

Earthquake Safety

Reading Preview

Key Concepts

- 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?

Key Terms

- liquefaction
- aftershock
- tsunami
- base-isolated building



Target Reading Skill

Asking Questions Before you read, preview the red headings and ask a *what*, *how*, or *where* question for each. As you read, write answers to your questions.

Earthquake Safety

Question	Answer
Where is quake risk highest?	Earthquake risk is highest . . .

Lab zone

Discover Activity

Can Bracing Prevent Building Collapse?

1. Tape four straws together to make a square frame. Hold the frame upright on a flat surface.
2. Hold the bottom straw down with one hand while you push the top straw to the left with the other. Push it as far as it will go without breaking the frame.
3. Tape a fifth straw horizontally across the middle of the frame. Repeat Step 2.

Think It Over

Predicting What effect did the fifth straw have? What effect would a piece of cardboard taped to the frame have? Based on your observations, how would an earthquake affect the frame of a house?

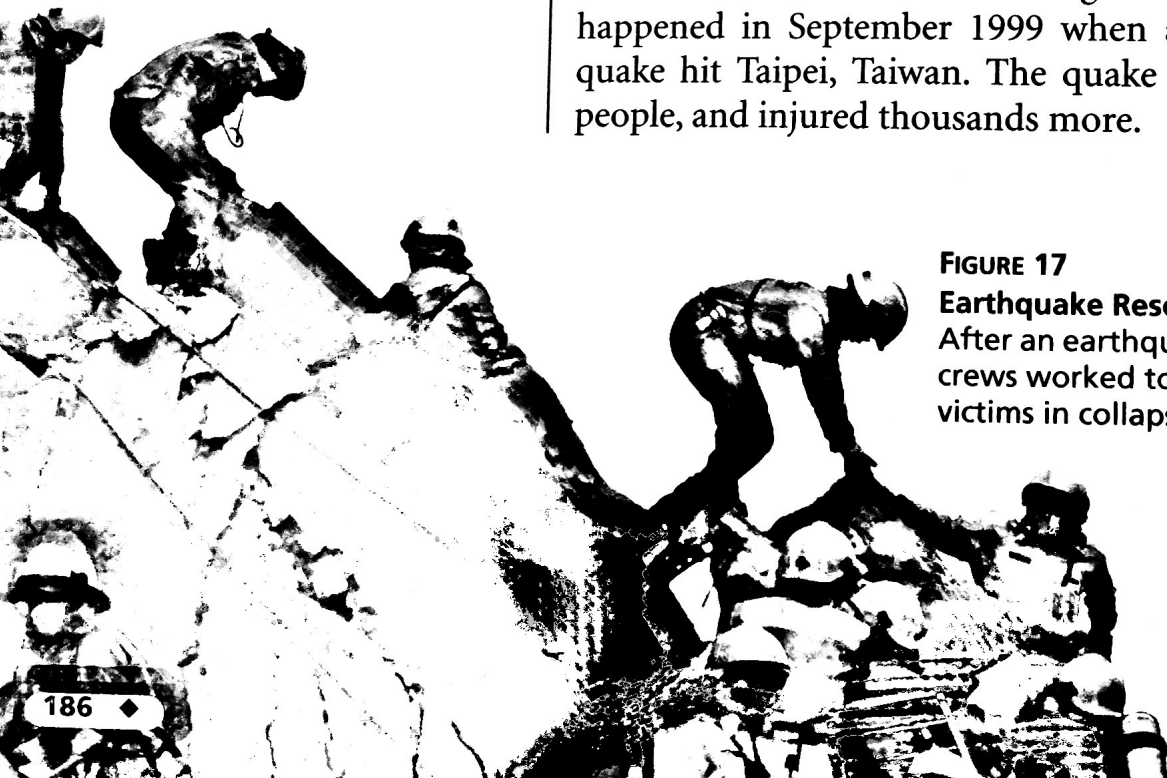


Imagine being sound asleep in your bed in the middle of the night. Suddenly, you are jolted wide awake as your home begins to rattle and shake. As objects fall off shelves and walls crack, you crouch under a desk for protection. Around the city, large buildings collapse and fires break out. The quake lasts less than a minute, but leaves behind great devastation. That's what happened in September 1999 when a magnitude 7.6 earthquake hit Taipei, Taiwan. The quake killed more than 2,000 people, and injured thousands more.

FIGURE 17

Earthquake Rescue

After an earthquake in Taipei, emergency crews worked to put out fires and rescue victims in collapsed buildings.



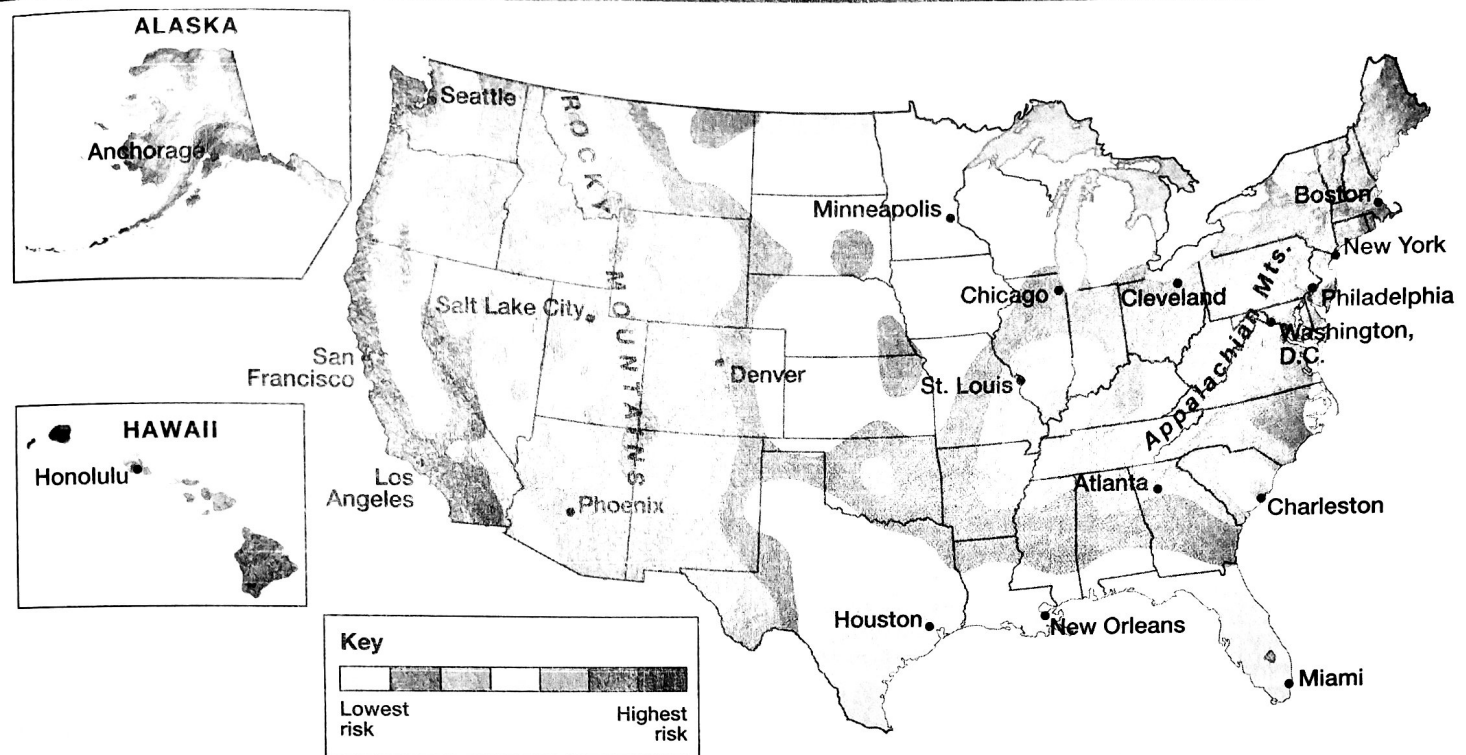


FIGURE 18

The map shows areas where serious earthquakes are likely to occur, based on the locations of previous earthquakes.

Interpreting Maps Where are damaging earthquakes least likely to occur? Most likely to occur?

Earthquake Risk

Geologists know that earthquakes are likely wherever plate movement stores energy in the rock along faults. **Geologists can determine earthquake risk by locating where faults are active and where past earthquakes have occurred.**

Look at Figure 18. In the United States, the risk is highest along the Pacific coast in California, Washington, and Alaska. Plates meet along the Pacific coast, causing many active faults. In California, the Pacific plate and 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. In Alaska, subduction of the Pacific plate causes many earthquakes.

The eastern United States generally has a low risk of earthquakes because this region lies far from plate boundaries. But, the East has experienced some of the most powerful quakes in the nation's history. Scientists hypothesize that the continental plate forming most of North America is under stress. This stress could disturb faults that lie hidden beneath thick layers of soil and rock.



**Reading
Checkpoint**

What area of the United States has the highest earthquake risk?

Lab zone Try This Activity

Stable or Unstable?

1. Make a model of a fault by placing two small, folded towels side by side on a flat surface.
2. Pile a stack of books on the fault by placing the light books on the bottom and the heaviest ones on top.
3. Gently pull the towels in opposite directions until the pile topples.
4. Repeat the process, but this time with the heavier books on the bottom.

Relating Cause and Effect

Which one of your structures was more stable than the other? Why?

How Earthquakes Cause Damage

When a major earthquake strikes, it can cause great damage. Causes of earthquake damage include shaking, liquefaction, aftershocks, and tsunamis.

Shaking The shaking produced by seismic waves can trigger landslides or avalanches. Shaking can also damage or destroy buildings and bridges, topple utility poles, and fracture gas and water mains. S waves and surface waves, with their side-to-side and up-and-down movement, can cause severe damage near the epicenter. As the seismic waves sweep through the ground, they can put enough stress on buildings to tear them apart.

The types of rock and soil determine where and how much the ground shakes. The most violent shaking may occur kilometers away from the epicenter. Loose soil shakes more violently than solid rock. This means a house built on sandy soil will shake more than a house built on solid rock.

Liquefaction In 1964, when a powerful earthquake roared through Anchorage, Alaska, cracks opened in the ground. Some of the cracks were 9 meters wide. The cracks were created by liquefaction. **Liquefaction** (lik wih FAK shun) occurs when an earthquake's violent shaking suddenly turns loose, soft soil into liquid mud. Liquefaction is likely where the soil is full of moisture. As the ground gives way, buildings sink and pull apart.

Aftershocks Sometimes, buildings weakened by an earthquake collapse during an aftershock. An **aftershock** is an earthquake that occurs after a larger earthquake in the same area. Aftershocks may strike hours, days, or even months later.



FIGURE 19

Liquefaction Damage

An earthquake caused the soil beneath this building to liquefy. Liquefaction can change soil to liquid mud.

Posing Questions What are some questions people might ask before building in a quake-prone area?

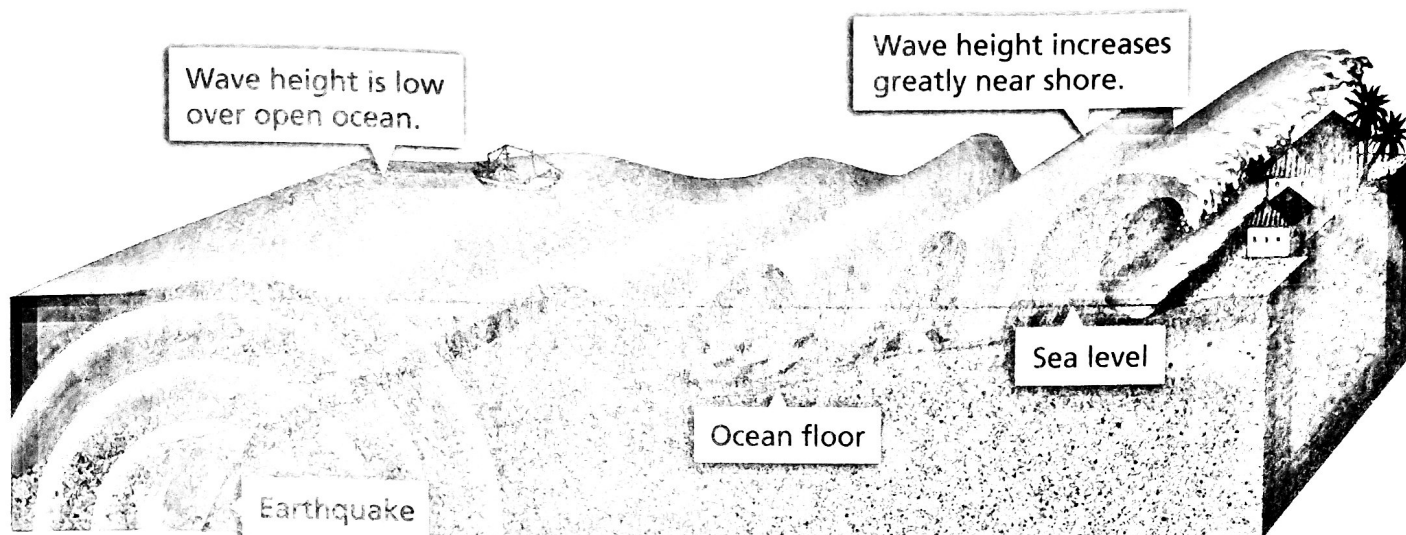


FIGURE 20

How a Tsunami Forms

A tsunami begins as a low wave, but turns into a huge wave as it nears the shore. In 2004, a powerful earthquake in the Indian Ocean triggered several tsunamis. The tsunamis caused great loss of life and destruction to coastal areas around the Indian Ocean.

Tsunamis When an earthquake jolts the ocean floor, plate movement causes the ocean floor to rise slightly and push water out of its way. The water displaced by the earthquake may form a large wave called a **tsunami** (tsoo NAH mee), shown in Figure 20. A tsunami spreads out from an earthquake's epicenter and speeds across the ocean. In the open ocean, the height of the wave is low. As a tsunami approaches shallow water, the wave grows into a mountain of water.

Steps to Earthquake Safety

What should you do if an earthquake strikes? The main danger is from falling objects and flying glass. **The best way to protect yourself is to drop, cover, and hold.**

If you are indoors when a quake strikes, crouch beneath a sturdy table or desk and hold on to it. If no desk or table is available, crouch against an inner wall, away from the outside of a building, and cover your head and neck with your arms. Avoid windows, mirrors, wall hangings, and furniture that might topple.

If you are outdoors, move to an open area such as a playground. Avoid vehicles, power lines, trees, and buildings. Sit down to avoid being thrown down.

After a quake, water and power supplies may fail, food stores may be closed, and travel may be difficult. People may have to wait days for these services to be restored. To prepare, an earthquake kit containing canned food, water, and first aid supplies should be stored where it is easy to reach.



**Reading
Checkpoint**

**How can furniture be dangerous during a quake?
How can it protect you?**

Designing Safer Buildings

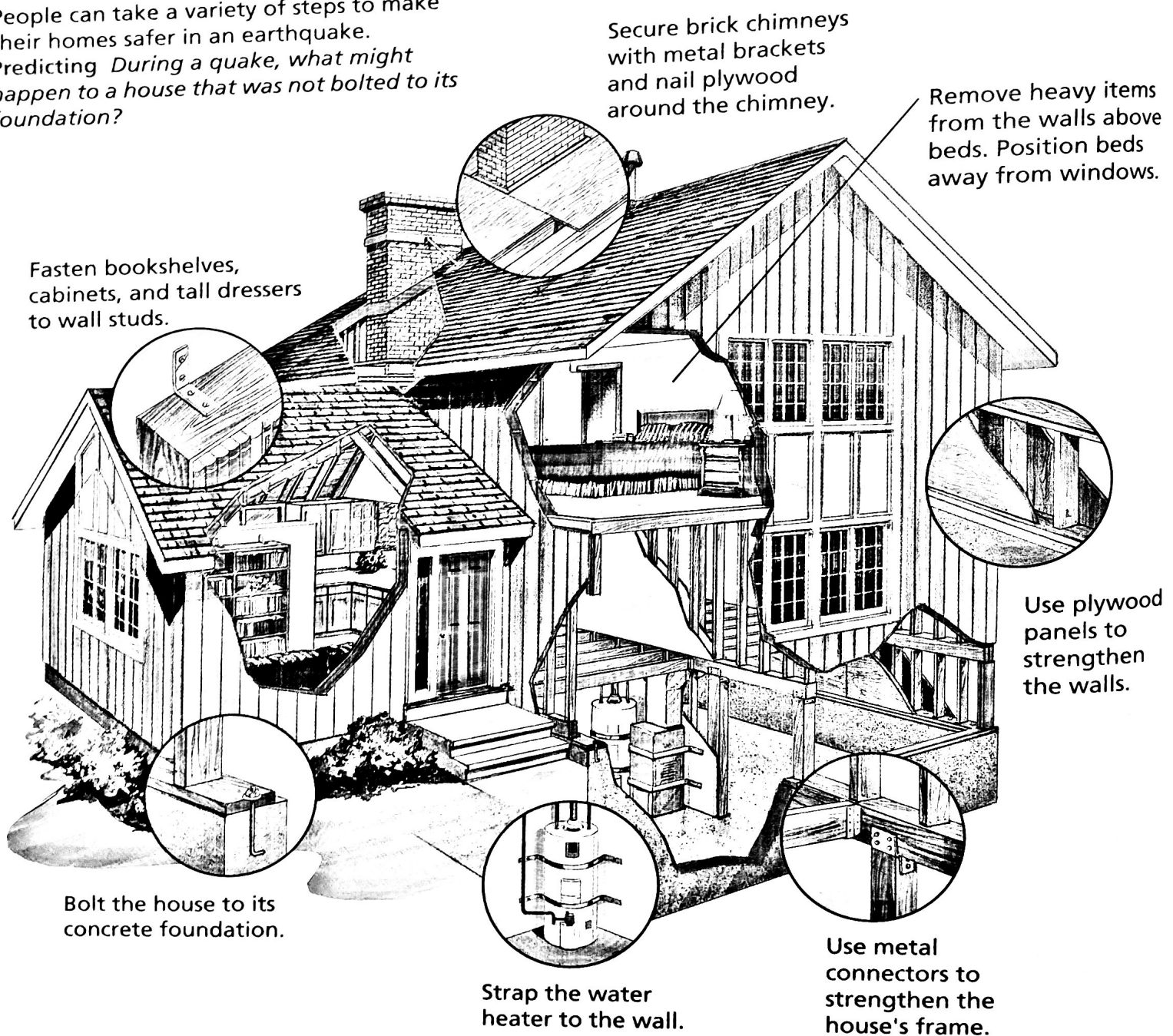
Most earthquake-related deaths and injuries result from damage to buildings or other structures. **To reduce earthquake damage, new buildings must be made stronger and more flexible. Older buildings may be modified to withstand stronger quakes.** People can protect their homes from the dangers of earthquakes. Figure 21 shows some of the steps that can make houses earthquake-safe. Some steps strengthen the house itself. Others may help to keep objects from tipping or falling and causing injury.

FIGURE 21

An Earthquake-Safe House

People can take a variety of steps to make their homes safer in an earthquake.

Predicting During a quake, what might happen to a house that was not bolted to its foundation?



Protecting Structures The way in which a building is constructed determines whether it can withstand an earthquake. During an earthquake, brick buildings and some wood-frame buildings may collapse if their walls have not been reinforced, or strengthened. To combat damage caused by liquefaction, new homes built on soft ground should be anchored to solid rock below the soil. Bridges and highway overpasses can be built on supports that go through soft soil to firmer ground. To find out more about how buildings can withstand earthquakes, look at *Seismic-Safe Buildings* on the following pages.

A **base-isolated building** is designed to reduce the amount of energy that reaches the building during an earthquake. A base-isolated building rests on shock-absorbing rubber pads or springs. Like the suspension of a car, the pads and springs smooth out a bumpy ride. During a quake, the building moves gently back and forth without any violent shaking.

Making Utilities Safer Earthquakes can cause fire and flooding when gas pipes and water mains break. Flexible joints can be installed in gas and water lines to keep them from breaking. Automatic shut-off valves also can be installed on these lines to cut off gas and water flow.



Reading
Checkpoint

How can utilities be protected from earthquake damage?

Go  online


PLANET DIARY

For: More on earthquake risk

Visit: PHSchool.com

Web Code: cfd-1024

Section 4 Assessment

 **Target Reading Skill Asking Questions** Work with a partner to check the answers in your graphic organizer.

Reviewing Key Concepts

1. **a. Identifying** What factors help geologists determine earthquake risk for a region?
- b. Comparing and Contrasting** Why does the risk of quakes vary across the United States?
2. **a. Listing** What are four ways that earthquakes cause damage?
- b. Relating Cause and Effect** How does liquefaction cause damage during an earthquake?
- c. Developing Hypotheses** How might heavy rain before an earthquake affect the danger of liquefaction?

3. **a. Reviewing** How can you protect yourself during an earthquake?

b. Describing What will happen to a base-isolated building when seismic waves strike the building during an earthquake?

Lab
zone

At-Home Activity

Quake Safety Plan Work with an adult family member to develop an earthquake safety plan. The plan should tell family members what to do during an earthquake. It should list items your family would need if a quake cut electrical power and water lines. It should also explain where to shut off the gas if your home has a natural gas line. Share your earthquake safety plan with the rest of your family.