

# Tsunamis

*A Reading A-Z Level S Leveled Book*

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# Tsunamis



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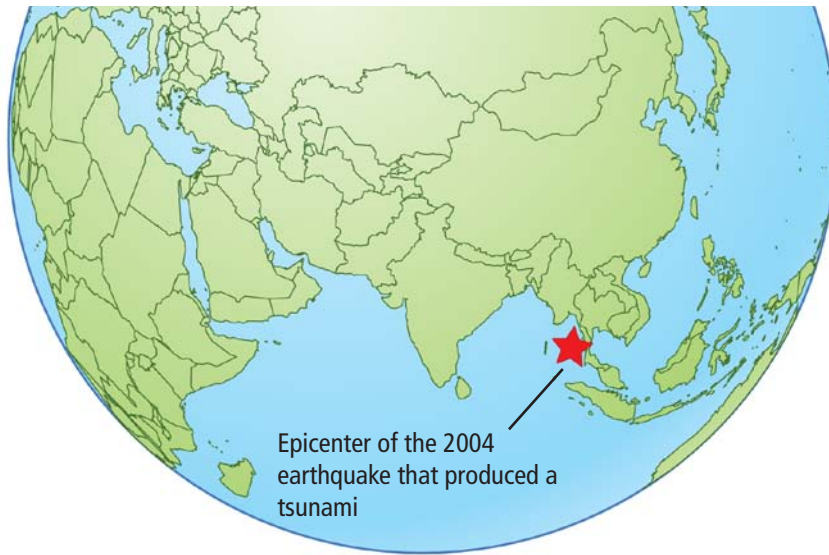
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The 2004 Indian Ocean tsunami washed away much of Banda Aceh, Indonesia.

## ***The Indian Ocean Tsunami***

On December 26, 2004, a powerful **earthquake** shook the ocean floor near the coast of Sumatra, Indonesia. People in nearby villages felt the earth shake. They didn't know that within minutes a massive wave, known as a **tsunami**, would flood their homes. The giant wall of moving water washed away entire towns. Within hours, the waves had pounded thousands of miles of coast in Indonesia, India, Africa, Thailand, Bangladesh, Malaysia, Maldives, Myanmar, and Singapore, among others.

People around the world were stunned each day as the reported death toll increased from 20,000 to 100,000 to 226,000. We will probably never know how many people died because many bodies were buried by the mud and debris or washed out to sea. Scientists think that the death toll would have been lower if more people had known about the danger of tsunamis and how to escape them.



Banda Aceh before tsunami



Banda Aceh after tsunami



Wooden raft used by one tsunami survivor

## Tsunami Survivor Stories

Amid the stories of loss were amazing stories of survival. One man from Indonesia was washed out to sea by the tsunami, but he was able to crawl onto a wooden raft. He survived by eating coconuts and drinking rainwater. A ship rescued him after two weeks at sea.

Some people outran the water or were washed inland by the wave. Others survived by hanging onto trees or by climbing to the tops of strong buildings. The people who headed for higher ground as soon as they felt the earthquake were most likely to survive. Experts say moving to higher ground or inland are the only true safe places to go when a tsunami hits.

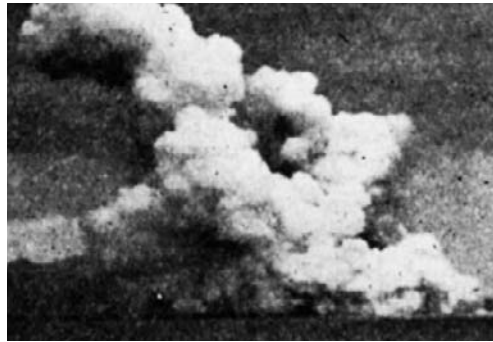


## History of Tsunamis

The word *tsunami* is Japanese and means “harbor wave.” It originated with Japanese fishermen who would return to port to find their towns destroyed by unusually large ocean waves that they hadn’t even noticed while out at sea.

Tsunamis can be **devastating** when they occur. Fortunately, they are very rare. There are usually six major tsunamis every 100 years worldwide.

In 1883 in Indonesia, the volcano Krakatoa exploded and caused a tsunami that killed 36,000 people. In 1958, a landslide in



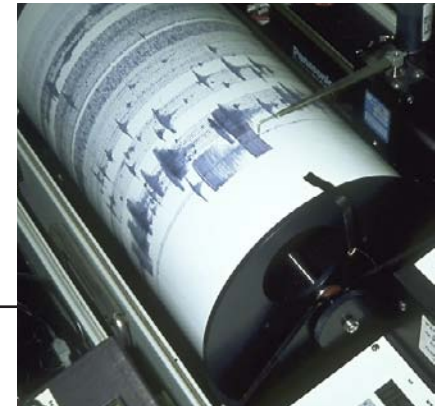
Krakatoa erupting in 1943

Alaska splashed into Lituya Bay, creating a wave 1,720 feet (524.26 meters) high. An earthquake off the coast of Chile caused a tsunami in 1960, devastating parts of South America, Hawaii, and Japan.

## Causes of Tsunamis

Earthquakes on the ocean floor cause most tsunamis. Underwater landslides, volcanic explosions, and meteor impacts also cause tsunamis.

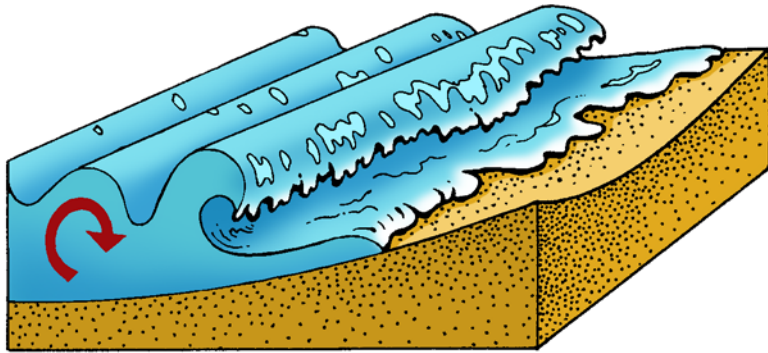
Not every earthquake in or near the ocean causes a tsunami. It depends on the strength of the earthquake and the kind of movement that occurs in Earth’s crust. An earthquake has to be at least 6.75 on the **Richter scale** to result in a tsunami. The Indian Ocean tsunami of 2004 was caused by a “mega-earthquake” with a **magnitude** of 9.0.



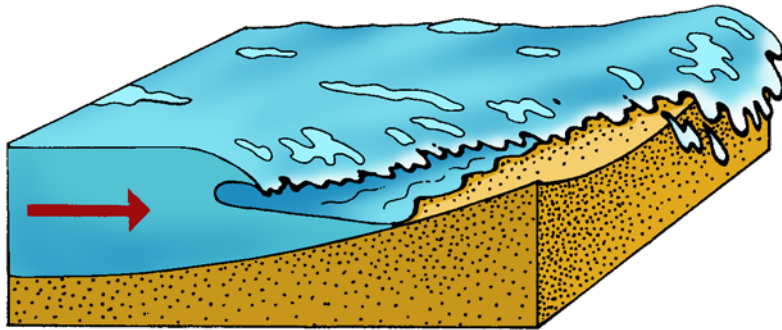
### How Strong Is It?

The force of an earthquake is described with the Richter scale. People do not feel a 2.0 earthquake at all. Seismographs all around the world can measure a 4.5 quake. With each step up the Richter scale, force increases rapidly. A magnitude 6.0 earthquake has 10 times the power of a 5.0 quake. So when you hear about a magnitude 7, 8, or 9 quake, remember that each unit is actually 10 times the strength of the unit before.

### Surface Waves vs. Tsunami Waves



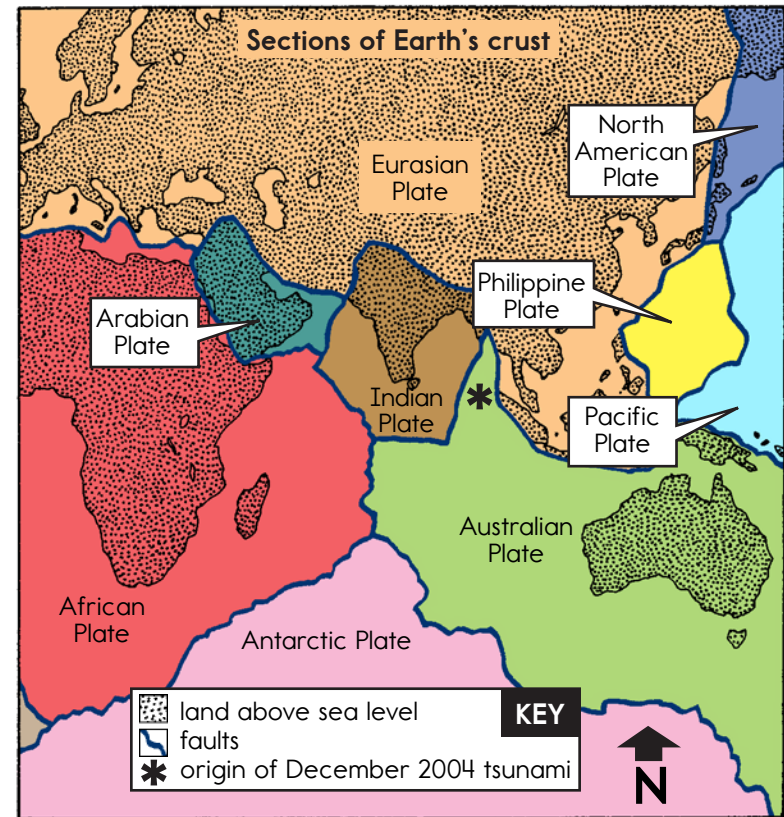
Surface waves roll onto shore fairly close together. As waves approach shallower water, the lower part of the wave drags on the ocean floor, slowing it down. The upper part of the wave pours onto land.



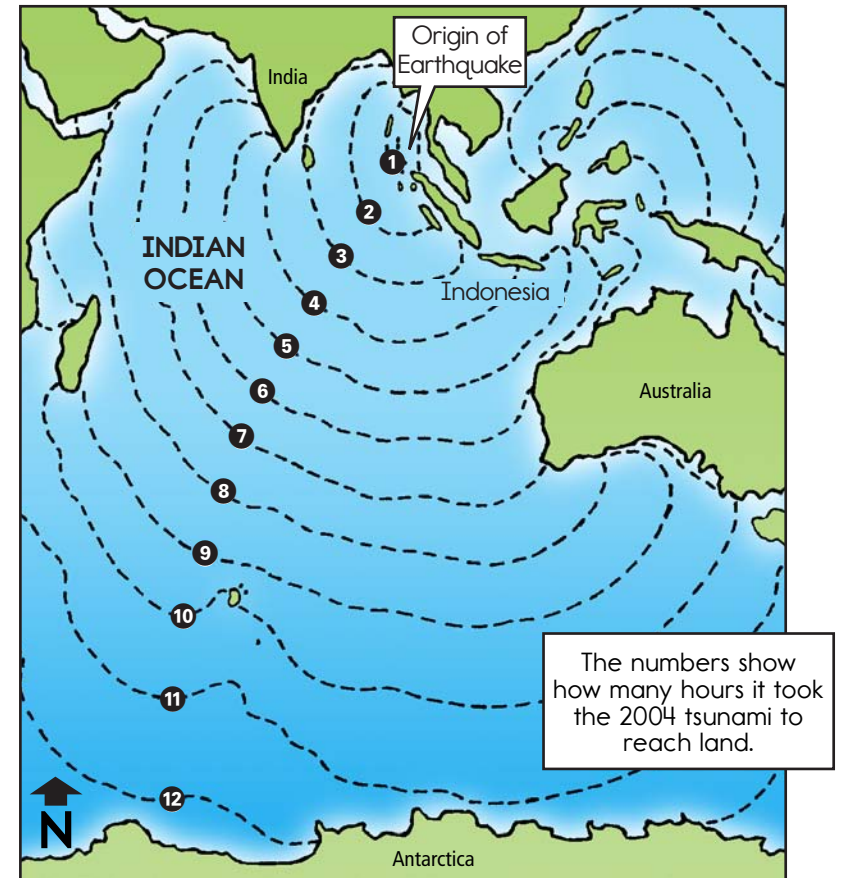
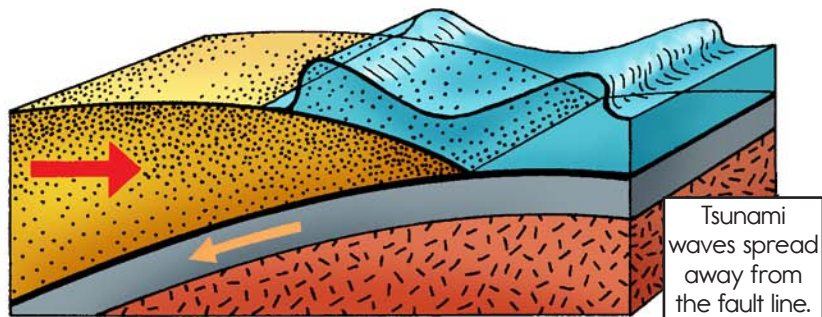
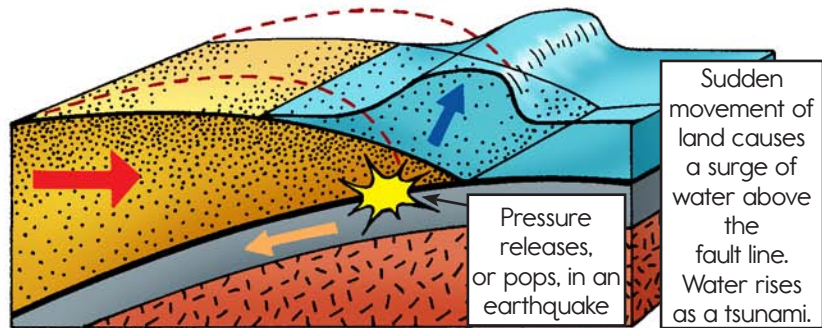
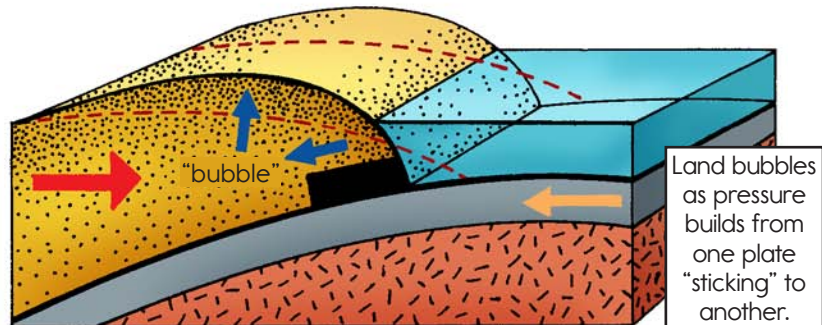
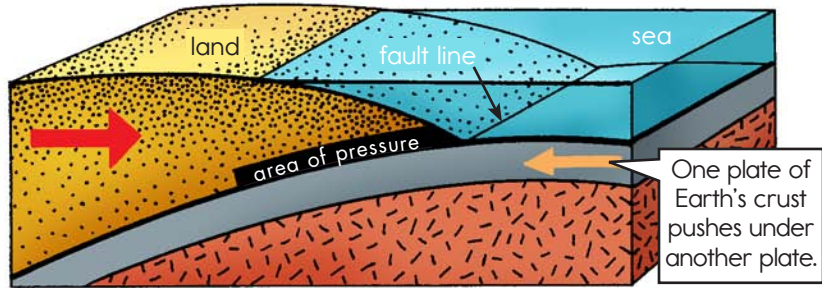
Tsunami waves act much as surface waves do. The bottom of the tsunami wave drags on the ocean floor slowing it down while the upper part pours onto the shore. Because tsunami waves are taller and farther apart, much more water pours onto shore at one time.

Tsunamis are sometimes called **tidal** waves because they rush in like a high tide, but in truth they have nothing to do with tides. Tsunamis are also different from normal surface waves caused by wind. Surface waves tend to roll onto shore in a circular motion.

Earthquakes occur when sections of Earth's crust suddenly slide against each other along a **fault**. If an up-and-down shift occurs on the seafloor, all the water above the seafloor moves, too, creating an enormous bulge of water, a tsunami. The tsunami moves almost invisibly in the open ocean because it is broad and very low compared to surface waves.



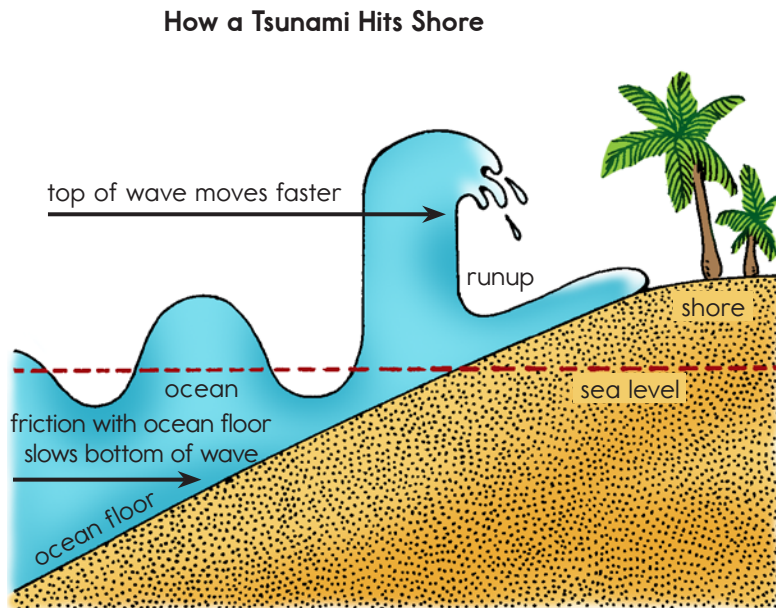




How long did it take the tsunami to reach Australia?

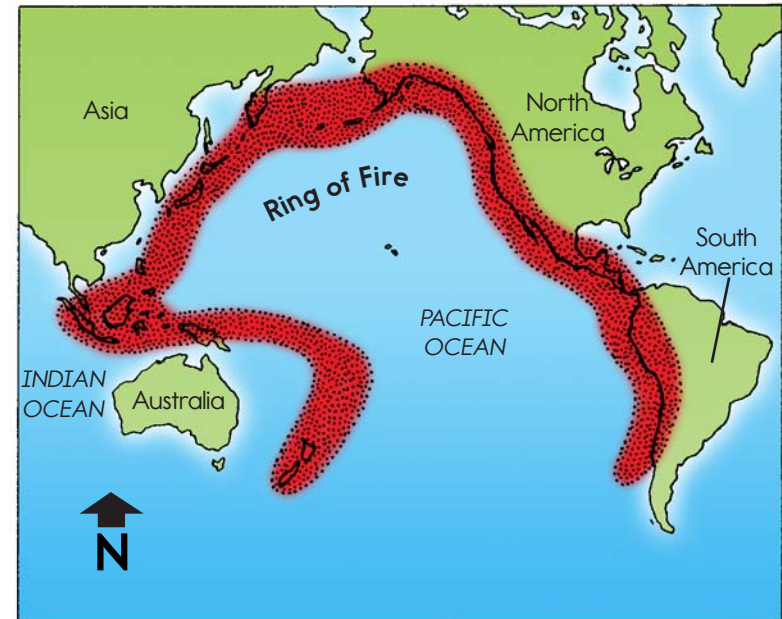
A tsunami can move as fast as a jet plane at speeds of 200-500 miles per hour (321-643 kph). Tsunamis retain their strength as they spread out over thousands of miles of ocean, like ripples in a pond. They can travel from one side of the Pacific Ocean to the other in less than a day.

When the wave runs into the shallow shoreline, it grows much higher and it slows down. First, the sea recedes as the wave approaches. Next, the sea floods in past the normal shoreline and gushes inland, sometimes far up rivers and streams that open to the ocean. Tsunami waves often come in sets. Observers report the first wave of the Indian Ocean tsunami was smaller than the second wave. Some people survived the first wave but did not keep running and were overwhelmed by the larger, second wave.



## **Areas At Risk for Tsunamis**

Low-lying coastlines in areas where earthquakes are common are most at risk for tsunamis. The Ring of Fire is a line of volcanoes stretching around the entire Pacific Ocean. Where there are volcanoes, frequent earthquakes occur with the movement of Earth's crust. Indonesia is also an area where Earth's crust moves often. Although we can't predict the exact time or location of an earthquake, we can estimate when an area is overdue for one.







Signs, such as this one, line areas near the coast in the western United States to warn people of the danger of tsunamis.

### ***Warning Systems***

There is no practical way to protect property from tsunami devastation, but with early warning, we can save lives. When an earthquake occurs at sea, there is usually some time before the resulting tsunami reaches land. Unfortunately for the people of Banda Aceh, Indonesia, there were only a few minutes between the quake and the wave. It took about three or four hours for the tsunami to reach India and Sri Lanka. This would have been enough time to radio a message ahead. Governments and scientists are working to build warning systems for future tsunamis around the world.



More buoys, such as this one in the Pacific Ocean, will be placed to help scientists monitor tsunamis and to provide warnings to areas at risk.

On the Pacific Coast of the United States, a tsunami warning system is in place. Seismographs all along the Pacific Coast detect earthquakes. A tsunami warning is issued any time there is an earthquake of 6.8 in Alaska or 7.5 in the western United States. **Buoys** that are anchored at sea can detect a tsunami's wave speed and direction and radio this information back to land. Radio messages and loud **sirens** warn people in seaside communities that a tsunami is coming. Signs along the highways label areas at high risk and suggest **evacuation** routes.

## How to Survive a Tsunami

People who live in areas at risk for tsunamis should keep these rules in mind:

- Find out what the safe evacuation routes are and develop a family emergency plan.
- Follow the evacuation directions if a tsunami warning is issued. Don't waste time saving property. Depending on the earthquake location, you may have hours or only minutes to leave.
- If an earthquake occurs, head immediately to higher ground. Make sure that everyone in the house knows to leave. Don't wait for evidence of an approaching tsunami. Outrunning a tsunami that has already arrived should be a last resort.
- Flee on foot. Traffic jams can quickly form, causing the waste of precious minutes.
- Don't stay in small buildings close to the coast. Most houses cannot withstand the force of a tsunami.
- Stay away from rivers near the coast. Tsunamis can wash far inland along river channels.
- Stay in a safe location until the authorities give an all-clear message. Remember, the first wave may not be the biggest, or the last.



An elephant helps clean up debris left by the devastating December 2004 tsunami in Banda Aceh.

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## Conclusion

Earthquakes and tsunamis are scary reminders of the power of nature. We can't prevent these events from happening, but we can prepare for them. Knowing what to do and getting an early warning can save lives.



## Glossary

<b>buoys</b>	floating objects anchored in bodies of water, such as the ocean; some buoys can send information about an area back to scientists (p. 16)
<b>devastating</b>	causing ruin (p. 7)
<b>earthquake</b>	the shaking of Earth where parts of the crust meet (p. 4)
<b>evacuation</b>	removal of people from a place of danger (p. 16)
<b>fault</b>	a crack in Earth's crust along which movement occurs (p. 10)
<b>magnitude</b>	greatness of size or intensity (p. 8)
<b>Richter scale</b>	a scale from 1 to 10 that measures the strength of an earthquake (p. 8)
<b>sirens</b>	devices used to make shrill warning sounds during emergencies (p. 16)
<b>tidal</b>	of or relating to tides caused twice daily by the attraction of the sun and moon on the surface of the ocean (p. 9)

<b>tsunami</b>	huge sea wave, or set of sea waves, caused by the movement of the earth under the ocean, such as in strong earthquakes (p. 4)
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