TSUNAMI

For 4th to 6th grades

International Strategy
ISDR
for Disaster Reduction

UNESCO

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ASIAN DISASTER REDUCTION CENTER

TSUNAMI

FOR 4th to 6th GRADES

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Preface

The Tsunami disaster occurred on December 26, 2004 caused the lost of thousands of lives and massive destruction. The serious damage was attributed to the lack of people's knowledge about tsunami and self management when they faced with a tsunami. In order to acquire the knowledge of tsunami and other natural disasters children should be educated both of the scientific and practical sides.

In this book, the contents are deliberated to provide the basic information about the scientific knowledge of earth, mechanism of earthquake and tsunami, tsunami warning system, self management when facing with tsunami, evacuation drills including short story from student's experience of the tragedy.

We hope that this book would be the most valuable material to educate children in schools as well as in communities and even at home for making societies resilient not only to tsunami but also to other natural disasters as well.

The Office of Basic Education Commission

Introduction

Tsunami is a Japanese word with the English translation, ***"harbor wave."*** Represented by two characters, the top characters ***"tsu"*** means harbor, while the bottom character ***"nami"*** means wave. In the past, tsunami was incorrectly referred to as ***"tidal waves"***.

tsu 津

nami 波

Table of Contents

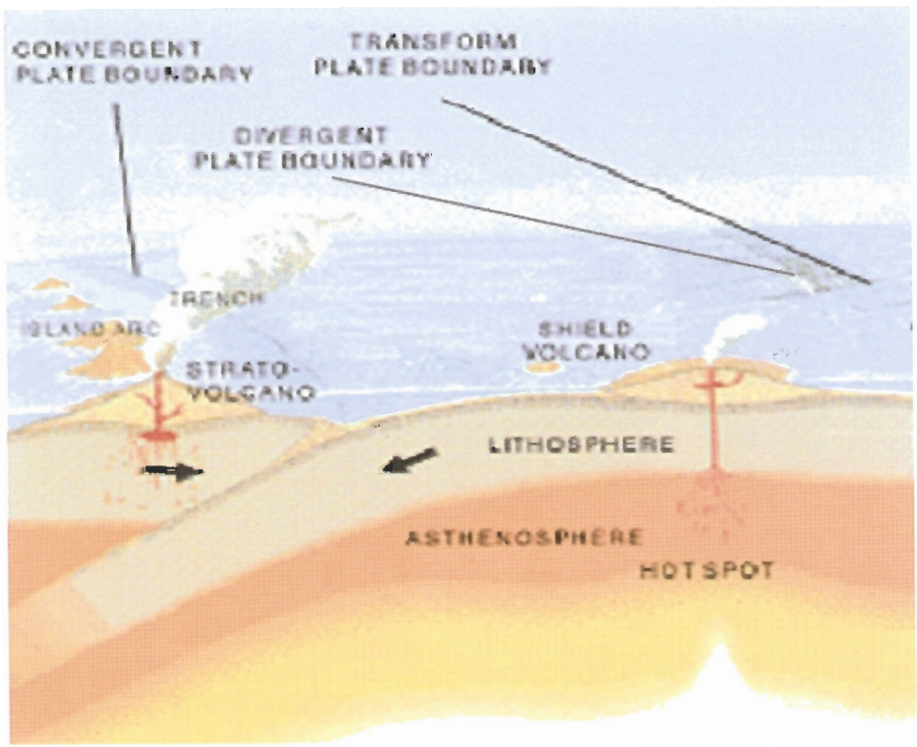
1. The EARTH

About the EARTH

The earth is the only heavenly body with volumes of water in the solar system, which is said to be born 4.6 billion years ago. A lot of thermal energy has been saved in the interior of the earth, causing geologic activities. The earthquake and the tsunami are one of the activities.

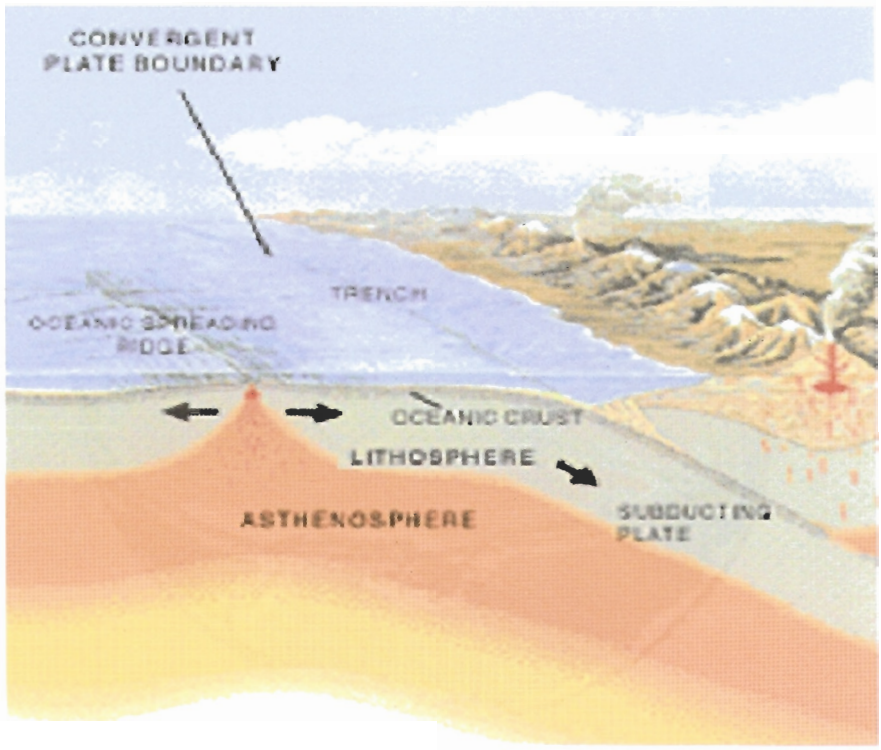
What is the surface of the earth ?

More than three quarters of the surface of our planet is covered by the water of the oceans. This ratio keeps about 15 degrees centigrade the normal temperature of the surface air and prevents a rapid temperature change. Thanks to the distance of the sun from the earth water and the atmosphere can exist on this earth. It is thought that water doesn't exist in Mercury and Venus because the sun's distance was too close to the planets.



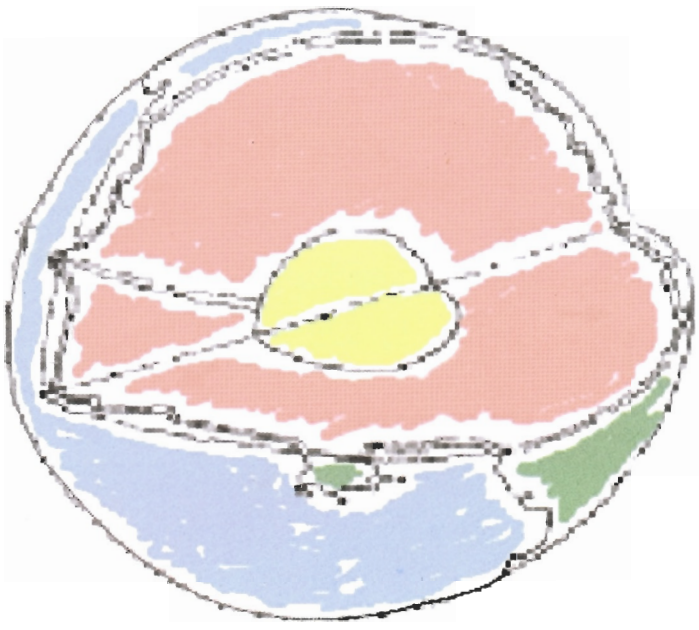
What does the bottom of the ocean look like ?

Imagine if all the water was removed from the ocean basins, there would be revealed a system of RIDGES and rises encircling the globe with intervening deep-sea basins between the ridges and the continents. As you can see in the picture, the deepest parts of the oceans are close to the continental boundaries. They are called TRENCHES. And the highest parts of oceans are spread to the continental boundaries. They are called RIDGES.



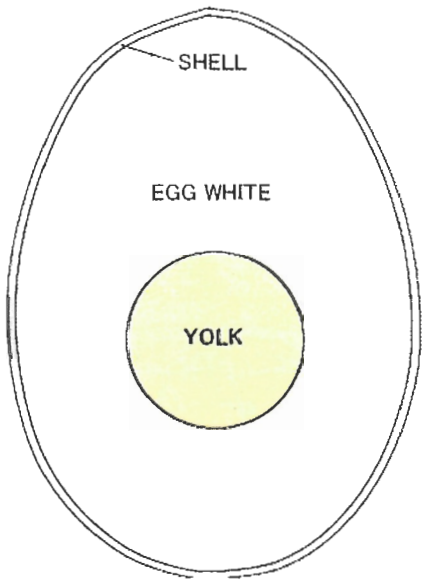
Do you know about the interior of the earth ?

We have looked at the surface of the earth, but can you imagine what the interior of the earth looks like? Until the beginning of seismology, the science that studies earthquakes, our knowledge about the interior of the earth rested on theories only. Today, thanks to the science, we know the composition of our planet.



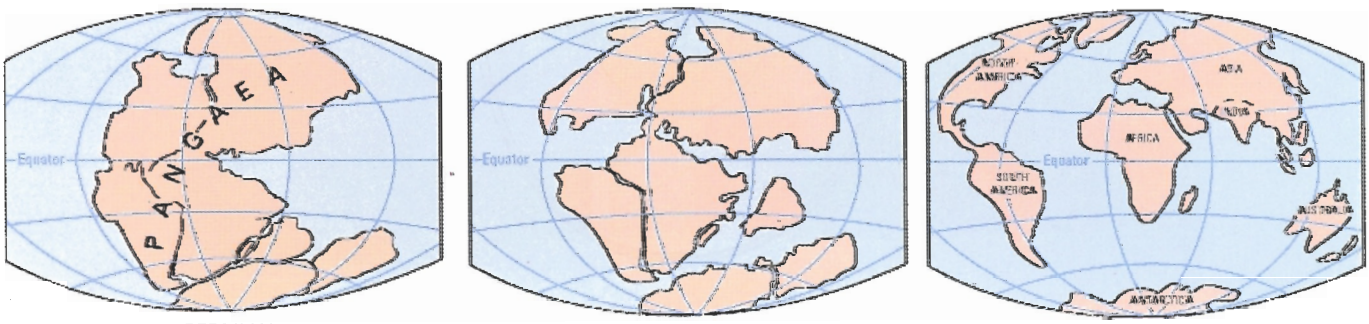
The interior of the earth looks like egg

The CRUST is the layer upon which we live, composed of solid rock. It is rigid and for this reason it breaks. We will call it the continental crust. The MANTLE is elastic because it bends but returns to its original shape. The CORE is the central portion in the earth. Comparing the egg with the layers of the earth, indicate which layer of the earth corresponds to each part of the egg.



Surface of the earth is moving

In 1912, Alfred WEGENER, a German scientist, proposed a theory that all continents where joined in the past in a huge mega-continent called "PANGAEA," which means "every lands" in Greek. WEGENER believed that Pangaea began breaking up and drifting many millions of years ago. He insisted that the appear of a jigsaw puzzle fit of the continents was not an accident, but the result of the splitting of Pangaea. He said that the continents slowly drifted over the ocean floor until they reached their present positions.



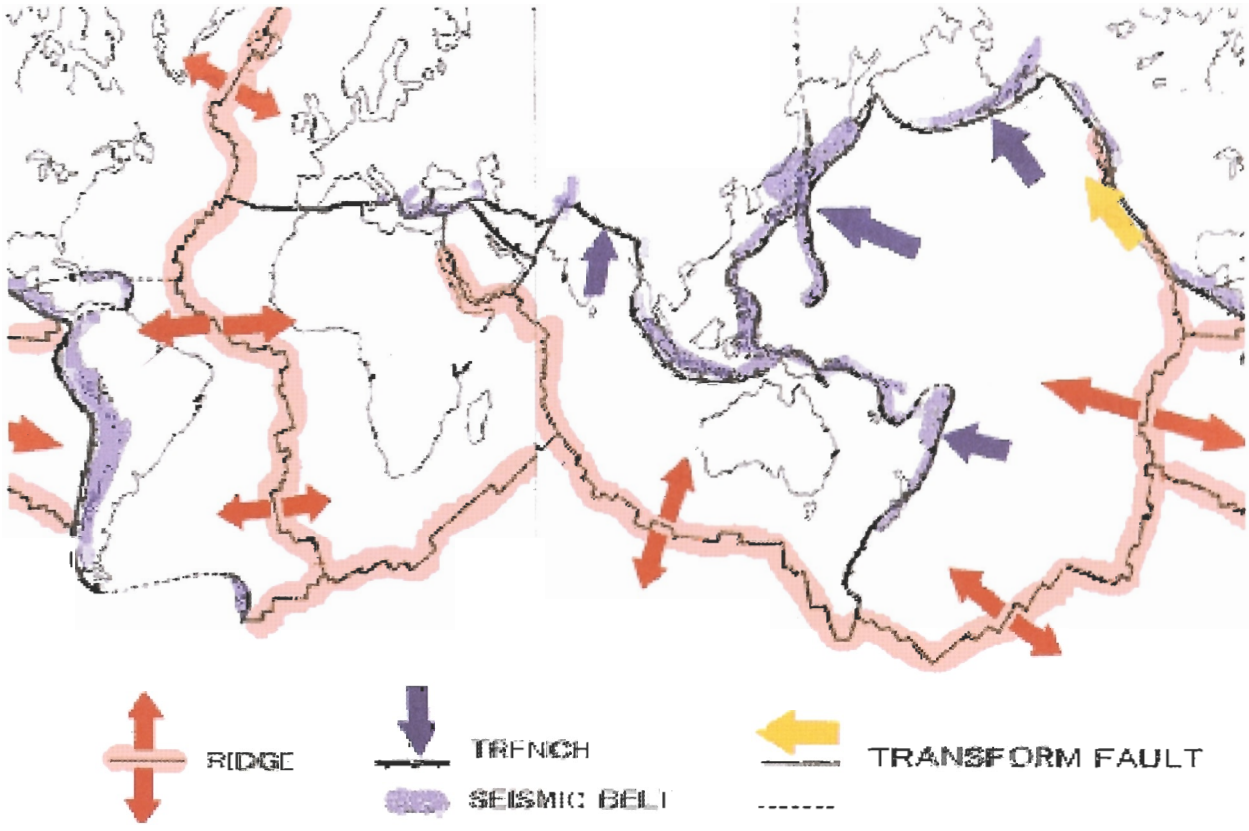
PERMIAN
225 million years ago

JURASSIC
135 million years ago

PRESENT DAY

The earth is composed of many plates

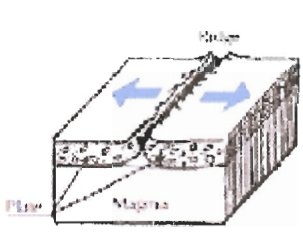
The earth's crust is composed of huge pieces from a gigantic jigsaw puzzle. Every piece is a "tectonic plate" and the zone where are plates met is called the "plate boundary." The crust is composed of plates moving over the mantle.



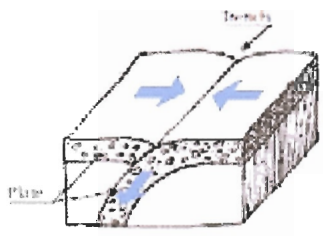
What are the plate boundaries ?

There are three kinds of plate boundaries. *Divergent boundary* is found where plates are moving apart, such as the India ridge. New crust forms at divergent boundaries. When Pangaea broke, it separated along the Indian ridge. It took 200 million years for the Indian Ocean to grow to its present size. *Convergent boundary* occurs where two plates crash into each other. The leading edges of plates smash into each other. The leading edge of one plate sinks into the mantle under the edge of another plate. Trenches bordering the Indian Ocean are regions where the Indian plate is sinking... This is why this ocean is slowly shrinking.

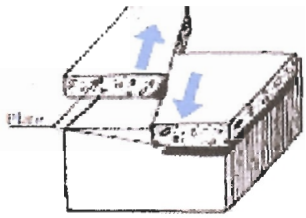
Transform boundary occurs where two plates rub past each other.



Divergent Boundary



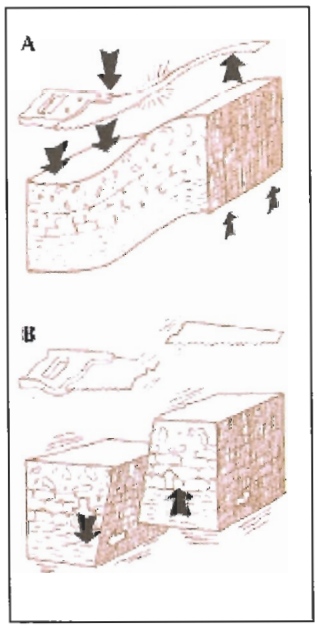
Convergent Boundary



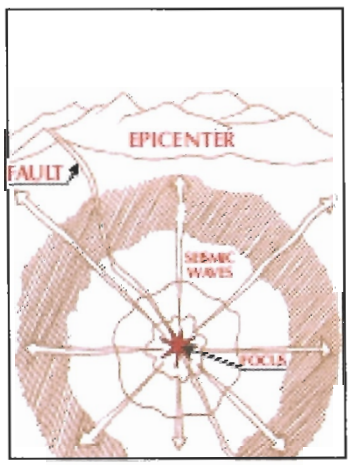
Transform Boundary

How is the earthquake caused ?

Most earthquakes are due to movement of the tectonic plates. When the plates slide or move against each other, the plate may be bent or stretched. The bending or stretching plate stores the energy. Sooner or later, the plate breaks and shifts. When the break happens, the stored energy is released in the form of seismic waves, which we feel as an earthquake shaking the ground. The seismic waves spread out from the underground focus or source of an earthquake in all directions. As the seismic waves travel away from the focus, they grow gradually weaker. So, the ground generally shakes less farther away from the focus.



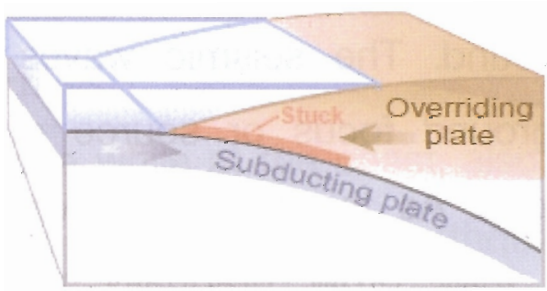
Seismic waves are generated by the break of the rocks.



Focus of an earthquake.

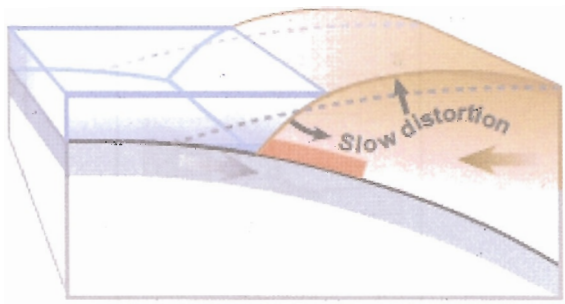
How is the tsunami generated ? (1)

One of the many tectonic plates that make up Earth's outer shell descends, or "subducts" under an adjacent plate. This kind of boundary between plates is called a "subduction zone." When the plates move suddenly in an area where they are usually stuck, an earthquake happens.



Vertical Slice Through a Subduction Zone

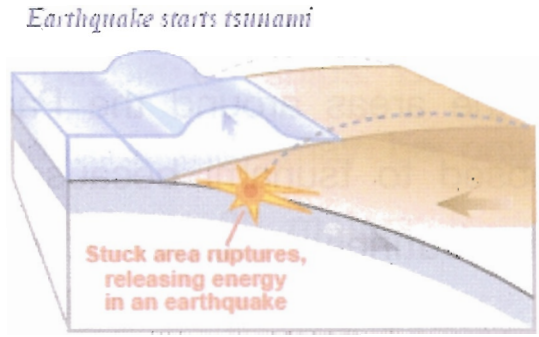
Stuck to the subducting plate, the overriding plate gets squeezed. Its leading edge is dragged down, while an area behind bulges upward. This movement goes on for decades or centuries, slowly building up stress.



A. Between Earthquakes

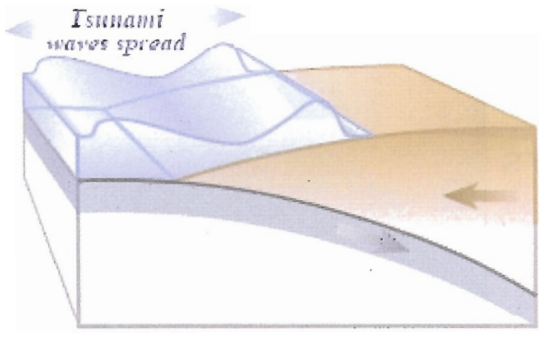
How is the tsunami generated ? (2)

An earthquake along a subduction zone happens when the leading edge of the overriding plate breaks free and springs seaward, raising the sea floor and the water above it. This uplift starts a tsunami. Meanwhile, the bulge behind the leading edge collapses, thinning the plate and lowering coastal areas.



B. During an Earthquake

Part of the tsunami races toward nearby land, growing taller as it comes in to shore. Another part heads across the ocean toward distant shores.

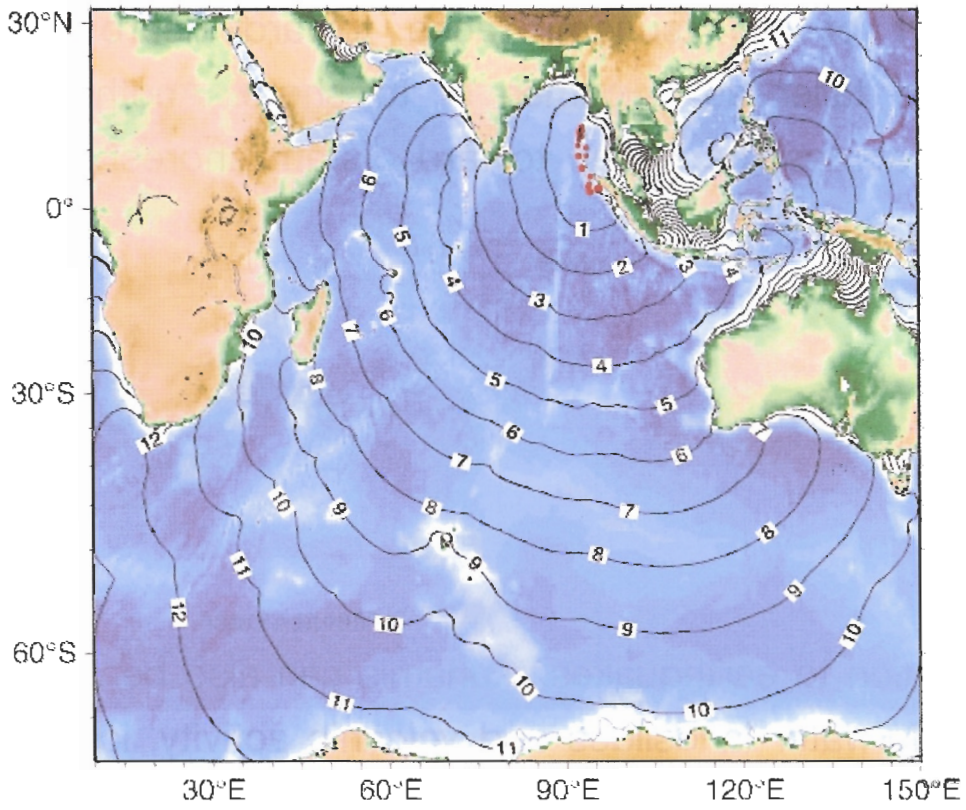


C. Minutes Later

In addition to earthquakes, tsunamis can also be caused by underwater landslides and volcanic activity, icebergs breaking apart, and meteorites striking the ocean.

Travel of the tsunami

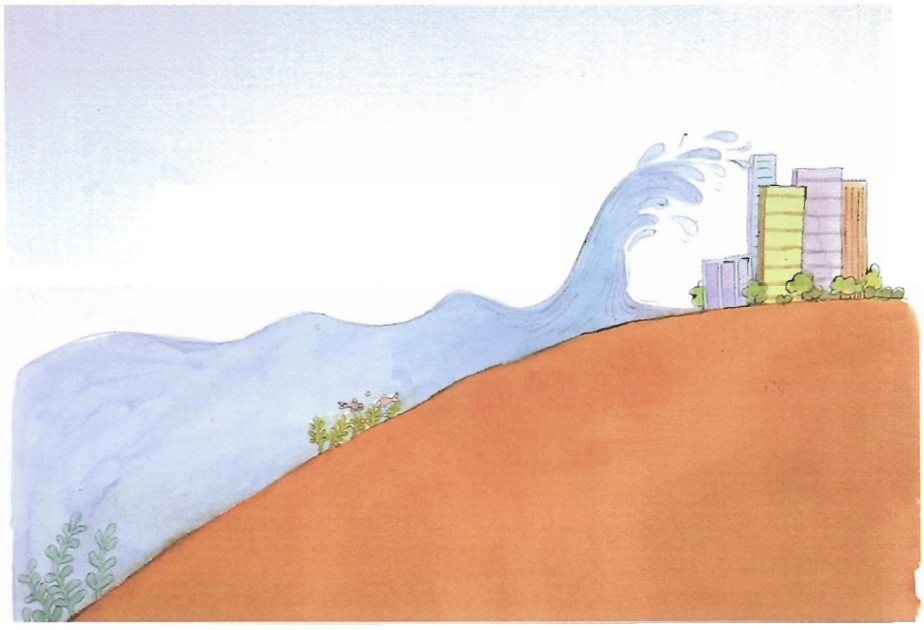
All coastal areas may be hit by tsunamis, even those thousands of kilometers away from the earthquake source. That's because tsunami can start off from one side of the ocean and travel all the way to the other side. The 26 December 2004 Indian Ocean tsunami traveled from Indonesia to as far west as Africa. But the areas around the Pacific Ocean are especially exposed to tsunami because of the large earthquakes that routinely happen there.



(http://staff.aist.go.jp/kenji.satake/Sumatra-E.html)

How big are tsunamis ?

Tsunami wave heights depend on depth of the sea and the strength of the earthquake. Out on the deep ocean, they are rather low, usually less than a meter high. This means they look like ordinary waves and usually pass unnoticed by people on ships. But when tsunamis reach shallower waters, they may be only a few centimeters, or rise as high as 30 meters, roughly the height of a 10-story building.

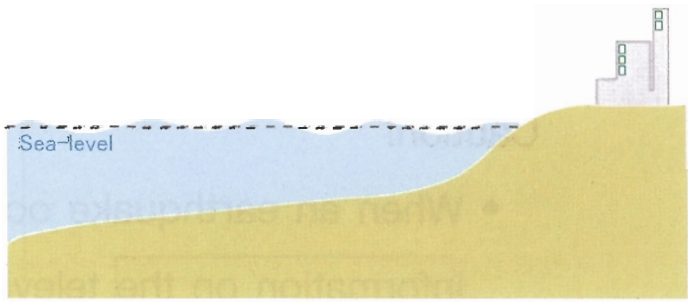


How fast are tsunamis ?

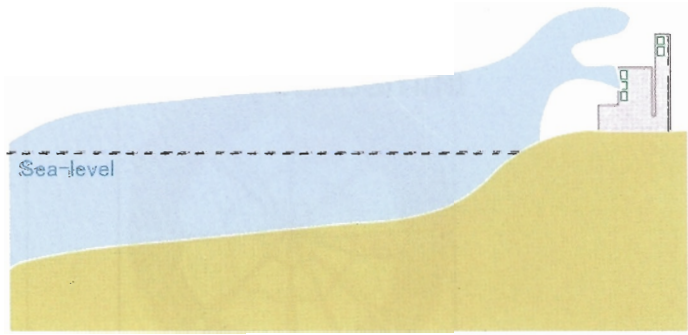
Tsunami speed changes depend on depth of the sea. In the deep ocean, the waves may be as fast as a jet plane, traveling over 800km in an hour. But when the waves reach the shallow waters near land, they slow down. For example, at a water depth of 10 meters, the speed would be about 36 km/hour. But a wave moving at that speed along the coastline would still be too fast to run away from.

What is the difference between tsunami and wind waves?

In wind waves, water moves only at the surface of the sea. But in a tsunami, the surface of the sea changes along with its movement through the bottom of the sea. As you can see in the picture, the wind wave has the feature of a short wavelength surge on the shore. On the other hand, the tsunami is a motion of huge seawater mass. Therefore, the tsunami can have more potential destructive force than wind waves. In addition, the tsunami rises rapidly along the coastline.



Wind Wave



Tsunami

3. Evacuation

What are the sign that tells a tsunami is coming?

The sea rapidly retreats and the sea bottom is exposed for hundreds of meters. Also, approaching tsunami waves sound like a train or jet engine. When you see or hear this, you must rush inland to higher ground or designate to a safe area immediately. You only have a few minutes to escape before the destructive tsunami arrives.

If you feel an earthquake while at the coast, also move inland to higher ground. Although not all earthquakes cause tsunami, never ignore them. Tsunami caused by a local earthquake, called "local tsunami", arrives quickly and the authorities might not have time to warn the public.

Caution!

- When an earthquake occurs, confirm the tsunami information on the television or radio!
- When the tsunami siren wails, rush to high place immediately.

3. Evacuation

- When you detect the signs of a tsunami, tell it to your parent or adults nearby quickly.
- As tsunami wave comes repeatedly, do not feel ease until the authorities announce that it is safe to nature to the coastline.

What if you are caught by a tsunami ?

If you are on the sea, tell your parents or adults nearby not return to the coast until the warning is canceled and stay out in the open sea. You are safe in the deep ocean.

If you are on a ship at a wharf or jetty, leave the ship and run inland or to the higher floors of concrete building. Just in case of caught by a tsunami wave, find something that floats and hang on to it!

Get reliable information

When you are in the evacuation area, listen carefully to the radio or television for the latest news. Return to the coastline only when the authorities say it is safe. Tsunamis can last for many hours. The size of succeeding tsunami may be bigger than the first one. Listen to announcements from the authorities.

Absolutely, do not believe rumors.

Help other people

Help those who need assistance such as children, elderly, sick people, pregnant women, and people with disabilities. But do not move people who are seriously injured. In this case, call for professional help.

What to do after tsunami ?

Inspect your house for damage. Look out for broken electric wires. Close the main valves if you find leaking gas tanks or pipes. Use a flashlight to light your way. Do not use kerosene lamps, candles, or matches. Also, do not drink water from wells. The water will certainly be contaminated. Additionally, do not eat food that has been wetted by the water.

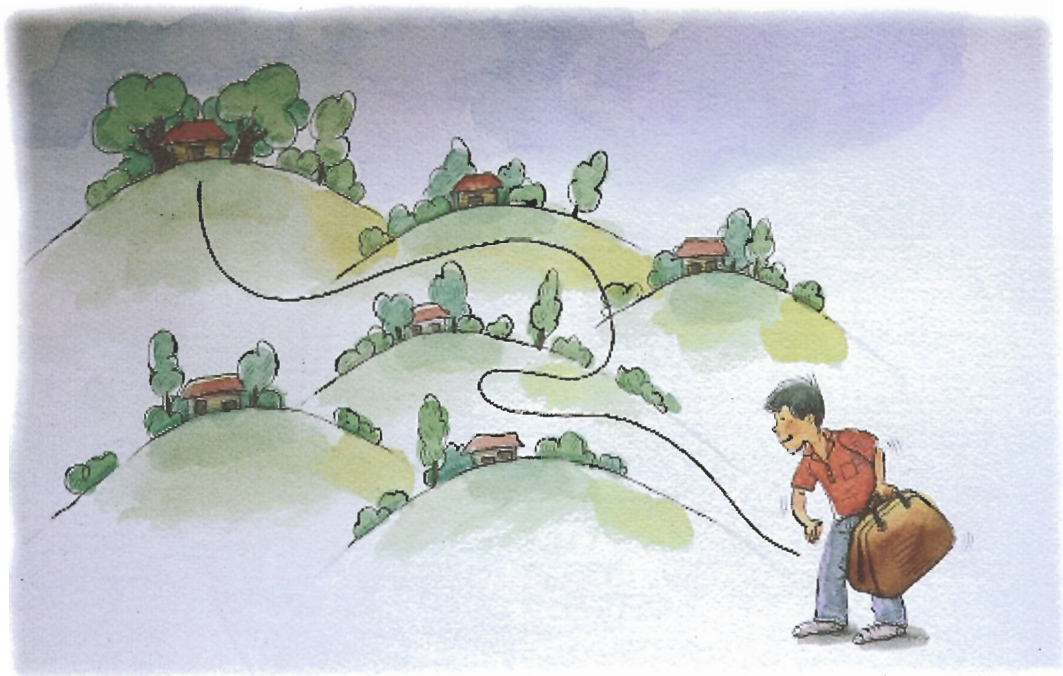
Check evacuation routes and safe places

Let's check the following information in your town.

- evacuation routes
- evacuation places

Where are you in case of the earthquake?

Are you in the school? Are you in your house? Are you visiting somewhere? Think about the most adequate evacuation route and safe place by assuming various cases.

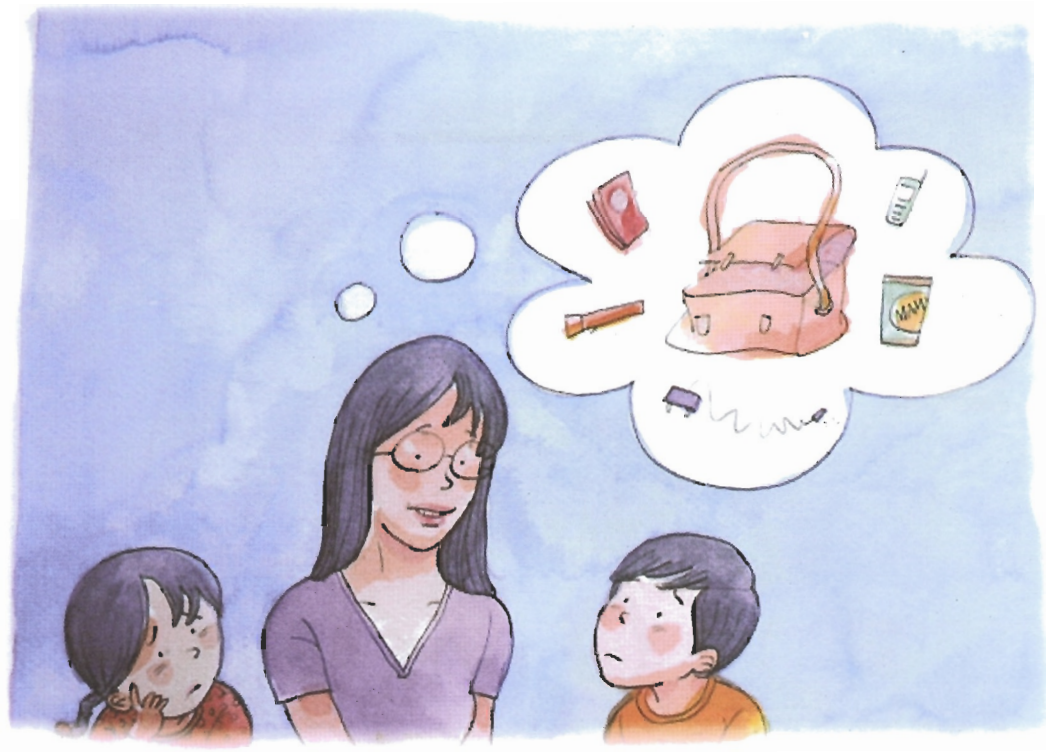


Prepare the survival kit

Prepare the emergency kit which includes the following:

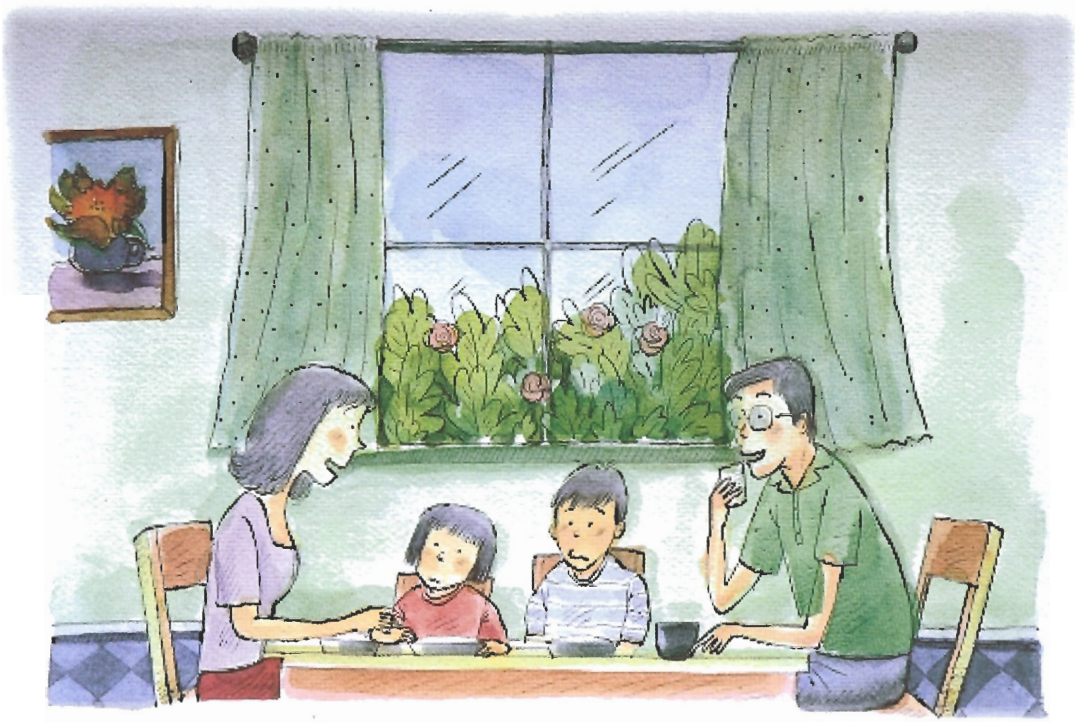
- Flashlight
- Portable radio
- Extra batteries
- First aid kit
- Canned food and can opener
- Drinking water
- Instant foods
- Mobile phone
- Cash
- Backpack

And put it at easy to pick up in case of emergency.



Let's talk about disaster preparedness with your family

Make sure every family member knows how to get to evacuation routes and safe places by using different routes. The evacuation site must be higher than 15 meters and, and away from the coast if possible. Also, family members should be able to contact each other in case of someone gets separated during a tsunami. It is helpful to have a relative or friend that everyone can call, preferably someone who lives in a different safe area.



5. Short Story

Record of one experience in my life about Tsunami

My house is located in Ban Tablamu. One day at 10 o'clock approximately, my mom drove her 3 wheel car to Ban Bang Niang in order to buy something. I also accompanied her. While she was driving slowly through the way, suddenly, we saw people in confusion, ran away from an incident. They shouted to us for escape. I and my mom thought that there was a bomb because the sound of water striking against the building was very loud and frightening . My mom started crying and turned her face to me. She, with her tearful face, continuously repeated that she was very sorry of bringing me to meet with an unexpected the danger. I was strong enough to be calm and comfort her to stop crying even we were encountering with the danger. Doing this could successfully lead my mom to recover consciousness. Soon after the loud noise, we saw a tourist bus in front of us moving forward because the bus was firmly closed and the passengers inside did not hear the noisy sound. A few minutes later, we saw the water violently stroke against the bus. The bus felt down confusedly to the huge water. Fortunately, my mom and I were in an opened 3 wheel car leading us to hear the warning sound for escape from people around us. We decided to left the car immediately and ran as fast as possible to the higher place together with other villagers. When we reached there, I was very impressed by the generosities of the local people. That impression seems to be endless in my mind. The telephones there were out of order at that time. My mom and I was worried about our family members who were at home. Therefore, at 2 pm., we decided to walked down to the low land despite of a large effort to stop us by all villagers. We insisted on

our necessity. My mom was nearly not able to drive due to her shaking with fear. Soon after driving, we reached Ban Tab Lamu.
I mostly lost my strength when hearing the news that our village was completely destructed by the frightening wave. We droved further to Khaow Klouy where was the safe place for most people. In Khaow Klouy, my mom found our relations and 2 sons but did not find dad because he went to find us out side this place. At that time, we felt more hopeless, the only one wish is an opportunity for our family member to live together again. My tearful mom and I started urging to find my dad. We walked forward through the village. On the way, there were some people telling us that my dad went to find us in Wat Lak Kaen. So, we continued to walk straight to Wat Lak Kaen. When we arrived there, we saw a large number of dead body causing my mom crying more and more. She was afraid that my dad might be one among them. At last, God bless me, I found my dad. I immediately ran toward him, embraced him and cried. Even though the Tsunami did not cause any losses of lives to my family, I absorbed many experiences from this tragedy. I saw much tears of losses, experienced a continuous support and generosities from Thai people all over the country. The most important is that I experienced an unforgettable love and relationship among our family members. The Tsunami taught us and told us about the great and powerful love and relationship among ourselves..

Ms. Nattanan Kiewtalab, Ban Tab Lamu School
Translated from Thai into English by
Ms Tipawan Yamlaksanalerd
Policy and Planning Bureau, MoE

Reference sources of information

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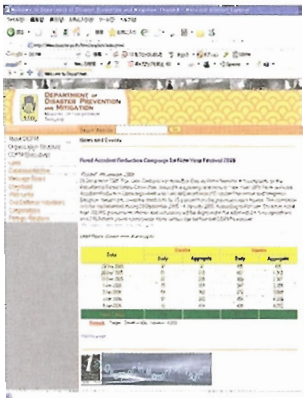
english/executives.html



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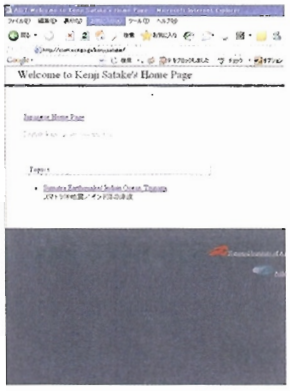

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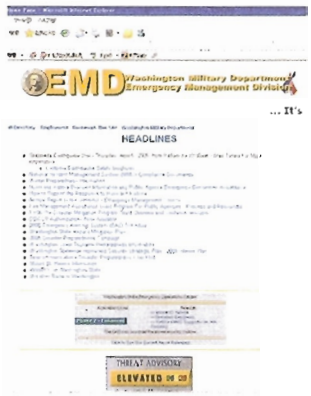

http://www.metho.Tokyo.jp/

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