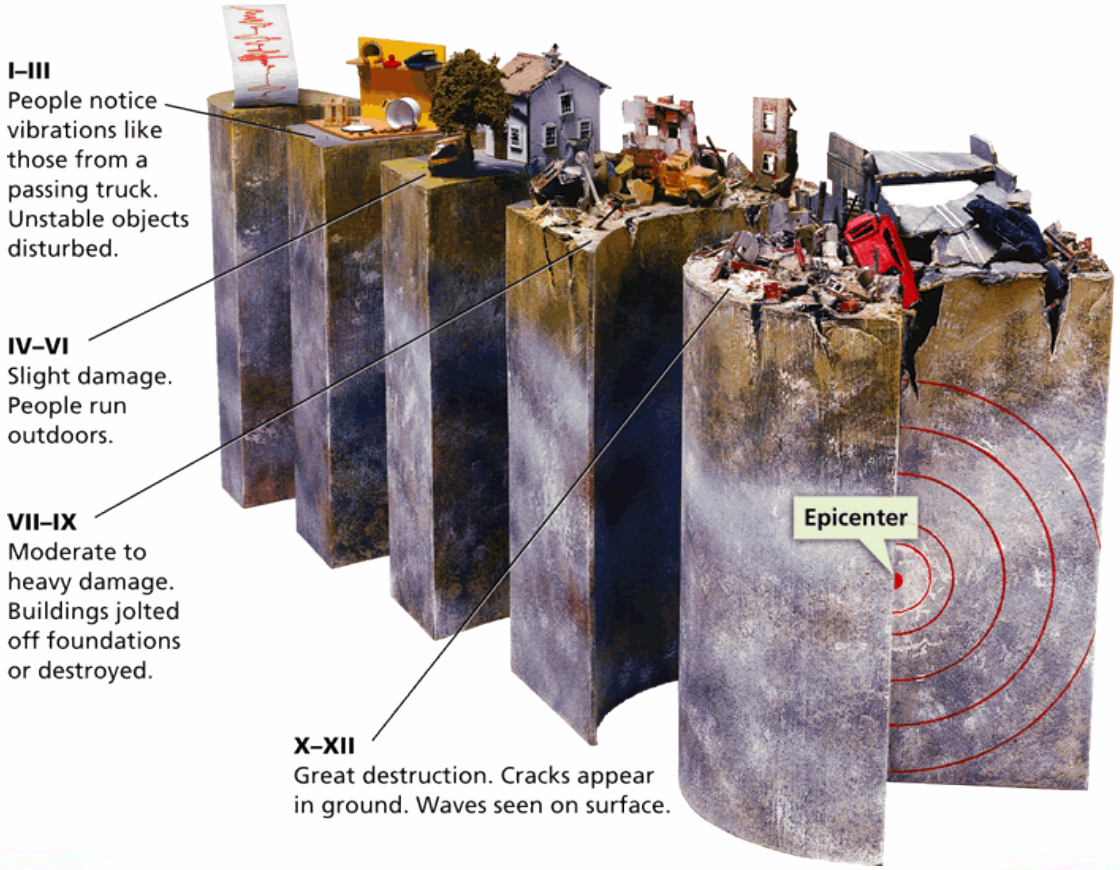


Seismic Waves Activity

Click the Active Art button to open a browser window and access Active Art about seismic waves.

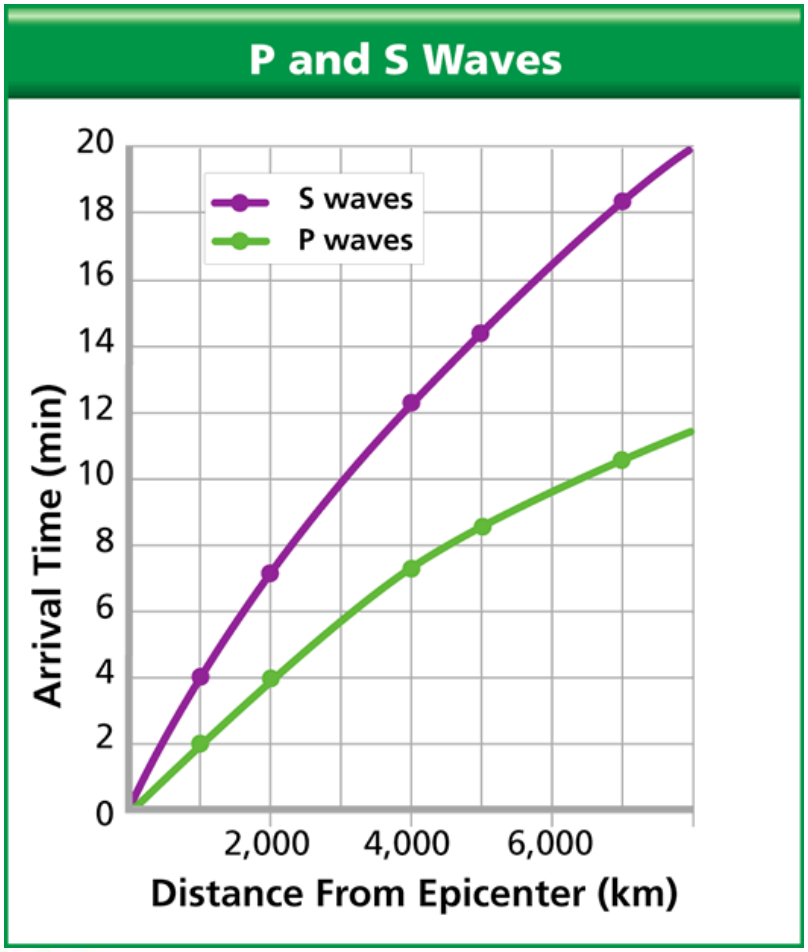
Measuring Earthquakes

The Mercalli scale was developed to rate earthquakes according to the amount of damage at a given place.



Math Analyzing Data

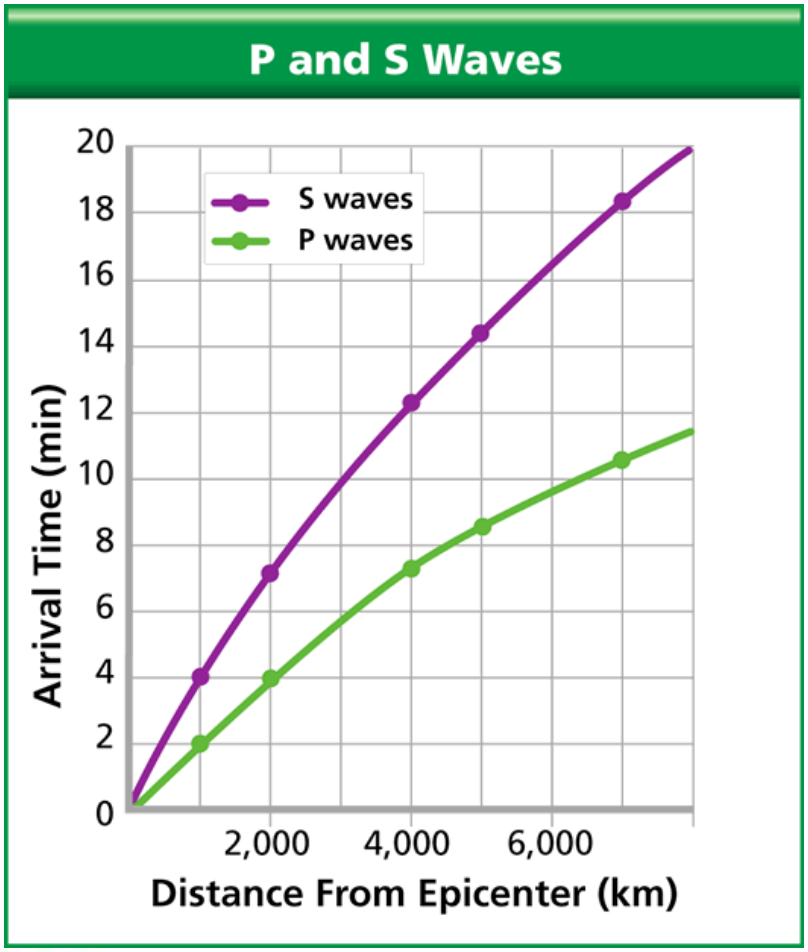
Seismic Wave Speeds



Seismographs at five observation stations recorded the arrival times of the P and S waves produced by an earthquake. These data are shown in the graph.

Math Analyzing Data

Seismic Wave Speeds



Reading Graphs:

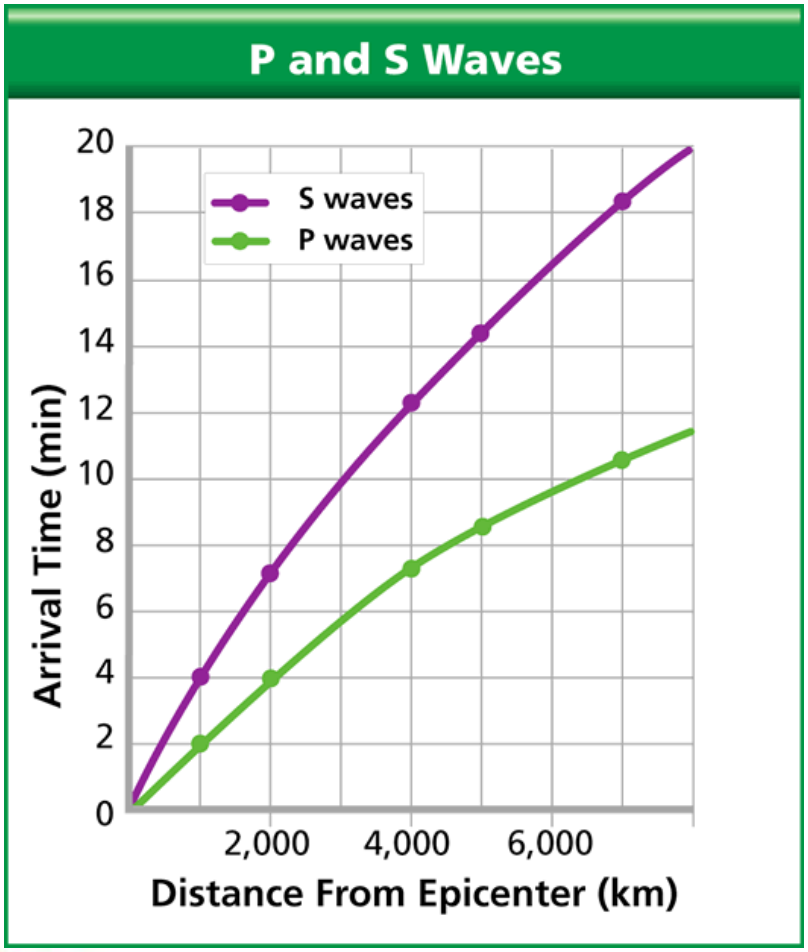
Q. –What variable is shown on the –*x*-axis of the graph? The *y*-axis?

A. –*X*-axis—distance from the epicenter; *y*-axis—arrival time.

End of Slide

Math Analyzing Data

Seismic Wave Speeds



Reading Graphs:

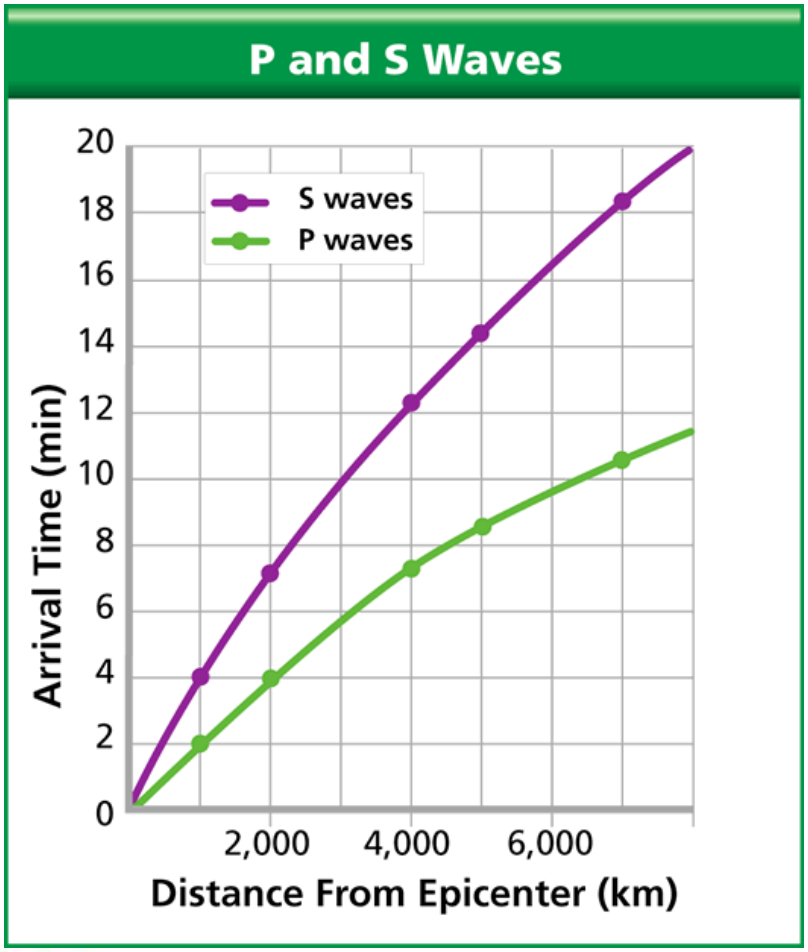
Q. –How long did it take the S waves to travel 2,000 km?

A. –7 minutes

End of Slide

Math Analyzing Data

Seismic Wave Speeds



Estimating:

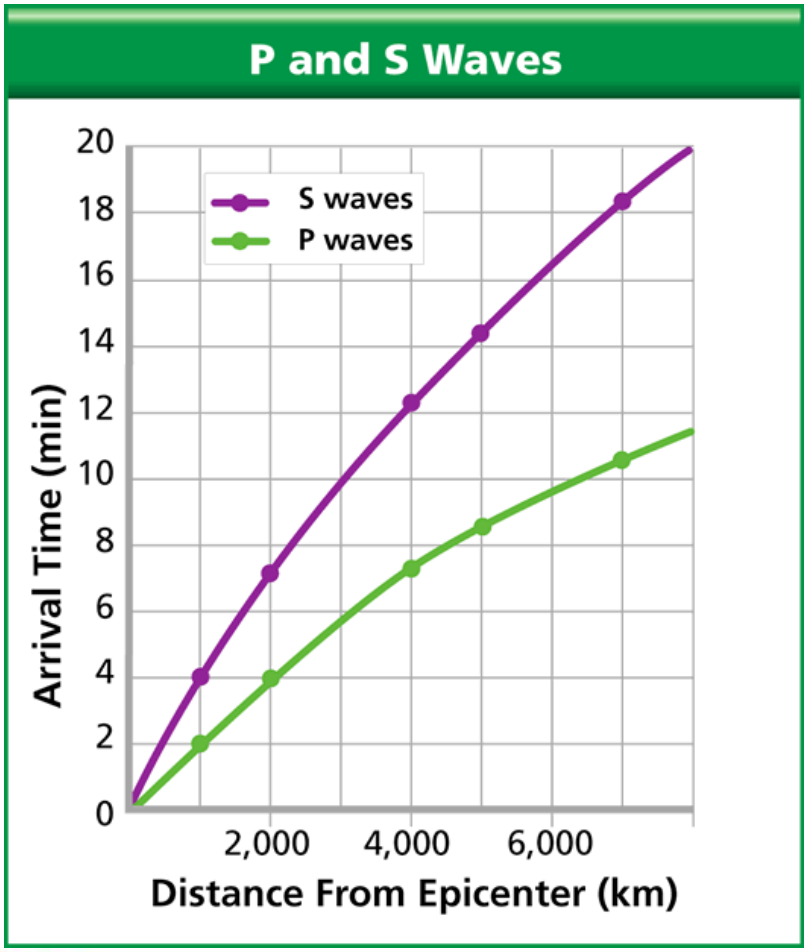
Q. –How long did it take the P waves to travel 2,000 km?

A. –4 minutes

End of Slide

Math Analyzing Data

Seismic Wave Speeds



Calculating:

Q. –What is the difference in the arrival times of the P waves and the S waves at 2,000 km? At 4,000 km?

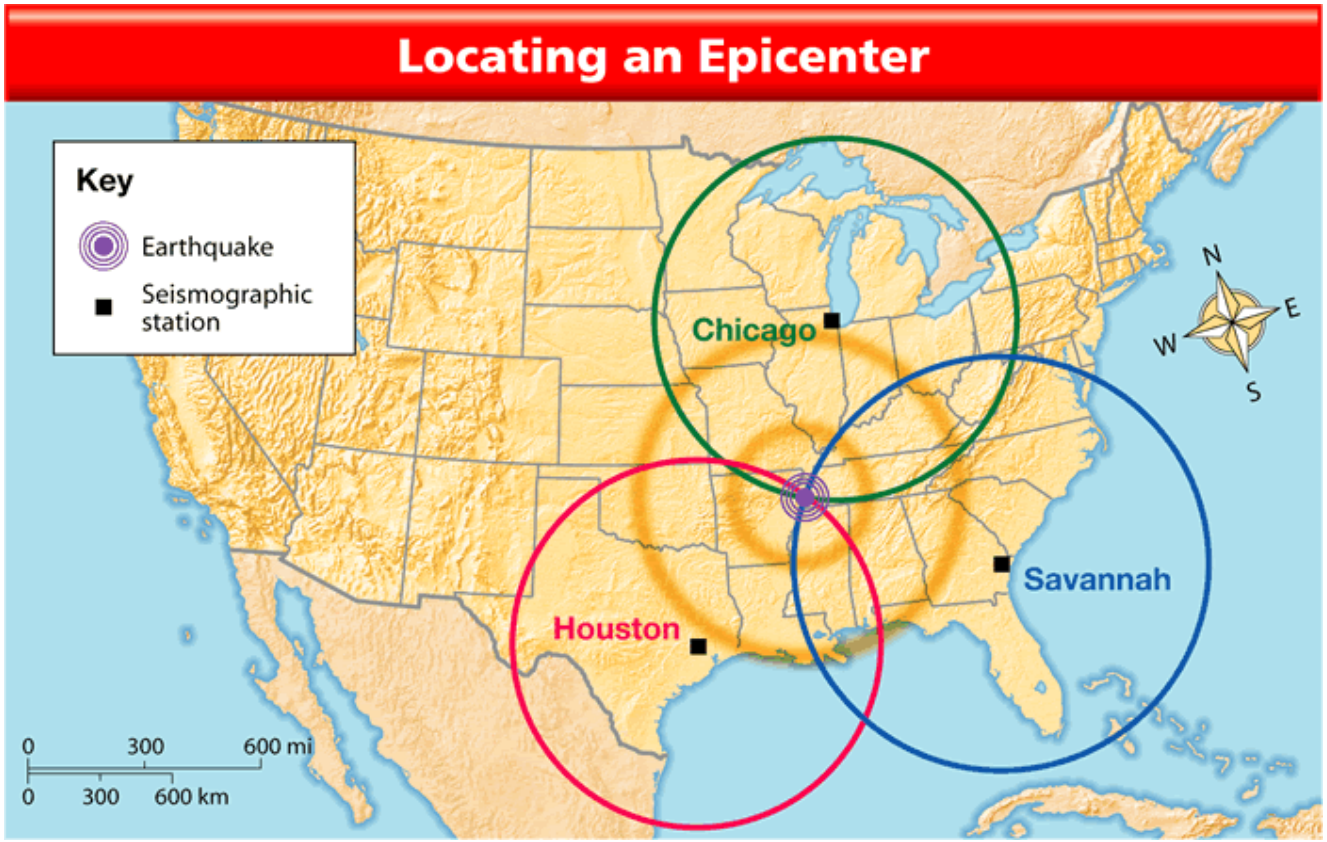
A. –2,000 = 3.5 minutes

–4,000 = 4.5 minutes

End of Slide

Locating the Epicenter

Geologists use seismic waves to locate an earthquake's epicenter.



Seismic Waves in the Earth

Click the Video button to watch a movie about seismic waves in the earth.

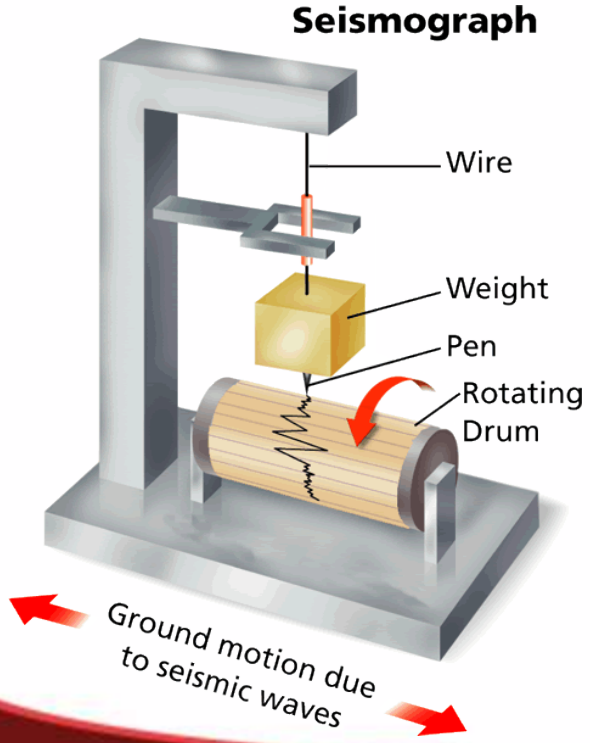
End of Section: Earthquakes and Seismic Waves

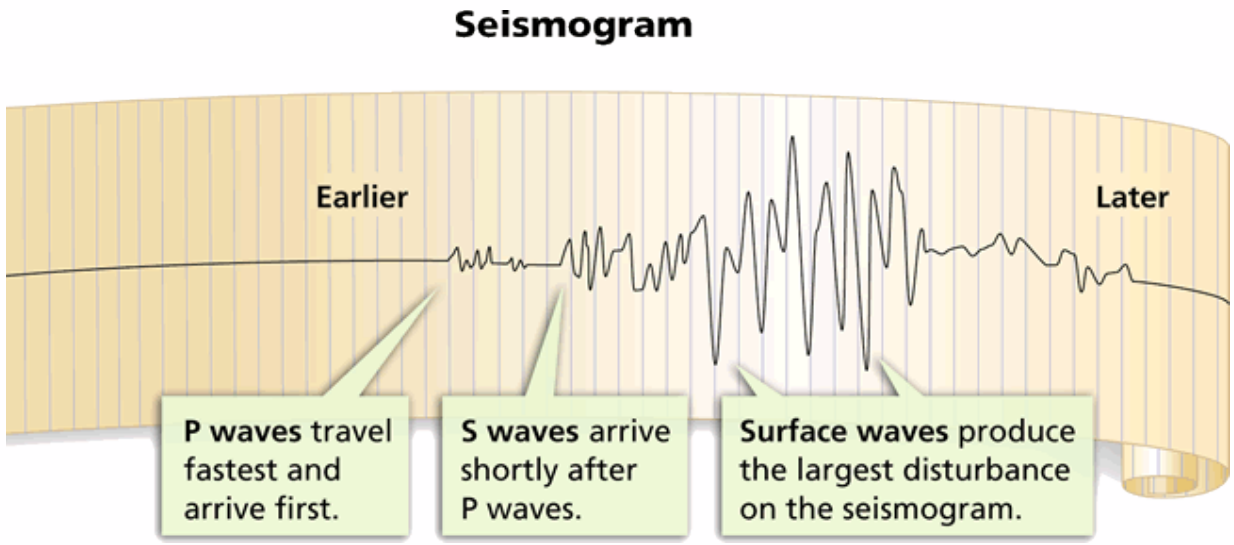
Section 3: Monitoring Earthquakes

- How do seismographs work?
- How do geologists monitor faults?
- How are seismographic data used?

The Seismograph

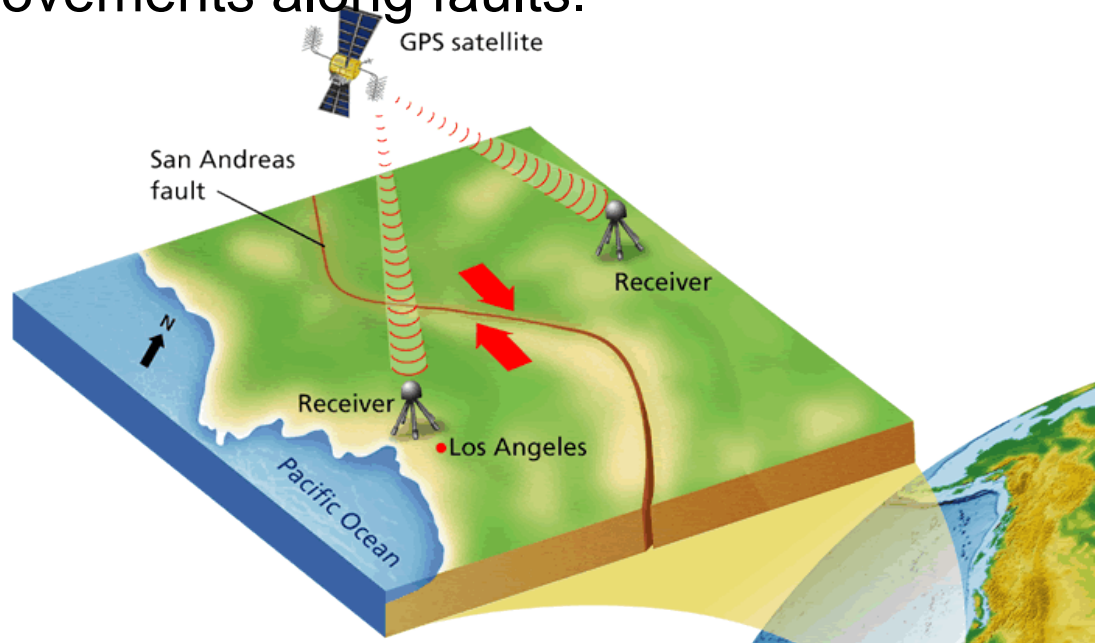
Seismic waves cause the seismograph's drum to vibrate. But the suspended weight with the pen attached moves very little. Therefore, the pen stays in place and records the drum's vibrations.





Instruments That Monitor Faults

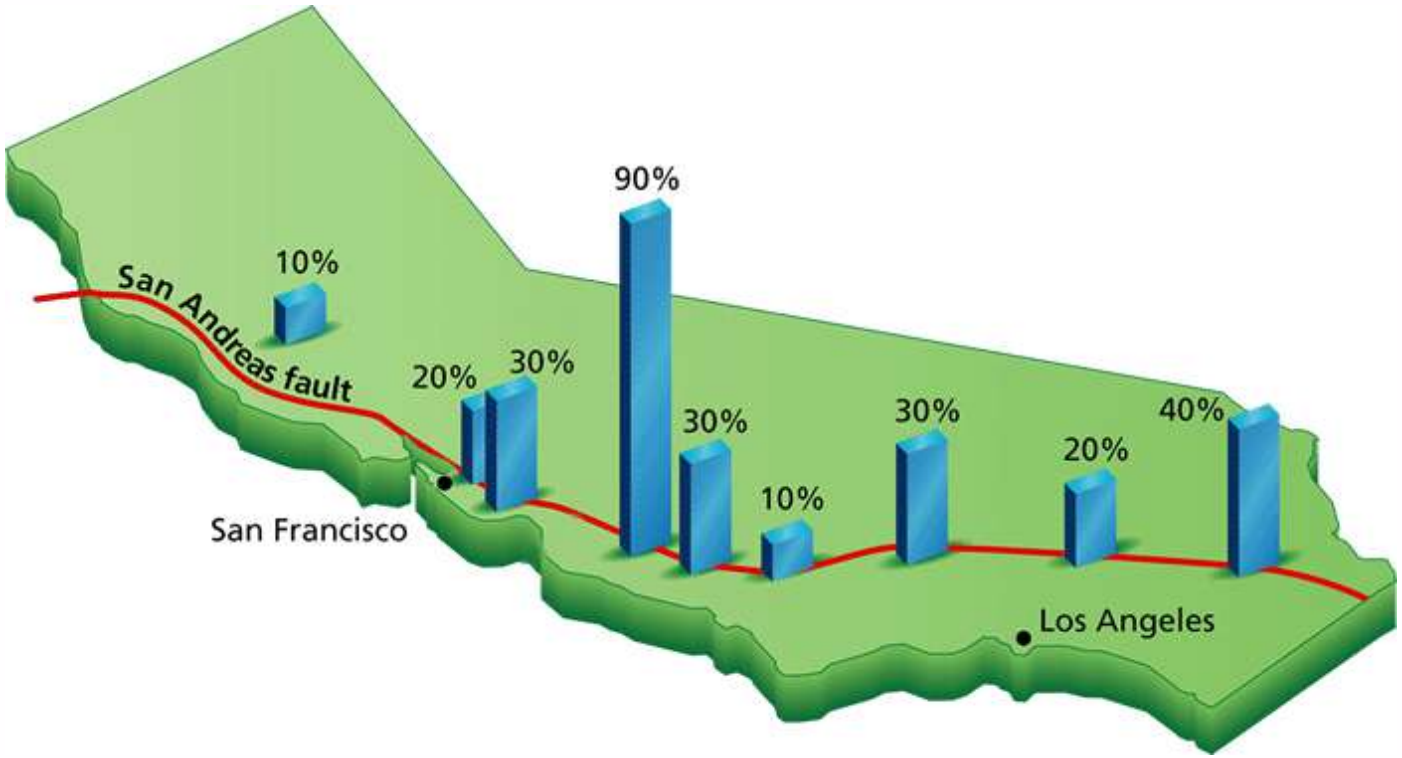
To monitor faults, geologists have developed instruments to measure changes in elevation, tilting of the land surface, and ground movements along faults.



GPS Satellites
Ground-based receivers use the GPS satellite system to measure changes in elevation and tilt of the land as well as horizontal movement along a fault.

Using Seismographic Data

The map shows the probability of a strong earthquake along the San Andreas fault. A high percent probability means that a quake is more likely to occur.



Links on Earthquake Measurement

Click the SciLinks button for links on earthquake measurement.

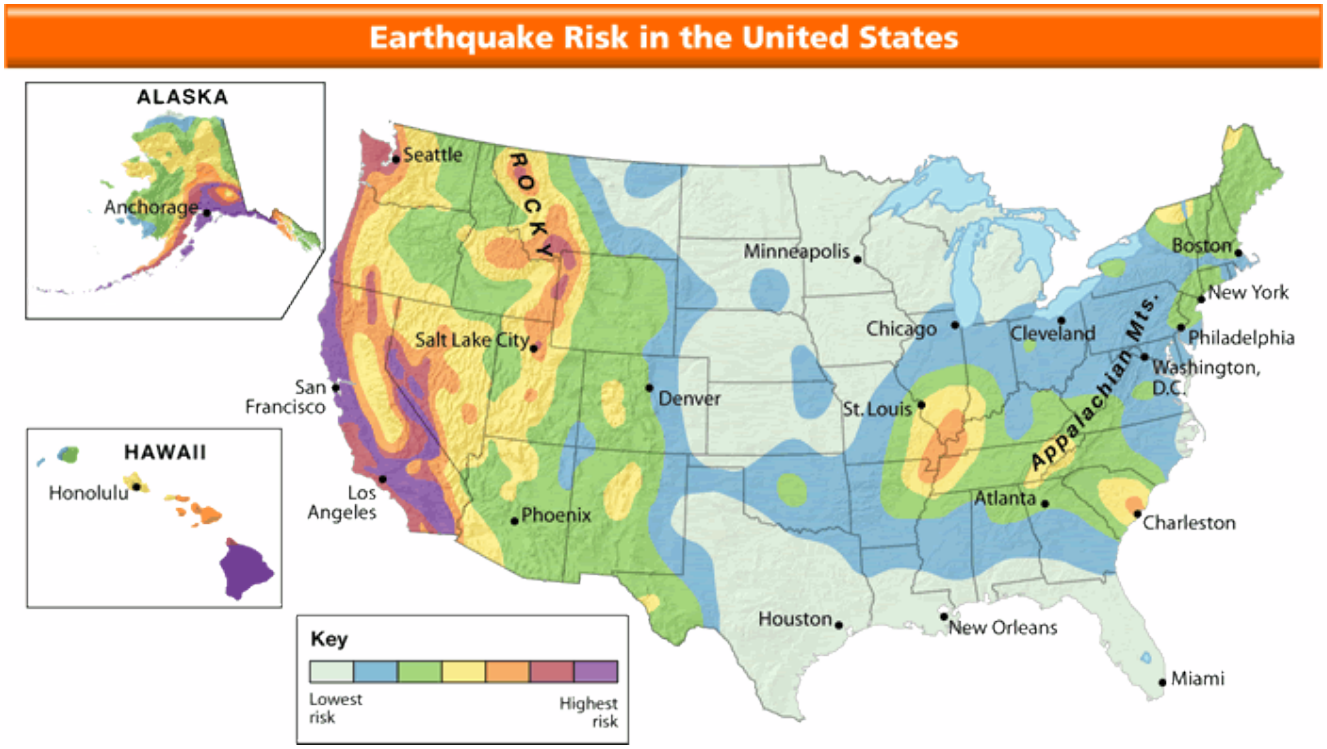
End of Section: Monitoring Earthquakes

Section 4: Earthquake Safety

- How do geologists determine earthquake risk?
- What kinds of damage does an earthquake cause?
- What can be done to increase earthquake safety and reduce earthquake damage?

Earthquake Risk

Geologists can determine earthquake risk by locating where faults are active and where past earthquakes have occurred.



Earthquake Intensity

Intensity maps use the Mercalli scale to show how the ground shaking and damage from an earthquake vary from place to place. This is an intensity map for the 1989 Loma Prieta earthquake.

Intensity	Shaking	Damage
I	Not felt	None
II-III	Weak	None
IV	Light	None
V	Moderate	Very light (some windows break)
VI	Strong	Light (some plaster falls)
VII	Very Strong	Moderate (chimneys break)
VIII	Severe	Moderate to heavy (chimneys and walls fall)
IX	Violent	Heavy (building foundations shift; ground cracks)
X+	Extreme	Very heavy (most structures destroyed; rails bend)

Earthquake Risk

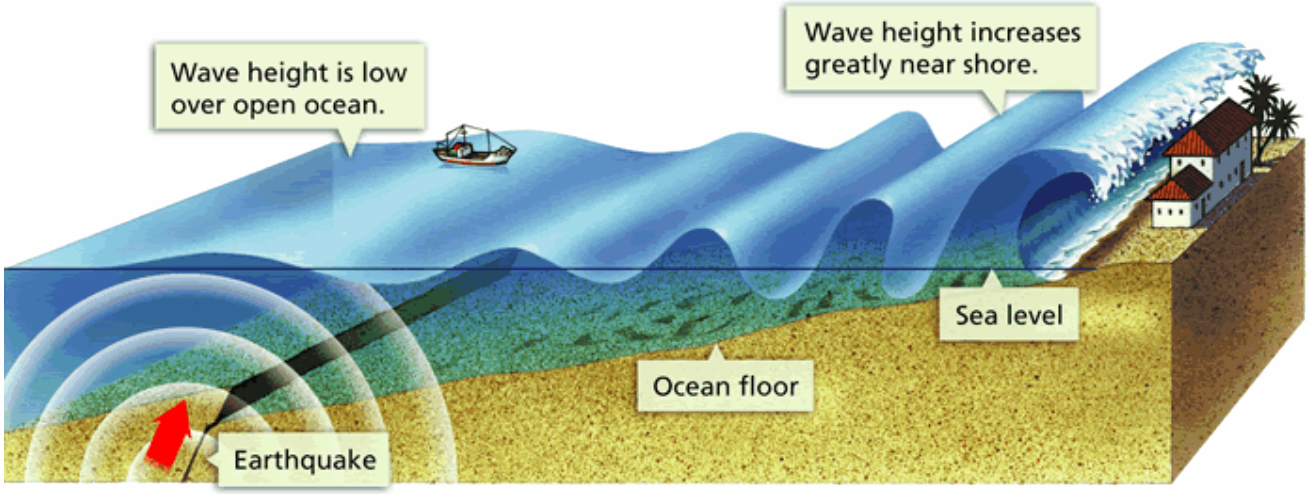
Past earthquakes can help geologists estimate the risk of future earthquakes. The table shows strong earthquakes of the past 100 years and their magnitudes.

Major Earthquakes

Earthquake	Moment Magnitude
San Francisco, California, 1906	7.8
Messina, Italy, 1908	7.2
Tokyo, Japan, 1923	7.9
Southern Chile, 1960	9.5
Anchorage, Alaska, 1964	9.2
Loma Prieta, California, 1989	6.9
Northridge, California, 1994	6.7
Indian Ocean, near Sumatra, Indonesia, 2004	9.0

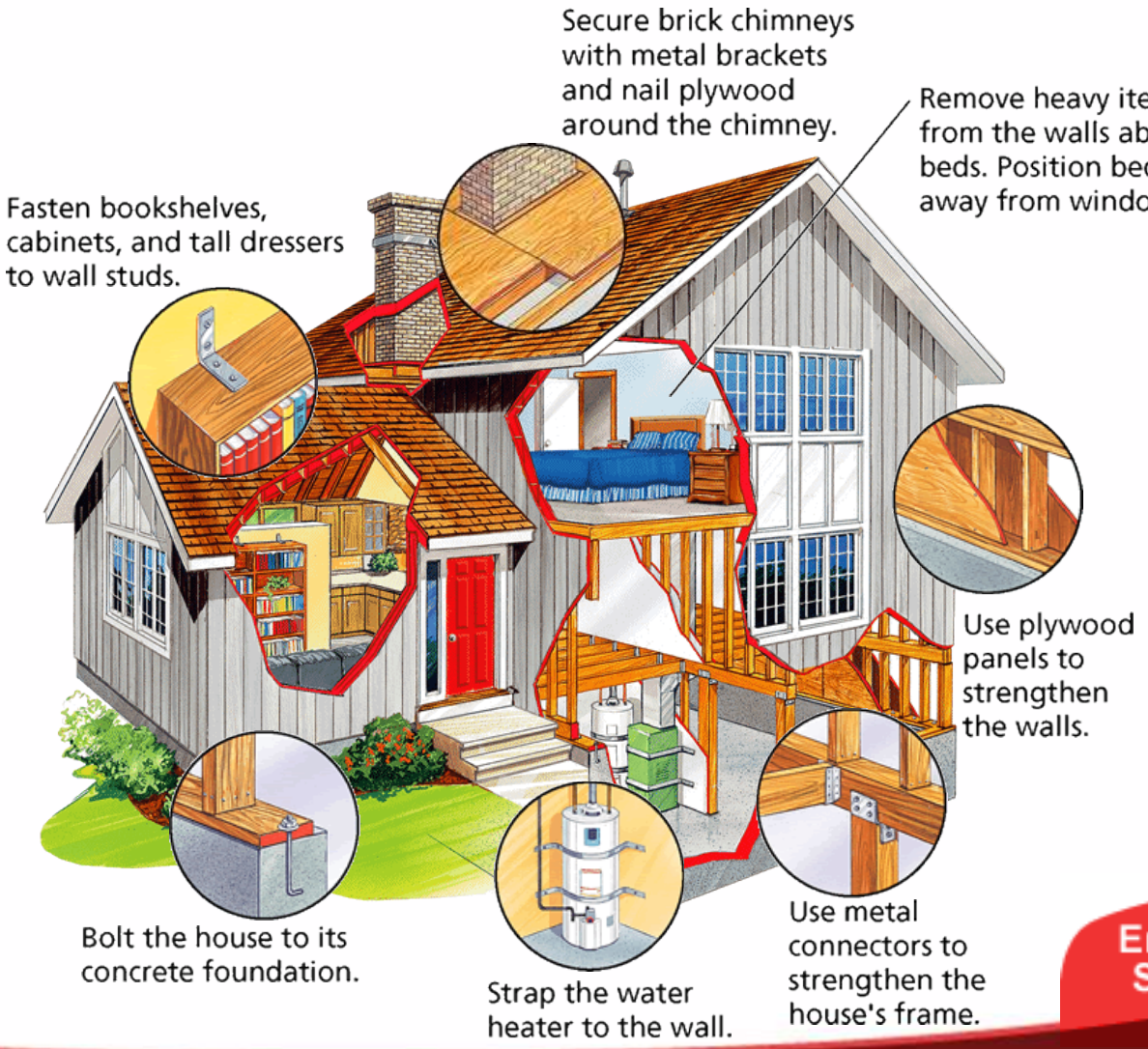
How Earthquakes Cause Damage

A tsunami spreads out from an earthquake's epicenter and speeds across the ocean.



Designing Safer Buildings

To reduce earthquake damage, new buildings must be made stronger and more flexible.



End of Slide

More on Earthquake Risk

Click the PHSchool.com button for an activity about earthquake risk.

Earthquake Damage

Click the Video button to watch a movie about earthquake damage.

End of Section: Earthquake Safety

QuickTake Quiz

Click to start quiz.