Lesson 3

Monitoring Earthquakes

UNLOCK THE Q

- How Do Seismographs Work?
- What Patterns Do Seismographic Data Reveal?

MY PLANET DIARY

Whole Lot of Shaking Going On

Is the ground moving under your school? A project that will monitor shaking underneath the entire nation might help you find out!

In 2004, scientists in the USArray project placed 400 seismographs across the western United States. Every month, 18 seismographs are picked up and moved east, "leapfrogging" the other seismographs. The map below shows one arrangement of the array. The seismic data that are obtained will help scientists learn more about our active Earth!

FUN FACT

Communicate Discuss this question with a group of classmates. Write your answer below.

When the array arrives in your state, what information might it provide?

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_____

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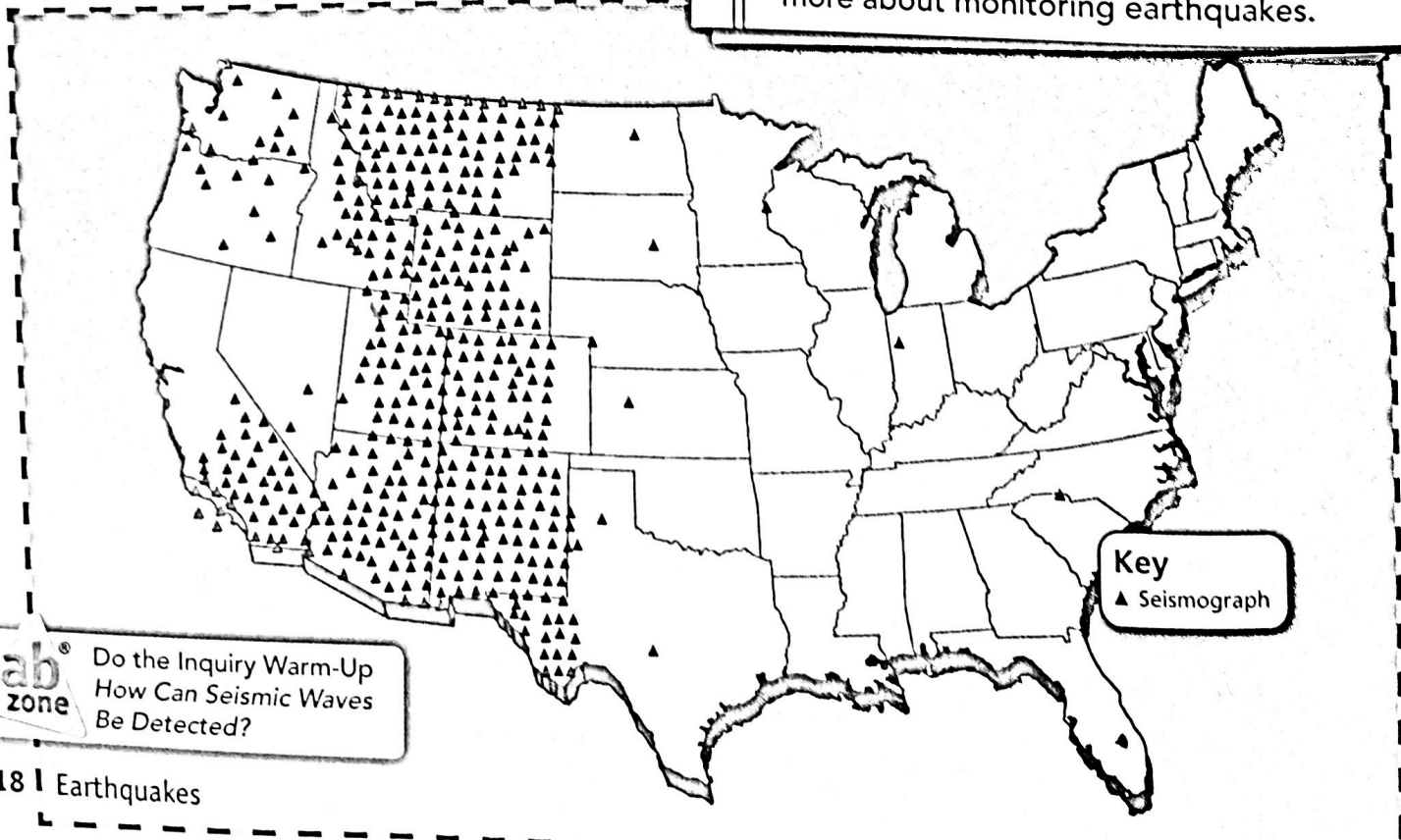
PLANET DIARY Go to Planet Diary to learn more about monitoring earthquakes.



Lab zone Do the Inquiry Warm-Up *How Can Seismic Waves Be Detected?*

Vocabulary

- seismogram

Skills

- Reading: Identify the Main Idea
- Inquiry: Predict

How Do Seismographs Work?

Today, seismographs are complex electronic devices. Some laptop computers and car air bags contain similar devices that detect shaking. But a simple seismograph, like the one in **Figure 1,** can consist of a heavy weight attached to a frame by a spring or wire. A pen connected to the weight rests its point on a drum that can rotate. As the drum rotates, the pen in effect draws a straight line on paper wrapped tightly around the drum. **Seismic waves cause a simple seismograph's drum to vibrate, which in turn causes the pen to record the drum's vibrations.** The suspended weight with the pen attached moves very little. This allows the pen to stay in place and record the drum's vibrations.

Measuring Seismic Waves

When you write a sentence, the paper stays in one place while your hand moves the pen. But in a seismograph, it's the pen that remains stationary while the paper moves. Why is this? All seismographs make use of a basic principle of physics: Whether it is moving or at rest, every object resists any change to its motion. A seismograph's heavy weight resists motion during an earthquake. But the rest of the seismograph is anchored to the ground and vibrates when seismic waves arrive.

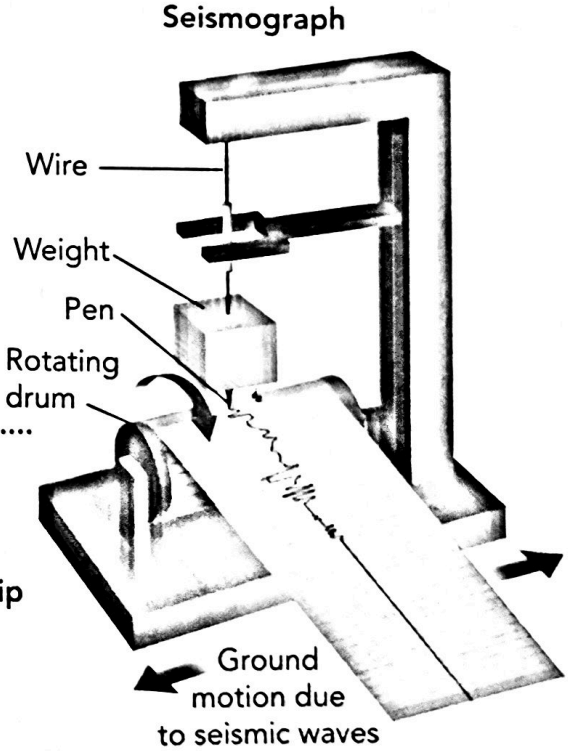


FIGURE 1

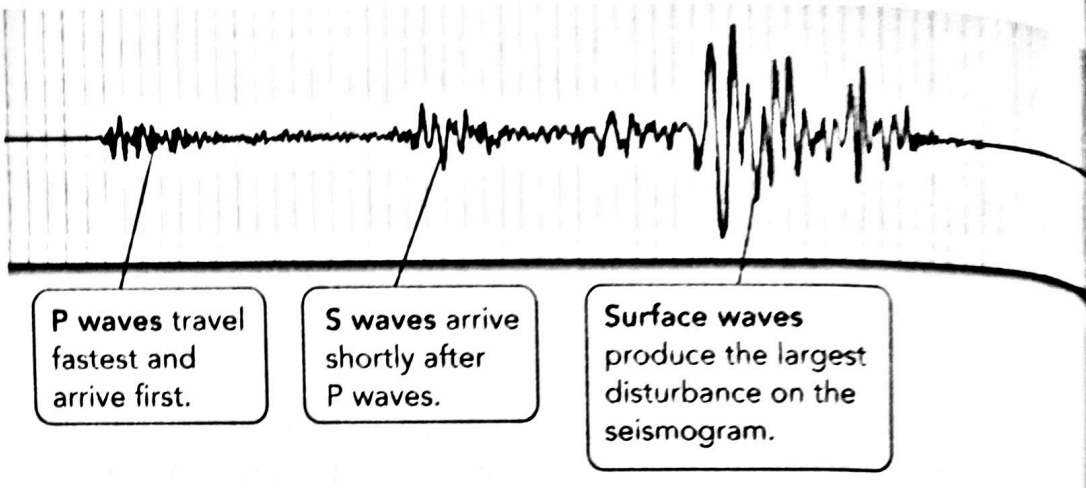
Recording Seismic Waves

In a simple seismograph, a pen attached to a suspended weight records an earthquake's seismic waves.

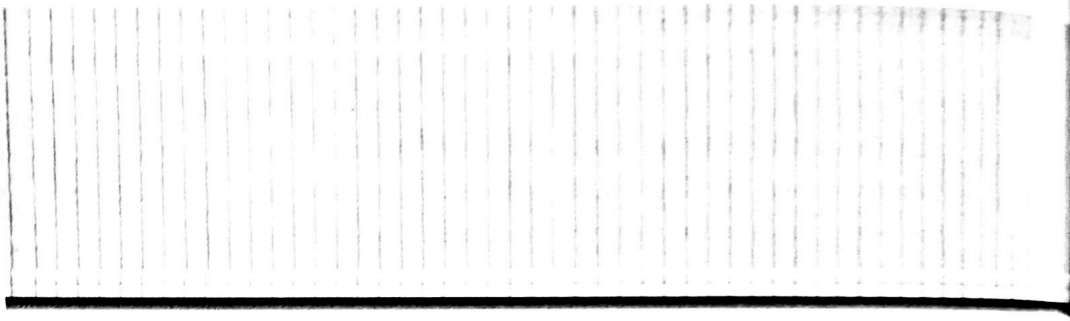
Make Models To mimic the action of a seismograph, hold the tip of a pencil on the right edge of the seismograph paper below. Have a classmate pull the right edge of the book away from your pencil while the classmate also "vibrates" the book side to side.

FIGURE 2

Seismograms
When an earthquake's seismic waves reach a simple seismograph, the seismograph's drum vibrates. The vibrations are recorded by the seismograph's pen, producing a seismogram, as shown on the top diagram.



CHALLENGE **An aftershock is a smaller earthquake that occurs after a larger earthquake. Draw the seismogram that might be produced by a seismograph during an earthquake and its aftershock. Label the earthquake and the aftershock.**



Reading a Seismogram You have probably seen the zigzagging lines used to represent an earthquake. The pattern of lines, called a **seismogram,** is the record of an earthquake's seismic waves produced by a seismograph. Study the seismogram in **Figure 2.** Notice when the P waves, S waves, and surface waves arrive. The height of the lines drawn by the seismograph is greater for a more severe earthquake or an earthquake closer to the seismograph.

Lab zone® Do the Quick Lab *Design a Seismograph.*

Assess Your Understanding

1a. Review The height of the lines on a seismogram is (greater/less) for a stronger earthquake.

b. Interpret Diagrams What do the relatively straight, flat portions of the seismogram at the top of **Figure 2** represent?

_____

_____

_____

_____

got it?

○ **I get it!** Now I know that a simple seismograph works when _____

_____

_____

_____

_____

○ I need extra help with _____

Go to my science coach *online for help with this subject.*

What Patterns Do Seismographic Data Reveal?

Geologists use seismographs to monitor earthquakes. Other devices that geologists use detect slight motions along faults. Yet even with data from many different devices, geologists cannot yet predict when and where an earthquake might strike. **But from past seismographic data, geologists have created maps of where earthquakes occur around the world. The maps show that earthquakes often occur along plate boundaries.** Recall that where plates meet, plate movement stores energy in rock that makes up the crust. This energy is eventually released in an earthquake.

Earthquake Risk in North America Earthquake risk largely depends on how close a given location is to a plate boundary. In the United States, two plates meet along the Pacific coast in California, Washington state, and Alaska, causing many faults. Frequent earthquakes occur in California, where the Pacific plate and the North American plate meet along the San Andreas fault. In Washington, earthquakes result from the subduction of the Juan de Fuca plate beneath the North American plate. Recall that during subduction, one plate is forced down under another plate.

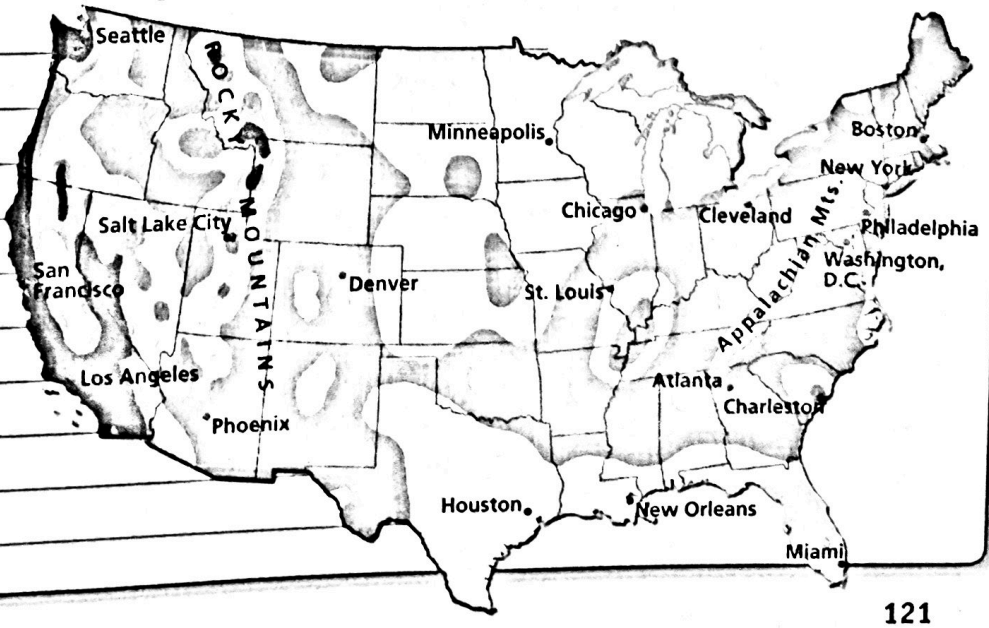
Identify the Main Idea
Underline the sentence in the second paragraph that describes the main factor in determining earthquake risk for a given location.

apply it!

The map shows areas where serious earthquakes are likely to occur, based on the location of past earthquakes across the United States.

1 Interpret Maps The map indicates that serious earthquakes are most likely to occur (on the east coast/in the midsection/on the west coast) of the United States.

2 Predict Based on the evidence shown in the map, predict where you think plate boundaries lie. Explain your reasoning.



Earthquake Risk Around the World Many of the world's earthquakes occur in a vast area of geologic activity called the Ring of Fire. In this area, plate boundaries form a ring around the Pacific Ocean. Volcanoes as well as earthquakes are common along these boundaries.The Ring of Fire includes the west coast of Central America and the west coast of South America. Strong earthquakes have occurred in countries along these coasts, where plates converge. Across the Pacific Ocean, the Pacific Plate collides with several other plates. Here, Japan, Indonesia, New Zealand, and New Guinea are seismically very active.

India, China, and Pakistan also have been struck by large earthquakes. In this area of the world, the Indo-Australian Plate collides with the Eurasian Plate. Earthquakes are also common where the Eurasian Plate meets the Arabian and African plates.

Earthquakes and Plate Tectonics

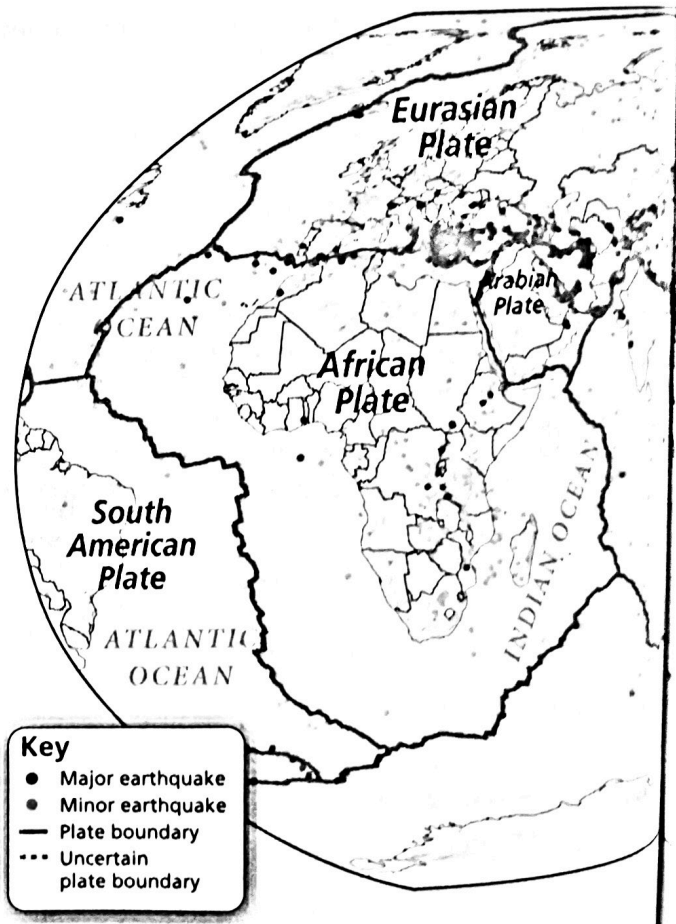
Why do earthquakes occur more often in some places than in others?

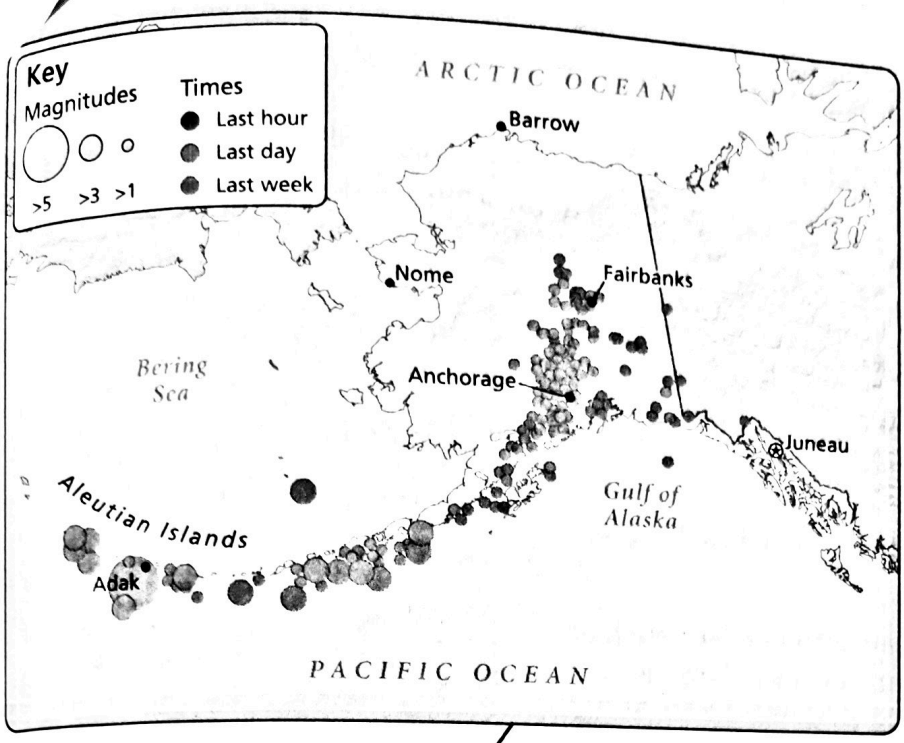
FIGURE 3

REAL-WORLD INQUIRY **Earthquakes Around the World**

Earthquakes are closely linked to plate tectonics. The map shows where past earthquakes have occurred in relation to plate boundaries.

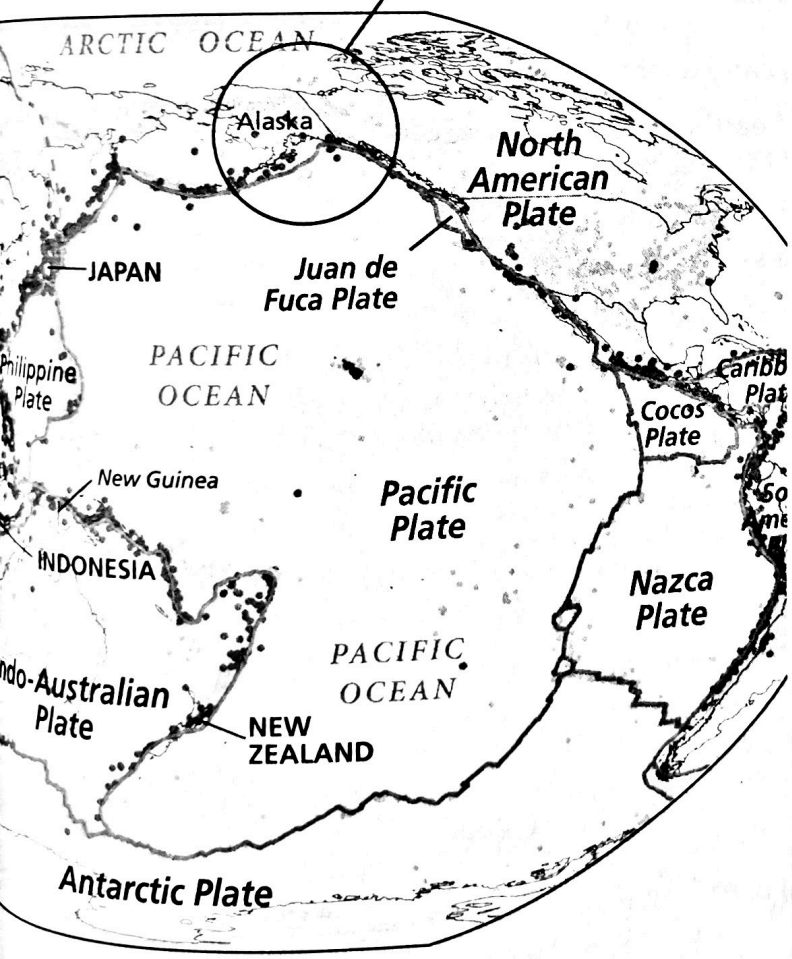
Make Judgments Draw an outline tracing the plate boundaries that make up the Ring of Fire. Then, look at North America. Draw a star where buildings should be built to withstand earthquakes. Put an X where there is less need to design buildings to withstand strong shaking. Do the same for another continent (not Antarctica). Explain your answers.





Earthquakes in Alaska

Look at the map of Alaska. Earthquakes here are the result of subduction. Infer Draw the plate boundary. Then draw arrows on either side of the boundary to show the direction in which the plates move relative to each other.



Lab zone Do the Quick Lab *Earthquake Patterns.*

Assess Your Understanding

2a. Review The _____ stored in rocks as a result of plate movement can be released in an earthquake.

b. ANSWER THE BIG Q Why do earthquakes occur more often in some places than in others?

_____

_____

_____

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_____

got it?

○ **I get it!** Now I know that seismographic data reveal that _____

_____

_____

○ **I need extra help with** _____

_____

Go to MY SCIENCE COACH *online for help with this subject.*