

39. **Avoiding Earthquake Surprises in the Pacific Northwest**

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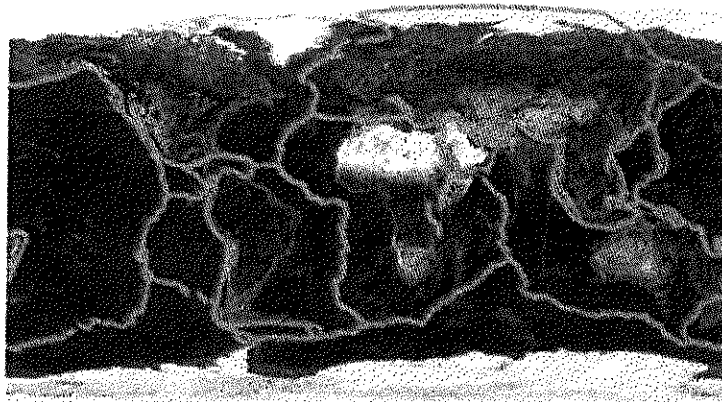
How Vulnerable Is the Pacific Northwest?

Cascadia is a region in the Pacific Northwest. It includes southern British Columbia, Washington, Oregon, and northern California. This region is at risk of being hit by earthquakes. Until the mid-1980s, Earth scientists thought that the threat was limited to quakes of magnitude¹ 7 or below.

But more recently, Earth scientists discovered evidence that more intense earthquakes repeatedly struck the region over the past several thousand years. And they are likely to occur again. Earthquakes of magnitude 8 and 9 are considered "great" quakes. An earthquake of magnitude 8 releases about thirty times as much energy as a quake of magnitude 7. A quake of magnitude 9 is another thirty times larger.

Why the Pacific Northwest Is At Risk

Earth's rigid outer shell is made up of vast rocky pieces called tectonic plates. These plates move as slowly as fingernails grow. They separate, collide, or grind against each other at plate boundaries. Where the plates grind together, pressure builds up and the rocks eventually break. This sends stored-up energy surging through Earth. This energy is what causes earthquakes.



Earth's surface is broken into massive rocky plates called tectonic plates.

¹ Over the years, seismologists devised various magnitude scales as measures of earthquake size. The "moment magnitude" scale is used today.

Most earthquakes occur along certain plate boundaries called subduction zones. A subduction zone is where a more dense oceanic plate subducts, or sinks below, a continental plate. Decades ago, scientists recognized that a subduction zone runs along the Pacific coast. It lies between southern British Columbia and northern California. It's called the Cascadia subduction zone.

The two largest earthquakes since 1900 occurred along subduction zones. They were a Chilean earthquake of magnitude 9.5 in 1960, and an Alaskan earthquake of magnitude 9.2 in 1964. During each of these earthquakes, the continental plate lurched 20 meters toward the sea. This movement thinned the plate by stretching its rocks. The thinning lowered the coast enough for tides to drown coastal forests. Today, ghostly tree trunks provide natural clues that the huge earthquakes occurred.

Clues of Ancient Quakes

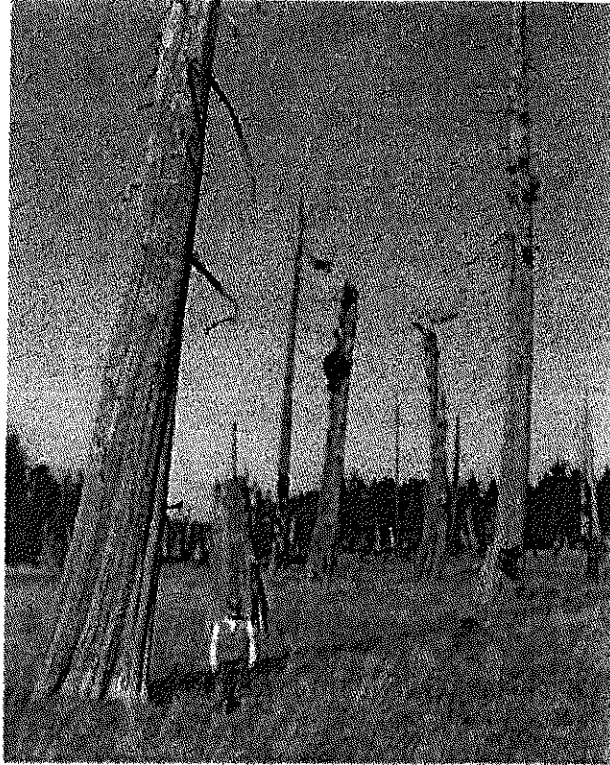
Earth scientists have found similar, much older, remains of flooded forests in Cascadia. They were discovered along bays and river mouths on the coasts of British Columbia, Washington, Oregon, and northern California. Scientists also found other evidence of strong earthquakes in the same locations. These include sheets of sand that were deposited by floods from the sea and ground cracks that were filled with quicksand. Scientists concluded that earthquakes of magnitude 8 or larger have struck Cascadia repeatedly in the past several thousand years.

Teams of scientists worked together to determine the exact date and an approximate size for the most recent of these Cascadia earthquakes. First, American scientists discovered clues in some dead trees. The trees recorded sudden lowering of coastal land during this earthquake. Radiocarbon dating showed that they died between 1680 and 1720.

Japanese researchers were paying attention to these discoveries in North America. They knew that if the Cascadia earthquake was big enough, it would have started a tsunami in the Pacific Ocean. And they had been looking for the mysterious source of a tsunami that caused flooding and damage in Japan in January 1700. They proposed that a great Cascadia earthquake occurred in the evening of January 26, 1700. They estimated its size as magnitude 9.

To test this proposed date and size, American scientists returned to some of the earthquake-killed trees in Washington. By measuring thin and thick rings, they assigned dates to individual tree rings. They were able to narrow the time of the earthquake to the months between

August 1699 and May 1700. This evidence supported the date proposed by Japanese researchers. The findings combined to give the 1700 Cascadia earthquake a place in history.



Scientists study dead trees in a tidal marsh along the Pacific coast of Washington. They provide evidence that a great earthquake occurred in January 1700.

Northwesterners Respond to the Risk

Earthquakes can't be prevented. However, people can take measures to minimize the damage they cause. In some cases, communities can strengthen structures that already exist. These include dams, bridges, water systems, schools, hospitals, and lifelines (electrical, gas, and water lines). They can also design and build earthquake-resistant structures in the future.

Until 1994, the Uniform Building Code² placed an area of Washington in a zone with the second highest hazard level (out of six). Most of the rest of Oregon and Washington was placed in a zone with a lower hazard level. The 1994 edition of the Uniform Building Code

² The Uniform Building Code was replaced in 2000 by the International Building Code.

redrew the map for the Pacific Northwest. All parts of Oregon and Washington that are at risk of great earthquakes were upgraded to the higher-level hazard zone.

This revision of the code was an important first step toward meeting the great-earthquake threat in the Pacific Northwest. In the areas upgraded to the second highest level, new buildings are designed to withstand earthquakes fifty percent stronger than under the old code.

How Safe Are Other Parts of the United States?

People in other earthquake-prone states started asking questions about whether they were adequately prepared for future earthquakes. These states include Massachusetts, New York, South Carolina, Missouri, Indiana, Utah, California and Alaska. Many of the questions cannot be answered satisfactorily until we know more about past earthquakes. Deciphering the geologic past is one of the ways that Earth scientists help to protect people from loss of life and property.

This reading was adapted from a 1995 USGS Fact Sheet, "Averting Surprises in the Pacific Northwest," by Brian F. Atwater, Thomas S. Yelin, Craig S. Weaver, James W. Hendley, II.

Name: _____ Date: _____

1. Where is Cascadia located?

- A in the Pacific Northwest
- B in Alaska
- C in Chile
- D in the middle of the Pacific Ocean

2. What is the cause of earthquakes?

- A the sudden breaking of the earth's rigid outer shell
- B the stretching and thinning of the rocks that make up a tectonic plate
- C the very slow movement of tectonic plates that are separating from each other
- D the energy released when two tectonic plates grind together and then suddenly move

3. What evidence led scientists to conclude that Cascadia had been hit by large earthquakes many times in the past?

- A the knowledge that the earth's outer shell is made up of tectonic plates
- B the remains of forests in Cascadia that had died because of flooding
- C the fact that Alaska had been hit by an earthquake of magnitude 9.2
- D the revision of the Uniform Building Code in the Pacific Northwest

4. Based on the text, what may have led people to revise the Uniform Building Code in the Pacific Northwest?

- A the need to prevent large earthquakes from happening in the Pacific Northwest region
- B the fact that buildings in the Pacific Northwest had recently fallen down during earthquakes
- C the desire to help scientists learn about buildings in areas that are likely to be hit by earthquakes
- D the evidence that large earthquakes had struck the Pacific Northwest in the past

5. What is the main idea of this article?

- A Scientists can tell where large earthquakes have occurred by studying dead forests along coastal land.
- B Earthquakes can occur along subduction zones, where an oceanic tectonic plate sinks below a continental plate.
- C Scientists have found evidence that the Pacific Northwest is at risk of being hit by major earthquakes.
- D Changing the Uniform Building Code in the Pacific Northwest was an important step toward meeting the threat of large earthquakes.

6. Read these sentences from the text.

"Earthquakes can't be prevented. However, people can take **measures** to minimize the damage they cause. In some cases, communities can strengthen existing dams, bridges, water systems, schools, hospitals, and lifelines (electrical, gas, and water lines). They can also design and build earthquake-resistant structures."

What does the word "**measures**" most nearly mean in this sentence?

- A questions
- B amounts
- C actions
- D lessons

7. Choose the answer that best completes the second sentence below.

Scientists used to think that Cascadia would only be struck by earthquakes of magnitude 7 or below. _____, they found more recent evidence of bigger earthquakes in the region.

- A Therefore
- B However
- C Indeed
- D For example

8. What did the drowned forests in Cascadia show scientists about the size of past earthquakes in the region?
