Let's learn about earthquakes

How to defend yourself against earthquake disasters

The Headquarters for
Earthquake Research Promotion

It's an earthquake! What would you do if one happened?

Earthquakes can strike at any time, at any place.

Earthquakes are more frightening than anything. They strike suddenly, and it is difficult to exactly know when and where they will strike. That's why we need to understand earthquakes correctly and acquire knowledge for coping with them.

At school

▲ School buildings damaged by an earthquake:
The Great Hanshin-Awaji Earthquake Disaster, 1995
*Photo provided by Kobe City

When going to and from school

▲ A concrete block wall collapsed by an earthquake:
Niigata Chuetsu Earthquake, 2004
*Photo provided by Tohoku University

At home

▲ A house whose ground floor was crushed completely:
Niigata Chuetsu Earthquake, 2004
*Photo provided by Tokyo Metropolitan University

Earthquakes bring a variety of disasters.

Japan has suffered from many earthquakes and sustained a great deal of damage. Due to their strong vibration of ground surfaces, earthquakes cause the collapse of houses and buildings, fires, landslides, or liquefaction of the ground. Occasionally, many lives are lost due to these consequences. If earthquakes occur at the bottom of the sea, the resulting tsunami can do tremendous damage to large areas. An example of this is the 2011 off the Pacific Coast of Tohoku Earthquake.

▲Fires caused by an earthquake: The Great Hanshin-Awaji Earthquake Disaster, 1995
*Photo provided by Mr. Katsuyuki Abe

▲An advancing tsunami wave: The Great East Japan Earthquake Disaster, 2011
*Photo provided by Miyako City, Iwate Pref.

▲Landslides: The Iwate-Miyagi Nairiku Earthquake, 2008
*Photo provided by Iwate Pref.

▲Liquefaction: The Great East Japan Earthquake Disaster, 2011
*Photo provided by a voluntary disaster prevention troop from the Tomioka Estate Housing Management Association of Urayasu City, Chiba Pref.

The Great East Japan Earthquake Disaster, which claimed many lives

The 2011 off the Pacific Coast of Tohoku Earthquake at 2:46 PM on March 11, 2011, and the following tsunami (together causing the Great East Japan Earthquake Disaster), inflicted enormous damage on East Japan. It centered on East Japan's Pacific coast, and the number of people dead or missing amounted to approximately twenty thousand. The earthquake destroyed or swept away more than one million houses, as well as roads and railroads. It also paralyzed services such as electricity, water supply, gas, and telephone service. Many inhabitants were forced to live in shelters or provisional houses for long periods of time.

Disaster victims speaking on specially-provided public telephones: The Great East Japan Earthquake Disaster, 2011
*Photo provided by TOHOKU REGIONAL BUREAU MINISTRY OF LAND, INFRASTRUCTURE AND TRANSPORT

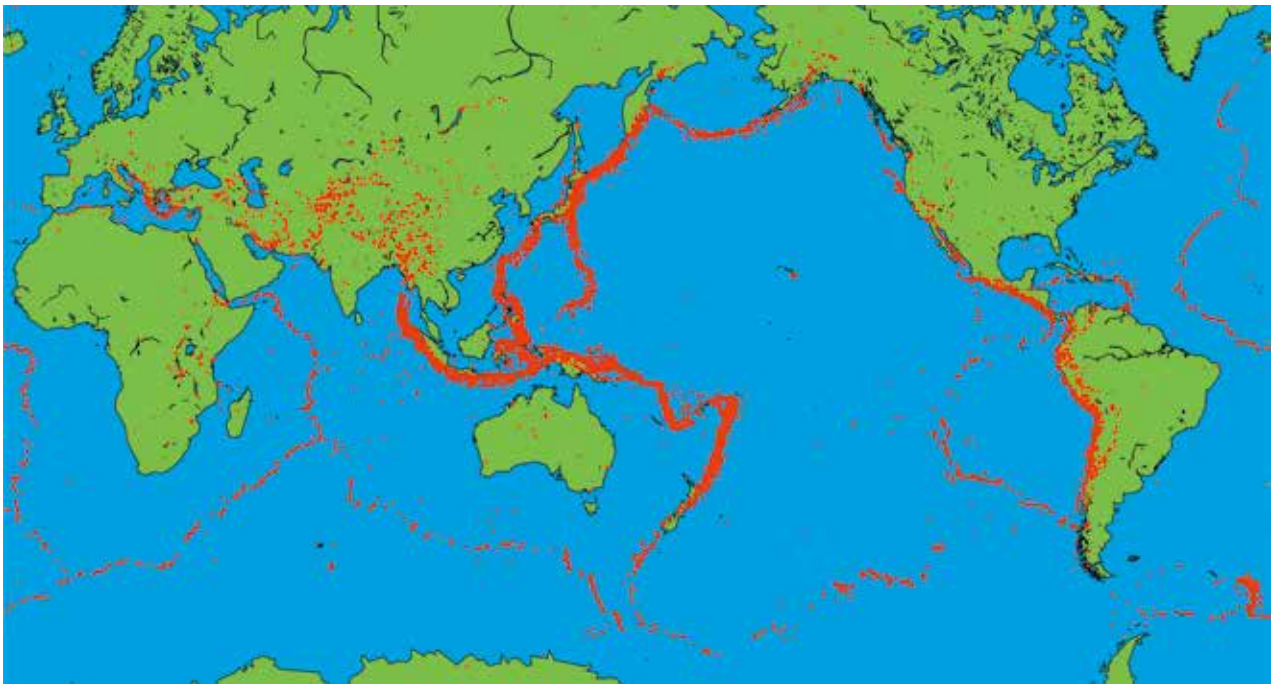
Japan is the world's foremost "Earthquake Country"

Approximately ten percent of the world's earthquakes occur in, or in the vicinity of, Japan.

Japan has been struck by approximately ten percent of the world's earthquakes. This is despite its small size, which is less than one percent of the world total land area. Including ones that we can't perceive, earthquakes occur at anytime, at anyplace. Japan is the world's foremost earthquake country.

World distribution map of earthquakes (1988-2007)

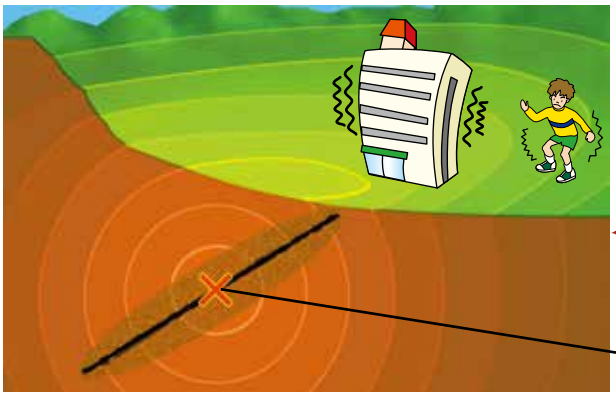
Red dots show the locations of earthquakes at a depth shallower than 100 km that have had an earthquake magnitude greater than 5.0.



*Prepared by the Japan Meteorological Agency based on the data from USGS (US Geological Survey)

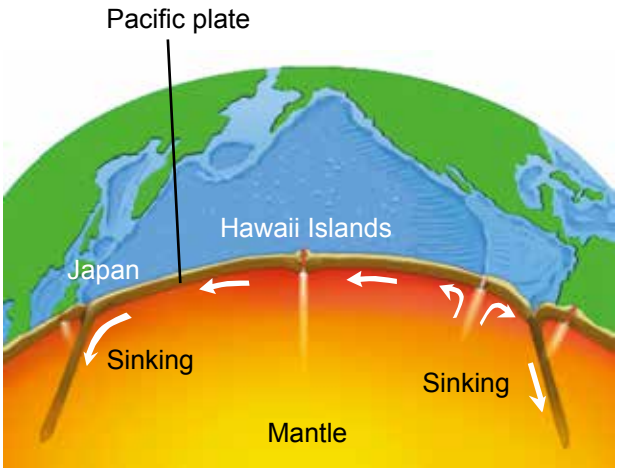
So, what actually is an earthquake?

Very large forces are acting on the rocks beneath the ground's surface. When the rocks cannot withstand the force any longer, they break along a certain plane in a sliding manner. This phenomenon is called an earthquake and the sliding plane is called a fault. The greater the fault and the greater the sliding, the greater the earthquake becomes.



When an earthquake occurs, vibration propagates through the rocks and shakes the ground surface. If the shaking is large enough we feel the vibration of the earthquake.

Why do we have a lot of earthquakes in Japan?

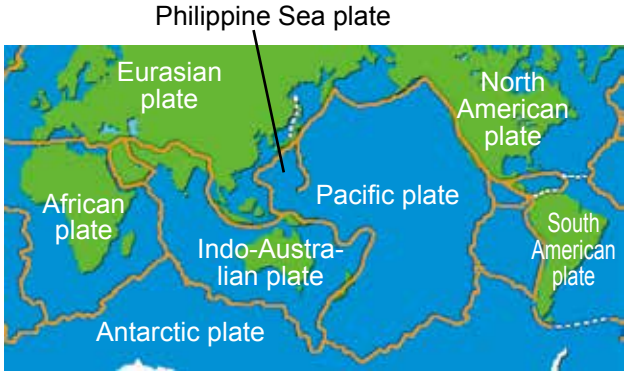


The surface of the earth is covered with more than a dozen layers of hard rock, called "plates." With continents and oceans on top of them, the plates move slowly. When one plate collides with another and two plates squeeze together, stress is generated in the plates. This stress is the main cause of earthquakes.

At the center of the earth there is the "core," which has a high temperature (approximately 6000ºC), and around the core is the "mantle." It is thought that the mantle undergoes a motion called "convection," which is like the boiling water in a pan over the fire, and that it is the convection that makes the plates move little by little.

The world's plate boundaries

If you look at the places where earthquakes have struck on a world atlas, you will find that earthquakes concentrate on belt-like zones along the plate boundaries.
(Compare with the "World Earthquake Distribution" map on the left page.)

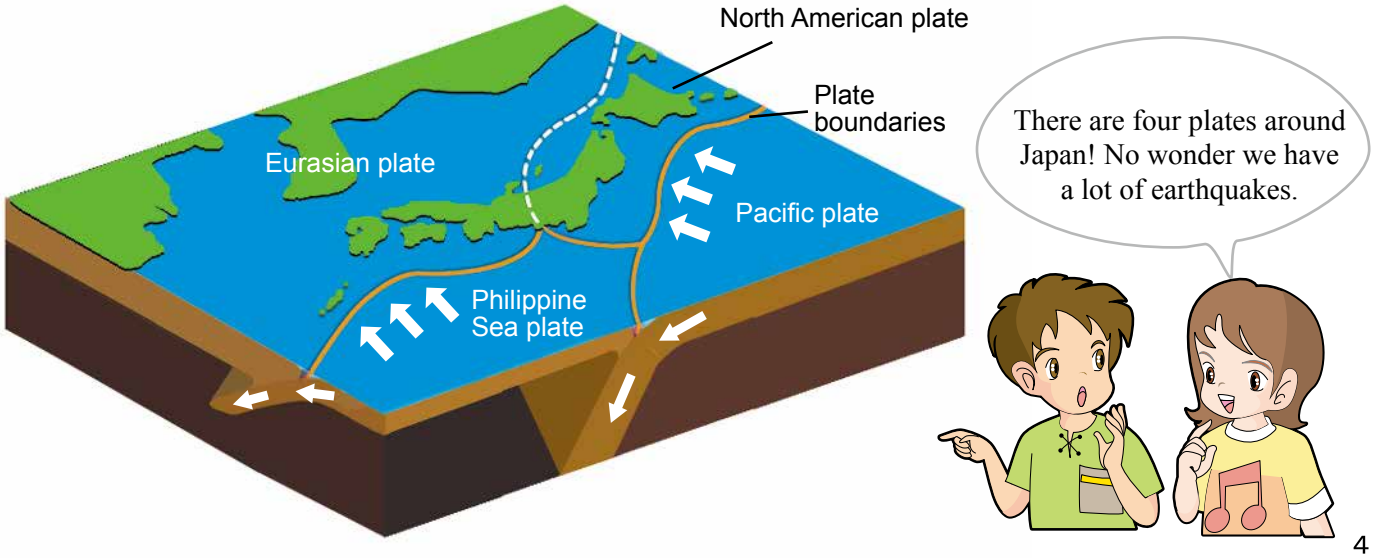


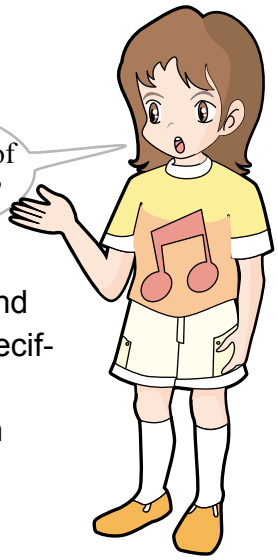
*The white dotted lines on the map show unclear plate boundaries.

The Japanese Archipelago and surrounding plates

There are four plates intricately intertwined around Japan. They are the Eurasian, North American, Pacific, and Philippine Sea plates. Japan is situated at a location where the plates are jammed together. That is why we have a lot of earthquakes.

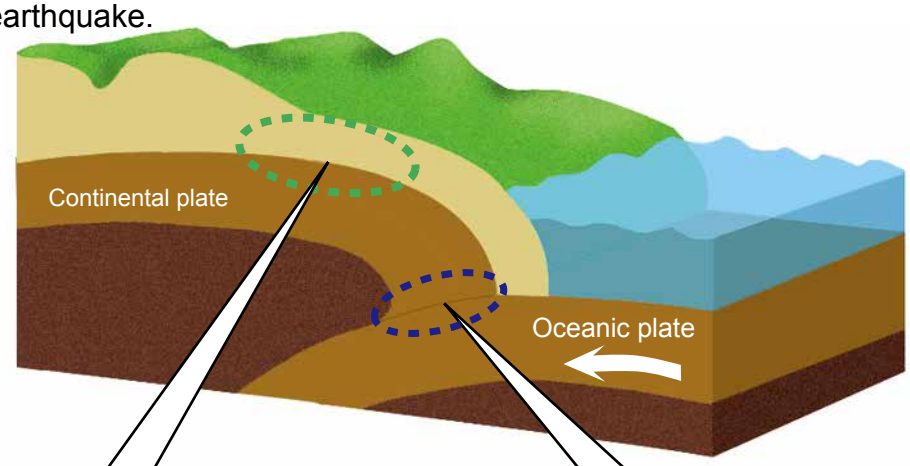
*The white dotted lines on the map show unclear plate boundaries.



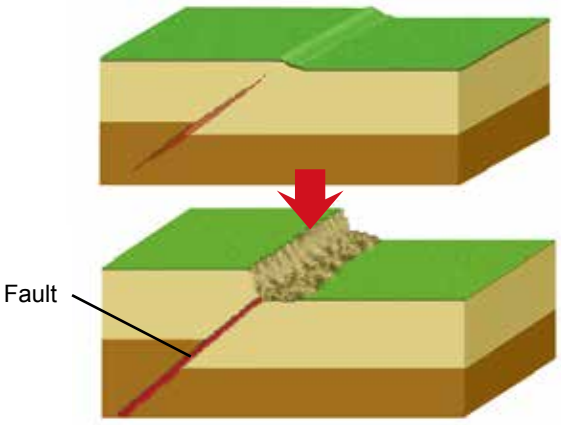


Where do earthquakes occur?

We have earthquakes in various parts of Japan. However, based on the place and cause, there are several types of earthquakes, with each type having its own specific features. A typical type is one that occurs along an active fault. Another typical type is an earthquake that occurs near a plate boundary, which is called a ocean trench type earthquake.



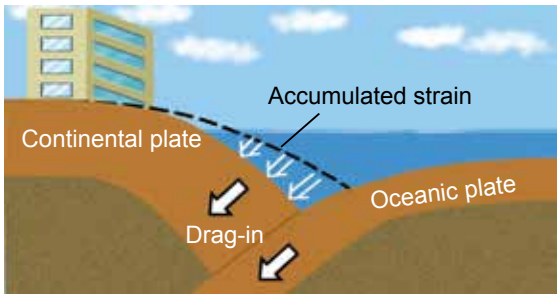
Active Fault Earthquake

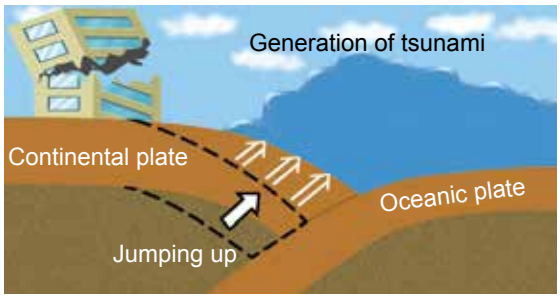


When the movement of an oceanic plate exerts force on the inside of a continental plate, earthquake can occur. This type of earthquake sometimes occurs directly beneath a densely populated area. If this happens, severe damage can be inflicted on the region. The 1995 Hyogoken-nanbu Earthquake, which triggered the Great Hanshin-Awaji Earthquake Disaster, was of this type.

A fault along which earthquakes have struck repeatedly in the past and that more earthquakes are anticipated in the future is called "an active fault."

Ocean trench type earthquake



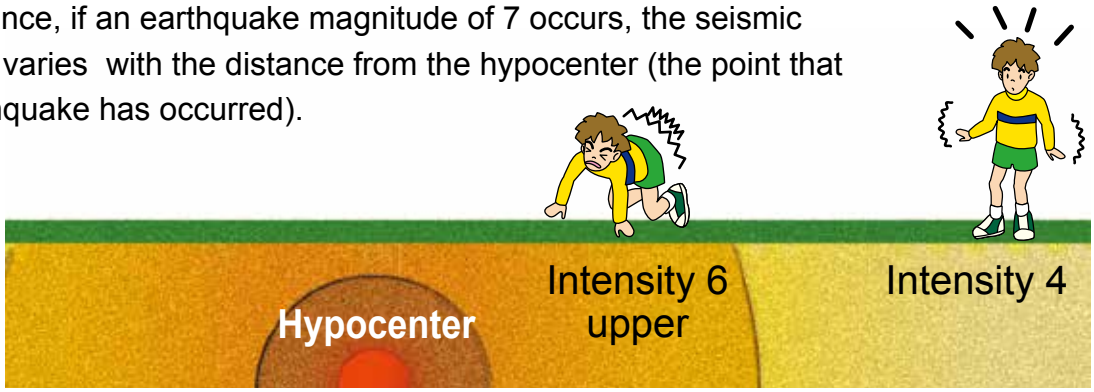


When an oceanic plate sinks under a continental plate, the edge of the continental plate is dragged downward. When the continental plate can no longer withstand the force, it tries to resume its original position and at that time an earthquake occurs. This type of earthquake can sometimes be massive and is usually accompanied by a tsunami.

What is the difference?

The difference between seismic intensity and earthquake magnitude

Seismic intensity indicates the strength of vibration at the point that an earthquake has struck. Earthquake magnitude (M), on the other hand, indicates the size of an earthquake. For instance, if an earthquake magnitude of 7 occurs, the seismic intensity varies with the distance from the hypocenter (the point that the earthquake has occurred).



●Difference of the human body's perception for each intensity

[Intensity 0]
Imperceptible to people.

[Intensity 1]
Felt slightly by some people keeping quiet in buildings.

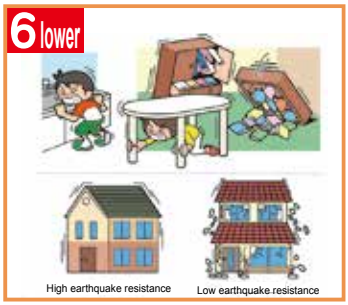
[Intensity 2]
Felt by many people keeping quiet in buildings.

[Intensity 3]
Felt by most people in buildings.

[Intensity 4]
- ○Most people are startled.
- ○Hanging objects such as lamps swing significantly.
- ○Unstable ornaments may fall.

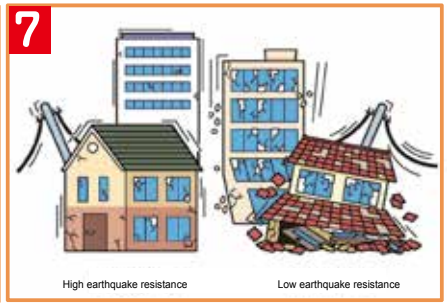
[Intensity 5 lower]
- ○Many people are frightened and feel the need to hold onto something stable.
- ○Dishes in cupboards and items on bookshelves may fall.
- ○Unsecured furniture may move, and unstable furniture may topple over.

[Intensity 5 upper]
- ○Many people find it difficult to walk without holding onto something stable.
- ○Dishes in cupboards and items on bookshelves are more likely to fall.
- ○Unsecured furniture may topple over.
- ○Unreinforced concrete-block walls may collapse.



[Intensity 6 lower]
- ○It is difficult to remain standing.
- ○Many unsecured furniture moves and may topple over. Doors may become wedged shut.
- ○Wall tiles and windows may sustain damage and fall.
- ○In wooden houses with low earthquake resistance, tiles may fall and buildings may lean or collapse.

[Intensity 6 upper]
- ○It is impossible to move without crawling. People may be thrown through the air.
- ○Most unsecured furniture moves, and is more likely to topple over.
- ○Wooden houses with low earthquake resistance are more likely to lean or collapse.
- ○Large cracks may form, and large landslides and massif collapses may be seen.



[Intensity 7]
- ○Wooden houses with low earthquake resistance are even more likely to lean or collapse.
- ○Wooden houses with high earthquake resistance may lean in some cases.
- ○Reinforced-concrete buildings with low earthquake resistance are more likely to collapse.

Tsunamis come to seaside regions.

Being surrounded by sea, Japan has been struck by large tsunamis many times in the past. Tsunamis are sea waves that are usually triggered by earthquakes. Japan is situated in the world's most tsunami-vulnerable region.

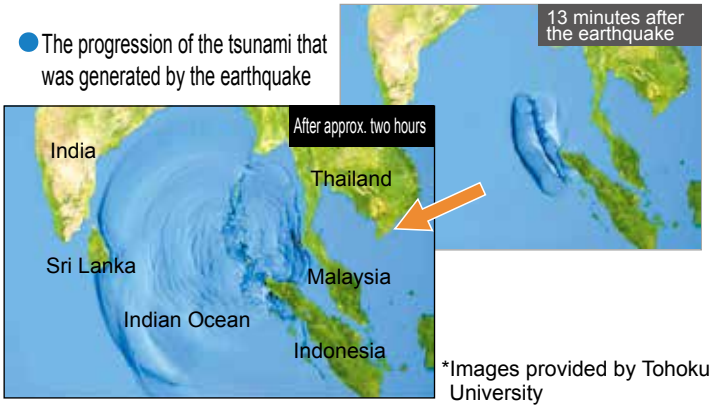
▲ Damage due to tsunami and post-earthquake fire
(The bare soil area in the foreground used to be a town):
The Hokkaido-nansei-oki Earthquake, 1993
*Photo provided by Mr. Katsuyuki Abe

▲A fishing boat washed ashore by a tsunami:
The Great East Japan Earthquake Disaster, 2011
*Photo provided by Kesennuma City, Miyagi Pref.

A tsunami attack from across the ocean

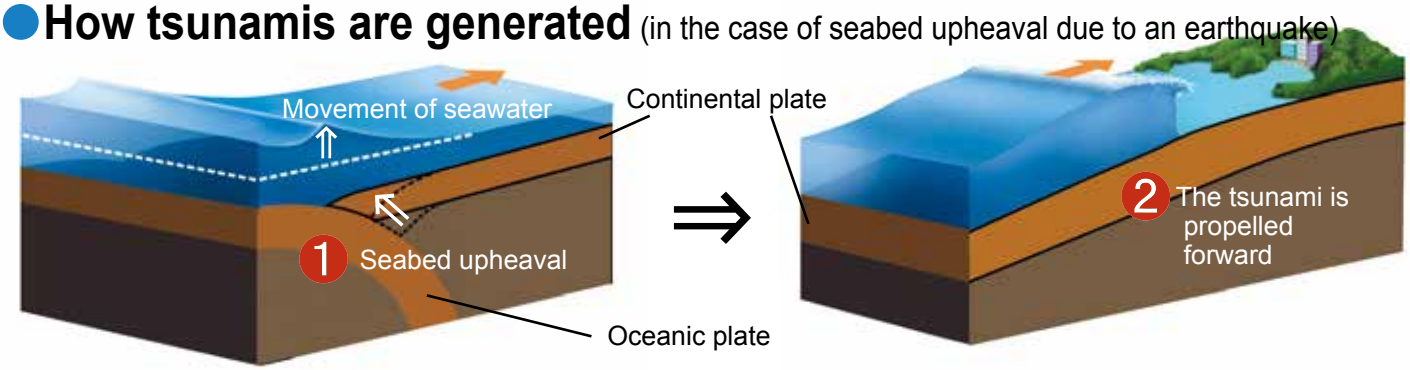
On December 26, 2004, a severe earthquake off Sumatra Island, Indonesia, generated a tsunami. It devastated nations along the Indian Ocean. More than 280 thousand people were dead or missing. In Sri Lanka, the tsunami arrived two hours after the earthquake and killed nearly forty thousand people.

● The progression of the tsunami that was generated by the earthquake



*Images provided by Tohoku University

●How tsunamis are generated (in the case of seabed upheaval due to an earthquake)

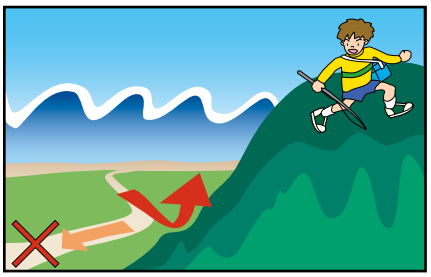


1 When a large earthquake occurs in an ocean, the seabed is either heaved upward or it sinks. As a result, the seawater above the seabed is displaced. This leads to the vast amount of seawater being moved peripherally; this is called a tsunami.

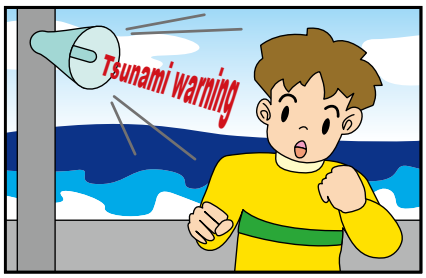
2 In deep seas, tsunamis travel fast. When they approach shorelines and the water depth decreases, the speed will decrease but the height of the wave will increase. A large tsunami can run up onto the land or go up a river.

What to do if a tsunami occurs.

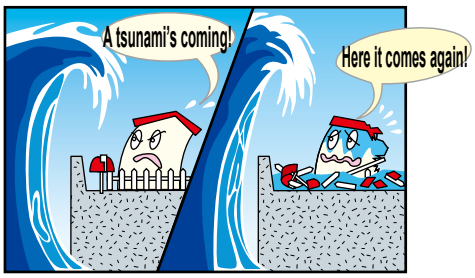
Even if the vibration of an earthquake is small, a large tsunami could still come. Tsunamis are much more powerful than high tides caused by a typhoon. If an earthquake does occur and you live in a seaside area or happen to be on seashore, keep the following in mind:



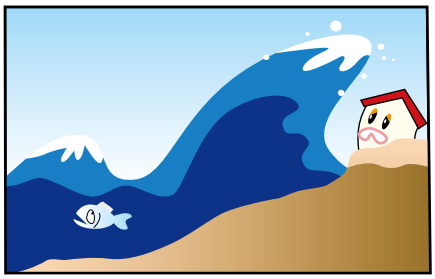
Don't try to run "away" from the tsunami, try to get to "a higher place." If you feel a strong vibration, or if you feel a jolt that is not that strong but is long in duration, evacuate immediately.



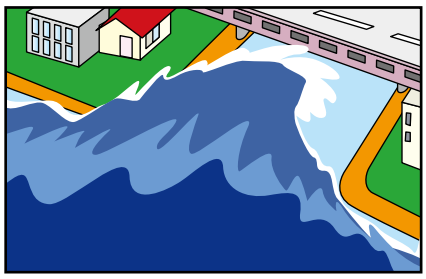
If a tsunami warning is announced, evacuate even if you did not feel an earthquake. During a tsunami advisory, refrain from sea bathing or seashore fishing.



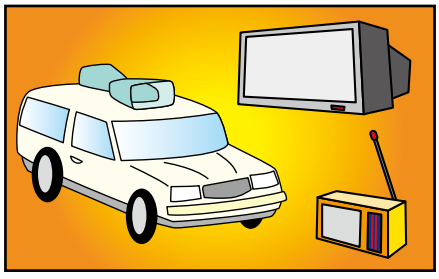
Tsunamis come again and again. Once you have evacuated, stay alert until the tsunami warning or tsunami advisory has been lifted.



Tsunamis will increase their height rapidly when they approach the shoreline.



Tsunamis can come up rivers. Never go near the sea or a river.



Stay up to date through information from the radio, TV, sound truck, or other sources.

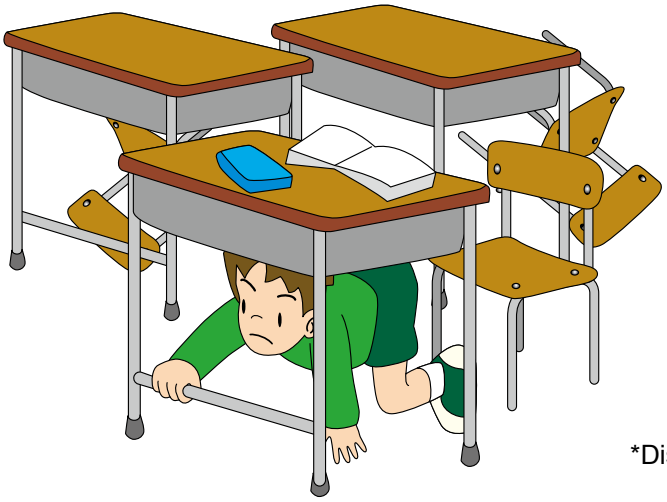
Memo: Make note of the safety precautions for earthquakes near the seaside.

Prepare for an earthquake

If an earthquake occurs, the important things to do are: “not to panic,” ”to protect yourself,” and ”to act calmly.” Let’s consider what you would have to keep in mind when evacuating at your school, outdoors, or at your home.

What if an earthquake occurred when you are at school…

Preparedness for evacuation



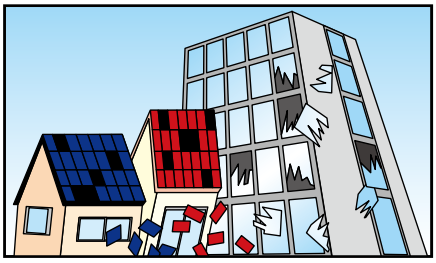
1. During violent shaking, stay under your desk.
2. Protect your head from falling objects.
3. Listen to your teacher before you act.
4. When evacuating, act calmly together.
5. Pay attention to falling objects from the ceiling or off shelves. Also look out for broken window.

*Discuss other things to keep in mind with your classmates.

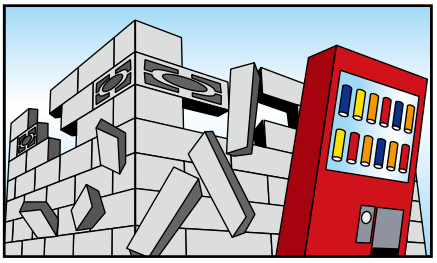
Let’s check the safety precautions for your route to school.

Imagine an earthquake occurring while you are outside, such as during your commute to and from school. Check out possible danger spots or possible shelters on or near the school route.

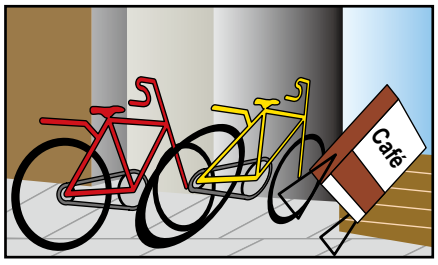
☐ Possible falling objects
Roof tiles, broken window glass fragments, etc.



☐ Possible collapsing objects
Concrete block walls, vending machines, etc.



☐ Obstacles that might block your path
Bicycles, signboards, etc.



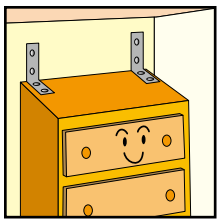
Memo: Make note of the points to pay attention to in case an earthquake occurs when you are in school or during your commute.

Do a safety check in and around your house!

In a large earthquake, many people can get hurt or even killed by fallen furniture, falling objects, or glass fragments. Check that there is nothing that could pose a danger during a disaster.

To protect furniture from toppling

Furniture that is likely to topple, such as cabinets or book-shelves, should be fixed with metal fixtures or strut bars.

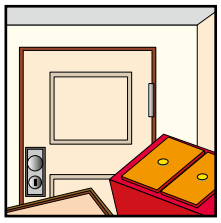


To prevent injury from falling objects or shattered glass

The doors of furniture, such as a kitchen cabinet, containing breakable objects should be fixed with fasteners to prevent the doors from opening.

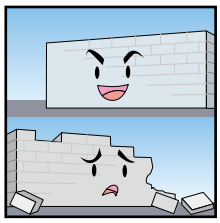
To prevent trapping yourself in your house

Do not put furniture or other things prone to toppling near doors that you might use as an escape route.



Are concrete block walls stable?

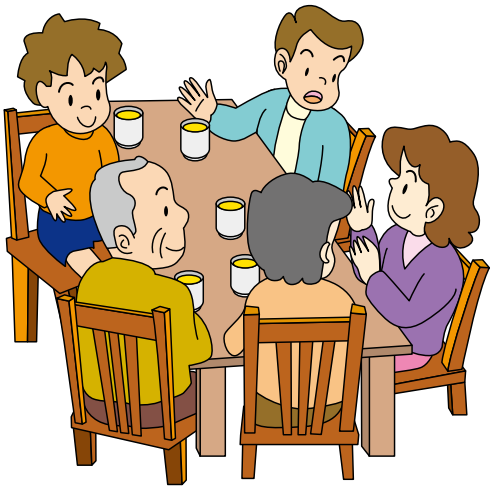
Ask your family member if the concrete block walls around your house are stable.



Ask your family members the following:

Have you ever talked with your family about what you would do if an earthquake were to suddenly strike? We should regularly check what to do in the event of an earthquake.

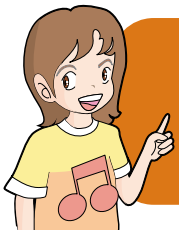
- ☐ Is my house robust enough to withstand an earthquake?
- ☐ Are there dangerous places in the house?
- ☐ Do I know where the evacuation shelter is and how to get there?
- ☐ Have we arranged in advance about where to meet if an earthquake were to occur?
- ☐ Have we arranged how to communicate?
- ☐ Are the items that we would need to take to the evacuation shelter being kept readily available?



Keep items that you would need to take readily available.

If an earthquake were to occur, the water supply, gas, or electricity might stop. In anticipation of such an occasion, keep enough water, food, and clothes for a family for three days or so readily available.

○Drinking water ○Boxes of matches, lighter ○Candles ○Clothes
○Portable radio ○Flashlight (with extra batteries) ○Foods ○Valuables
○First-aid kit ○Portable gas burner ○Rain gear ○Toilet paper, etc.



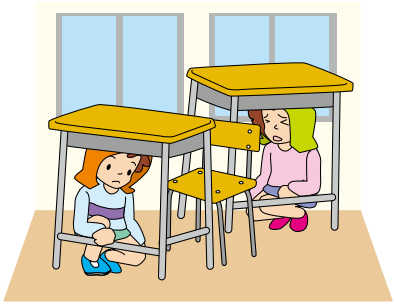
What is the earthquake early warning?

The system catches earthquakes quickly and notifies that a strong quake will come within several to a dozen seconds.

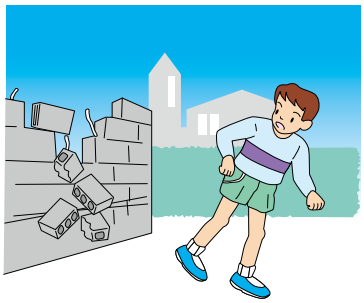
What to do when you hear that a strong quake will come

If you are at school

Listen to your teacher's instructions and protect yourself. You might do this by crouching under your desk.



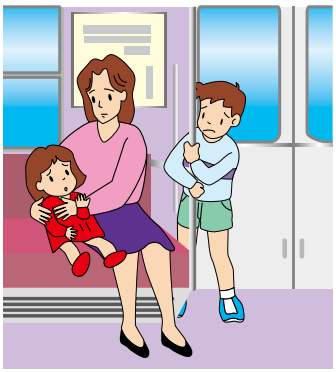
If you are out of doors



Step away from an object that might fall or collapse, such as a concrete block wall.

If you are riding on a train or a bus

Holding on to handles or other firm objects and prepare for the vehicle to stop suddenly.



If you are in a crowded place

Do not rush to an exit. Follow the instructions of the person in charge and do not panic.

The above applies in the event of a sudden jolt.

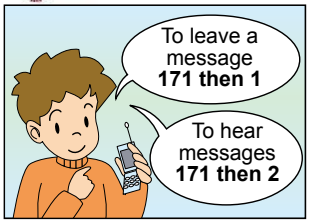
Remember. For the Disaster Emergency Message Dial 171.

When an earthquake disaster happens, everybody tries to make contact with each other and telephone connections may not work very well. If this happens you can use other means such as the "Disaster Emergency Message Dial 171," the "Web171 Disaster Message Board," or the "Disaster Message Board Service" for cell phones. If you are unable to make contact with your family, you can use the "Disaster Emergency Message Dial 171", for example. You can either leave a message or hear messages from your family. Let's learn how to use the "Disaster Emergency Message Dial 171."

*Example of leaving your message: "I'm OK. I've taken refuge at XX Elementary School."

*You can use this service from a general subscriber phone, public telephone, cell phone, or PHS.

How to use "Disaster Emergency Message Dial 171" service (you can leave a message or hear messages with audio guidance)



To leave a message

▶ Push 171 and then push 1.

➡ Enter your phone number. (Do not forget to include your area code.)

To hear messages

▶ Push 171 and then push 2.

➡ Enter your phone number. (Do not forget to include your area code.)

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100-8959 3-2-2 Kasumigaseki, Chiyoda-ku, Tokyo Tel: 03-5253-4111 (switchboard)
■URL: http://www.jishin.go.jp/en/ Word to search: headquarters for earthquake Search

(March 2014)