

United Nations
Educational, Scientific and
Cultural Organization



Intergovernmental
Oceanographic
Commission



National Oceanic
and Atmospheric
Administration



International Tsunami Information Center

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The International Coordinating Group for the Tsunami Warning System in the Pacific of the Intergovernmental Oceanographic Commission of UNESCO, at its Thirteenth Session in Ensenada, Mexico (September 1991), encouraged the preparation of a book designed to inform young persons about tsunamis, the dangers which they present, and what should be done to save lives and property.

The original authors of this book are Dr. George Pararas-Carayannis, Ms. Patricia Wilson, and Mr. Richard Sillcox, and the illustrations were created by Mr. Joe Hunt. Since then, it has been adapted for use in different tsunami source regions by other countries and the ITIC, and translated into many languages.

To learn more about tsunamis and what you should do when a tsunami is coming, we encourage you to read *Tsunami The Great Waves*. You can also visit www.tsunamiwave.org.

Please also contact your State and County Emergency Management Agency or Disaster Management Office to find out about the tsunami evacuation zones for your area.

This book was revised by the International Tsunami Information Center in 2005, 2013, and 2020 .

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International Tsunami Information Center

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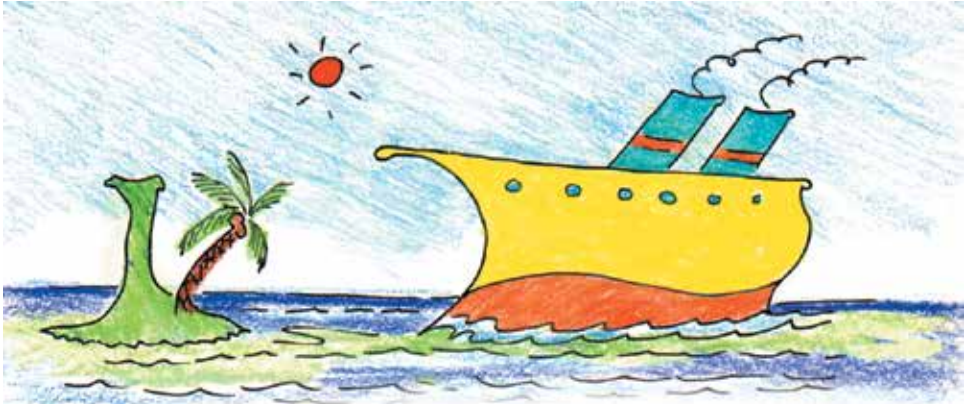
1845 Wasp Boulevard, Building 176

Honolulu, Hawai'i 96818, U.S.A.

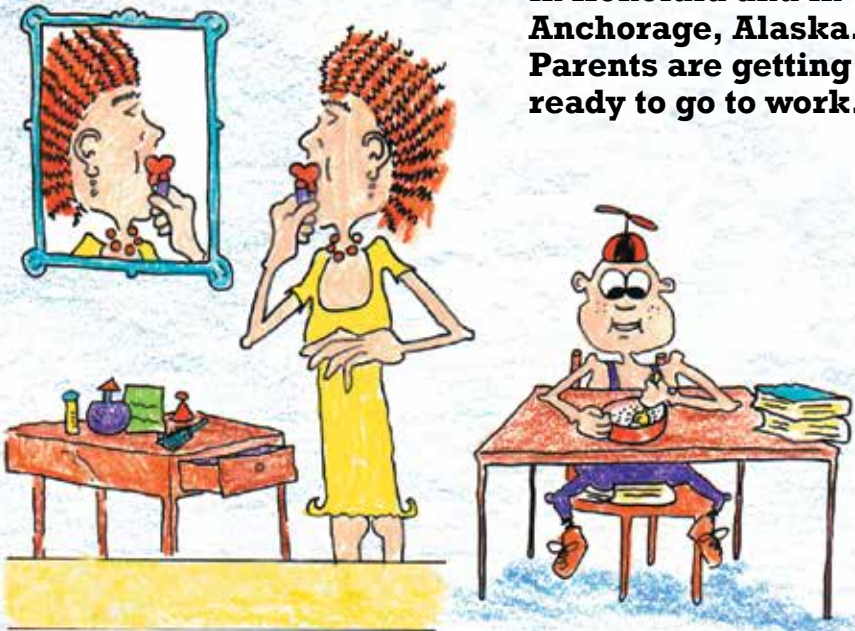
E-mail: itic.tsunami@noaa.gov

<http://www.tsunamiwave.org>

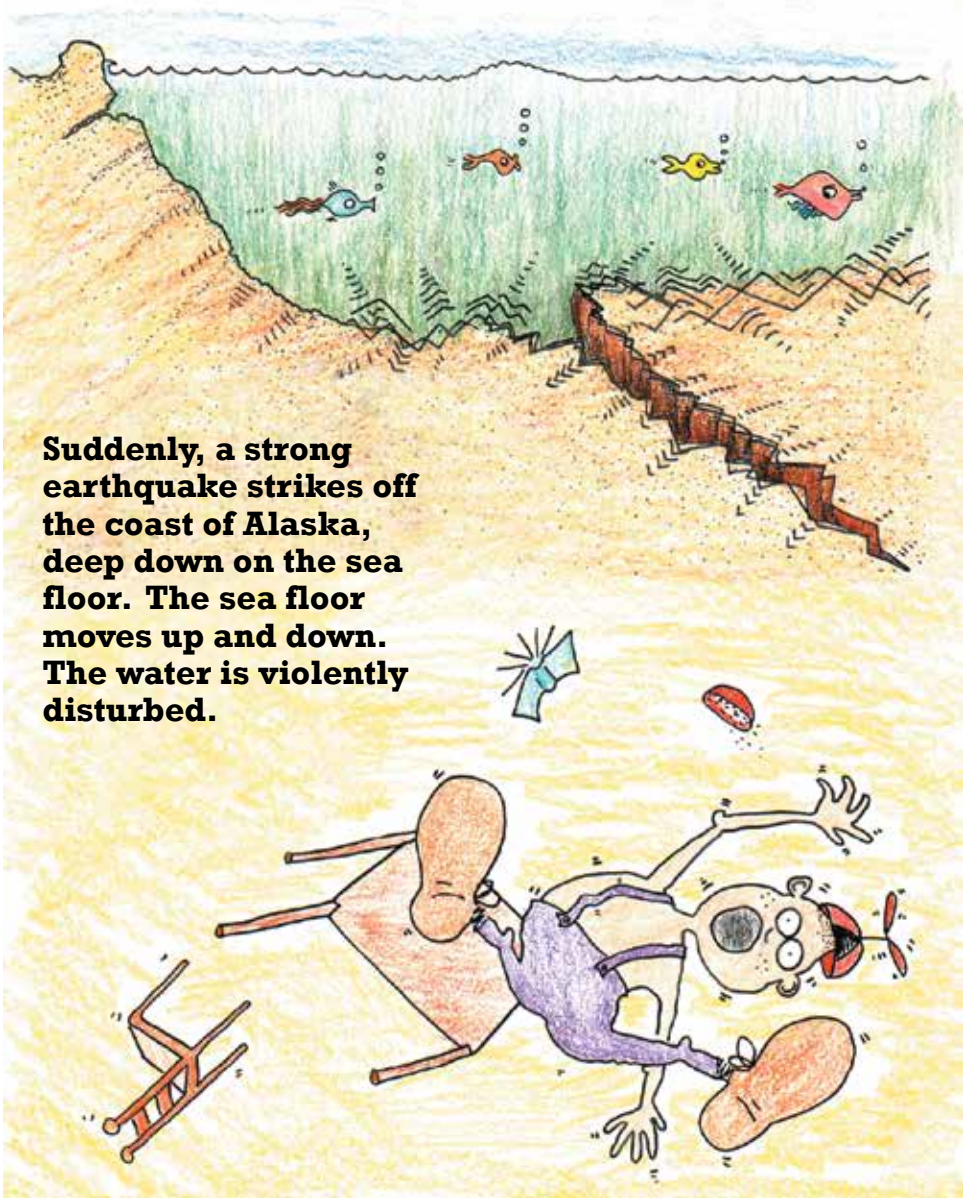
Over the blue, calm water of the Pacific Ocean, a cruise ship is sailing towards Hawai'i. It is warm and sunny in Honolulu. Thousands of miles (kilometers) away, in Alaska, it is snowy and cold.



It is breakfast time in Honolulu and in Anchorage, Alaska. Parents are getting ready to go to work.



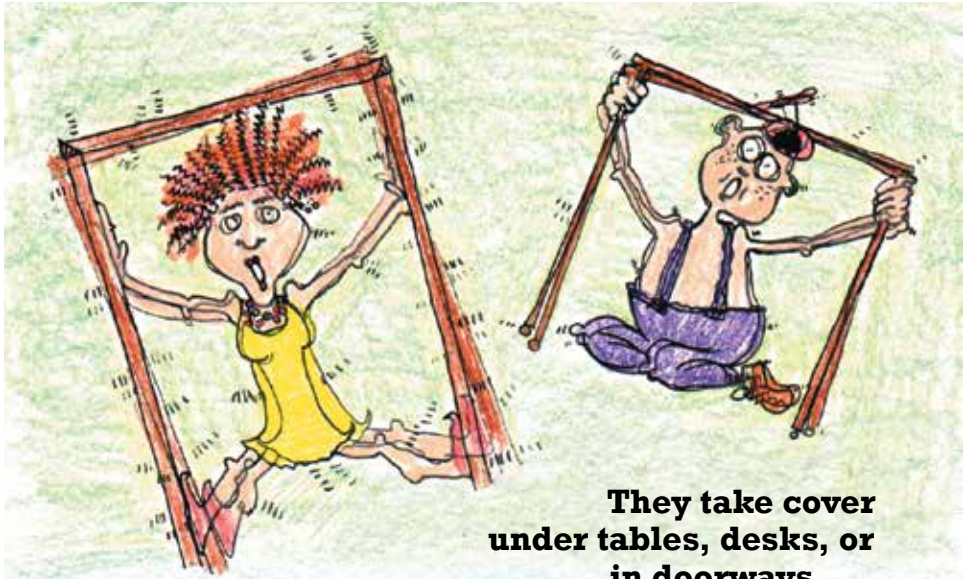
Children are getting ready to go to school.



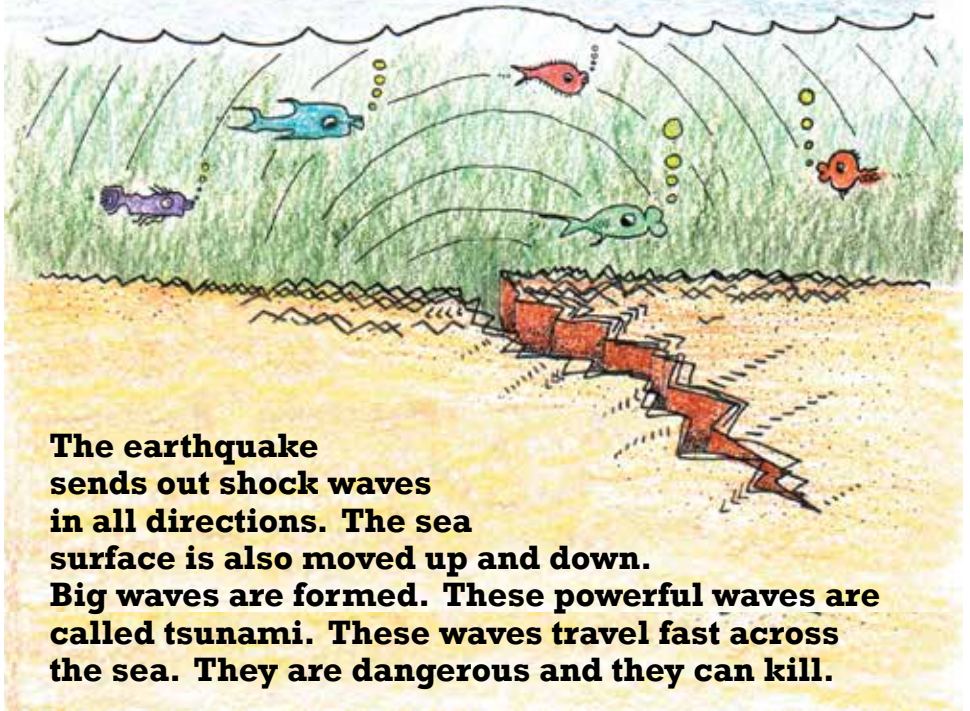
Suddenly, a strong earthquake strikes off the coast of Alaska, deep down on the sea floor. The sea floor moves up and down. The water is violently disturbed.

In Alaska, the walls and floors of the houses suddenly start to shake. Chairs topple over. Things rattle and break. Dishes crash to the floor.

It is an earthquake! People know what to do. They do not run outside.



They take cover under tables, desks, or in doorways.

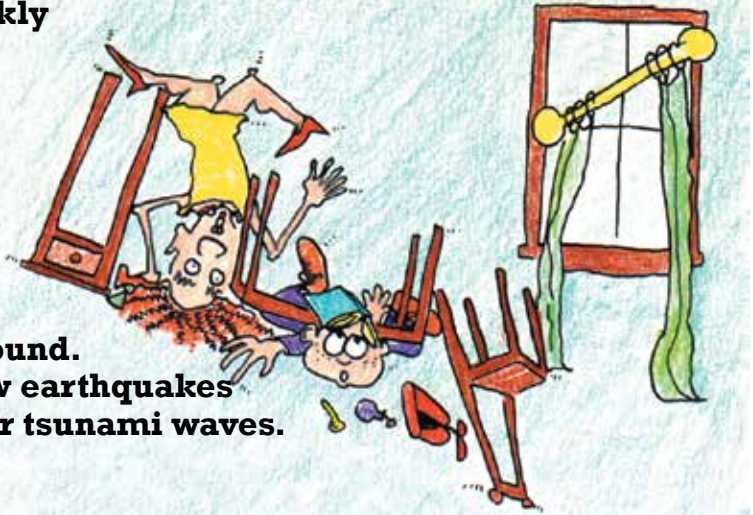


The earthquake sends out shock waves in all directions. The sea surface is also moved up and down. Big waves are formed. These powerful waves are called tsunamis. These waves travel fast across the sea. They are dangerous and they can kill.

When the shaking stops, people living by sea know what to do. They do not start to clean up the mess.

They quickly leave their homes and move inland away from water to higher ground.

They know earthquakes can trigger tsunami waves.

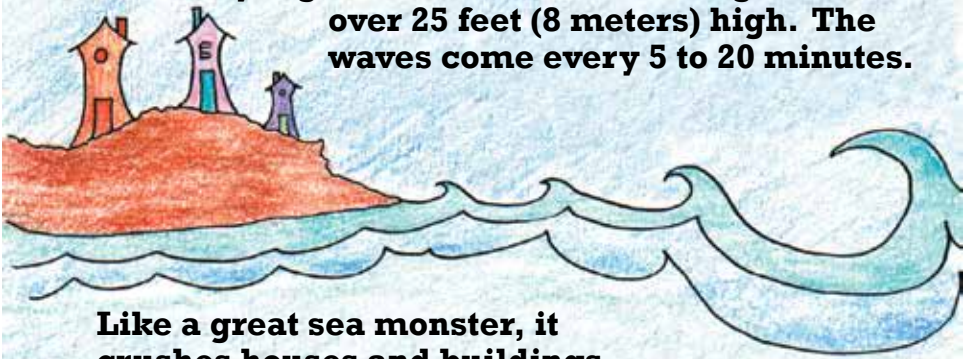


The US Tsunami National Warning Center (NTWC) in Alaska issues a tsunami warning.



Then the Alaska Division of Homeland Security and Emergency Management alerts people a tsunami is expected. There is not much time. People hurry to safety, away from the shore and wait for the tsunami to come.

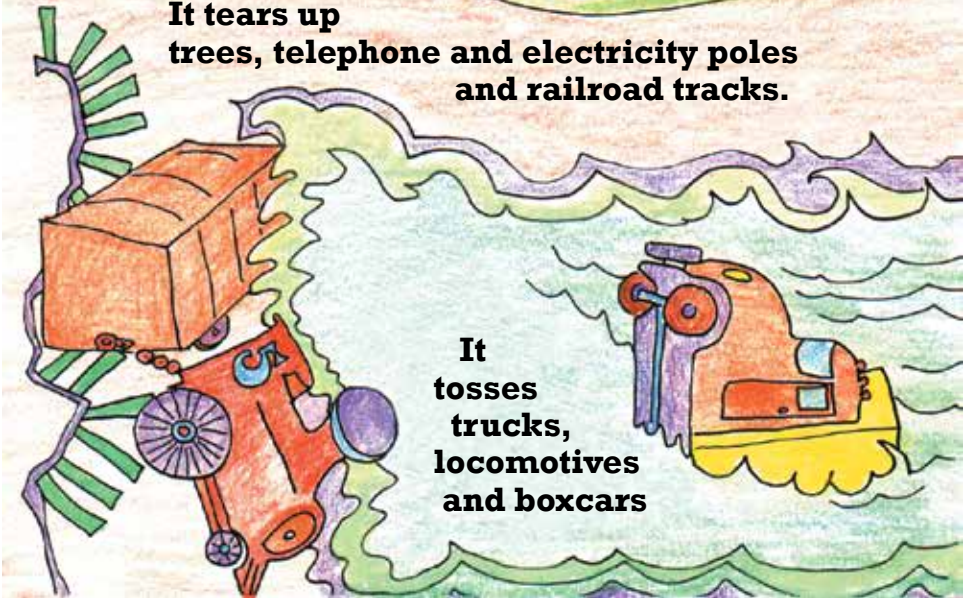
The waves of the tsunami start to roll in 10 minutes after the earthquake. This time the first few waves are not very big, but the third wave is huge and over 25 feet (8 meters) high. The waves come every 5 to 20 minutes.



Like a great sea monster, it crushes houses and buildings.



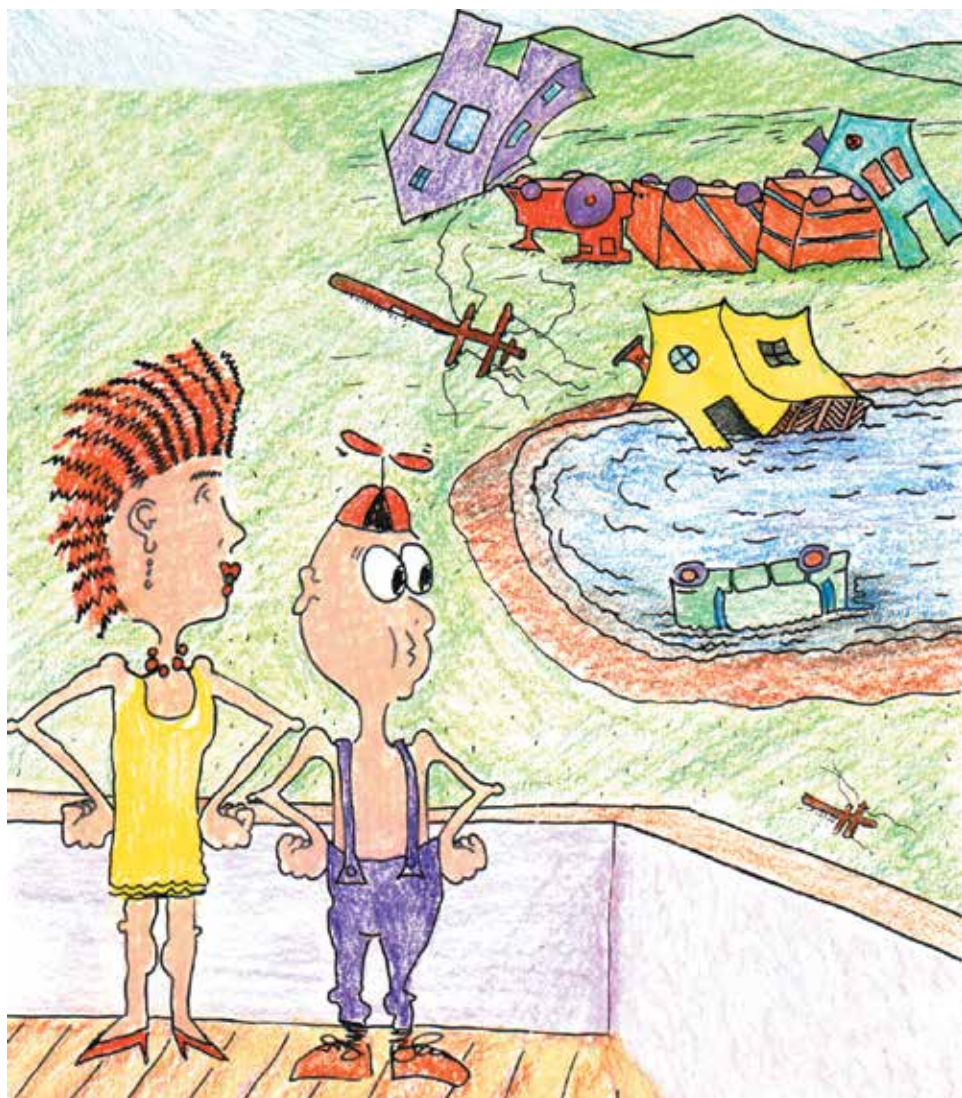
It tears up trees, telephone and electricity poles and railroad tracks.



It tosses trucks, locomotives and boxcars

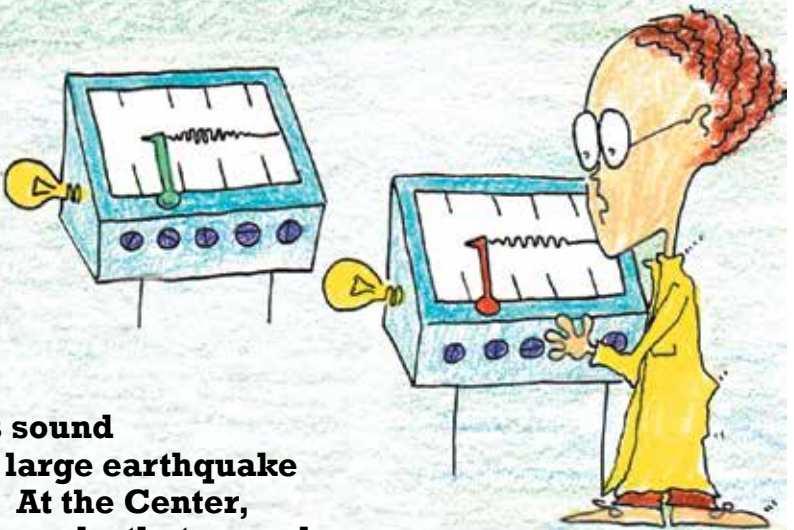
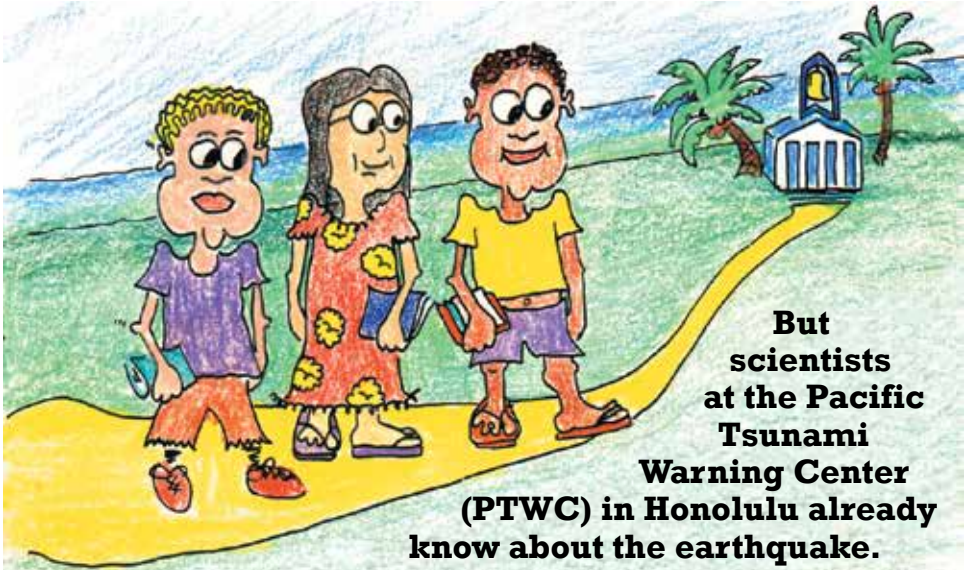
as it sweeps over the land. It pushes and floods everything over a half-mile (800 meters) from shore.

The tsunami waves keep coming and they grow smaller, but ocean currents are still dangerous for many hours. The tsunami has caused a lot of damage, but luckily, no one has been killed.



When the earthquake shaking stopped, everyone immediately left the tsunami hazard zone. Everyone rushed to safety and higher ground. They evacuated the area and were safe.

In Honolulu, Hawai'i, breakfast is finished and parents and children leave home. They have not yet heard about the earthquake or tsunami off Alaska.

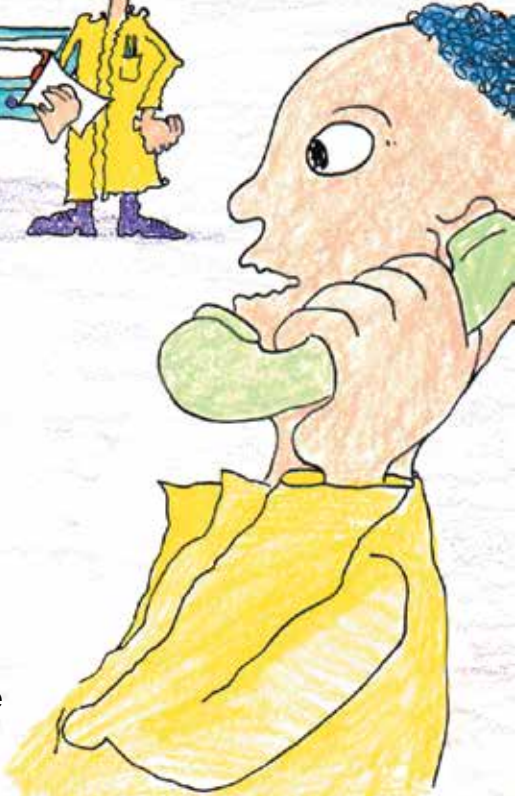


The scientists work all day and all night in shifts. There is always someone on duty checking for earthquakes and tsunamis.

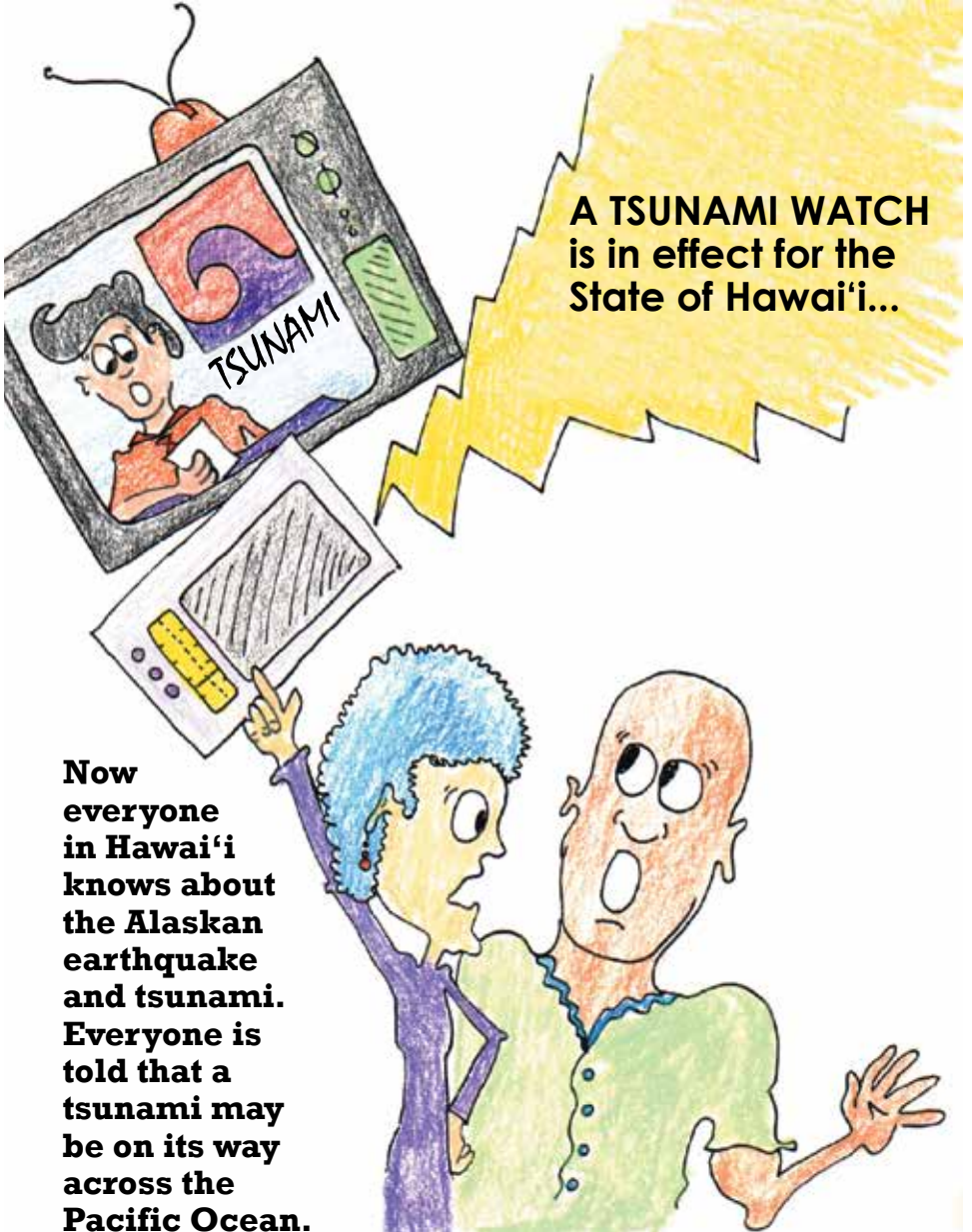


Quickly the scientists send messages to other tsunami warning centers in many countries all around the Pacific Ocean.

They tell them that the Alaskan earthquake was big and a tsunami is now crossing the Pacific Ocean in all directions.



The scientists at the PTWC initially issue a TSUNAMI WATCH. The Hawai'i State and County Emergency Management and Civil Defense Agencies agencies prepare for a tsunami. All radio and television stations broadcast news about the tsunami.



Now everyone in Hawai'i knows about the Alaskan earthquake and tsunami. Everyone is told that a tsunami may be on its way across the Pacific Ocean.

The scientists at the Pacific Tsunami Warning Center are in contact with scientists all over the Pacific trying to assess the size of the tsunami.



They talk by telephone. They send messages by satellite, e-mail, and fax.



In the Center, they run computer programs to calculate how big the wave is expected to be. They check their instruments to see if a big tsunami has been recorded, and if the sea levels are rising or falling. They want to know if tsunami waves are seen in other places in Alaska.



They call the Hawai'i State and County Emergency Management and Civil Defense Agencies to tell them what they have found and whether the tsunami will be dangerous when it hits Hawai'i.

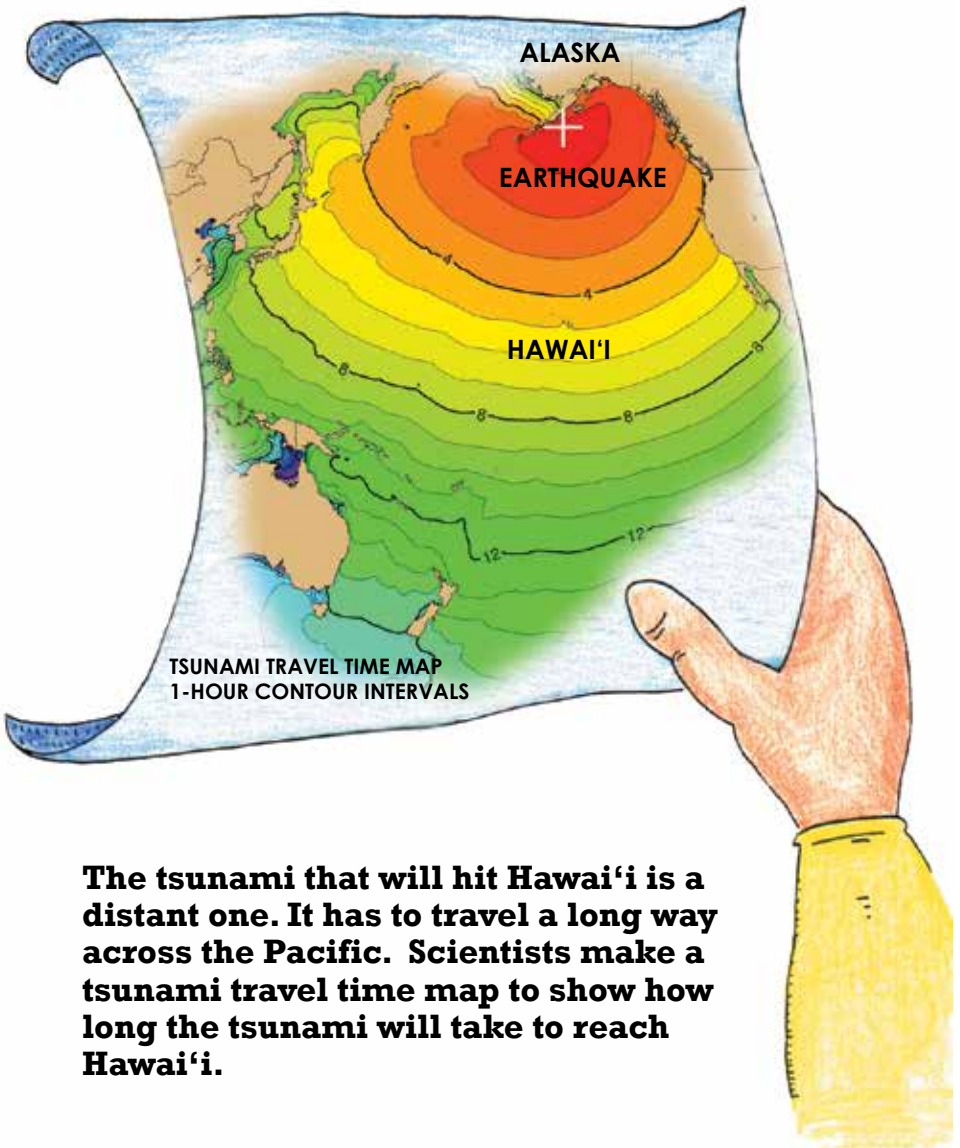
By now the scientists have a lot of information. They know that a tsunami is coming across the Pacific.



They must warn everyone. At 9 o'clock, 3 hours before the tsunami will arrive, they issue a TSUNAMI WARNING.

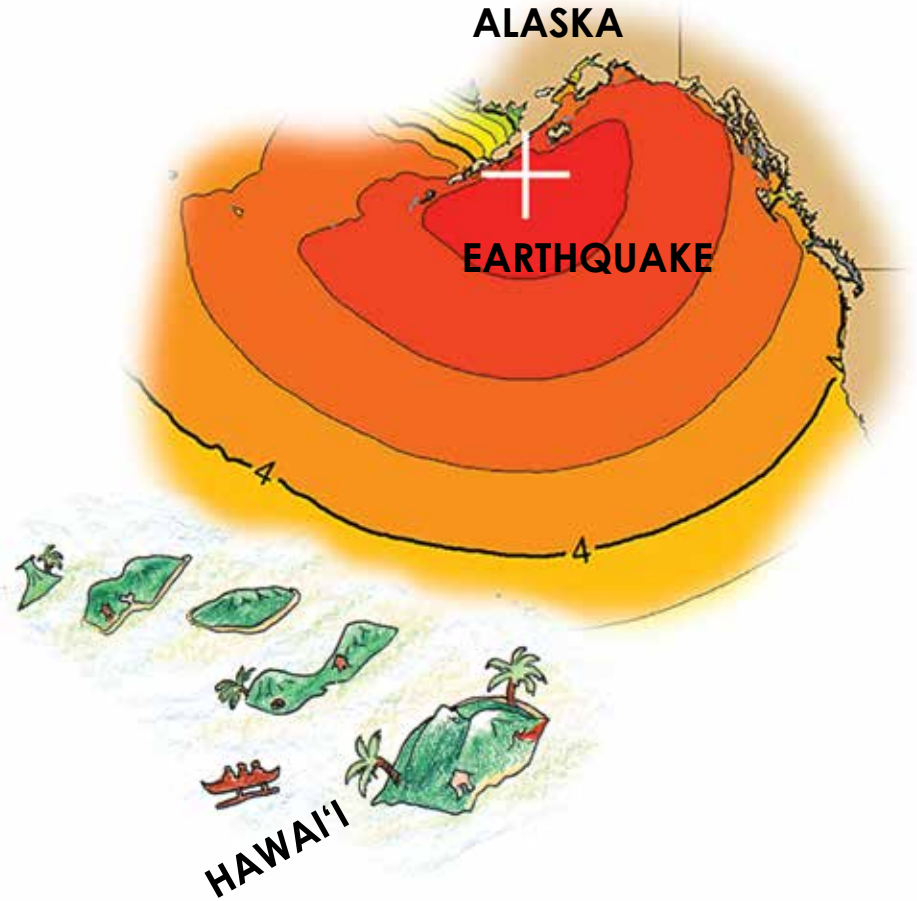


The tsunami that damaged Alaska was a local one because it happened in the same place as the earthquake and the ground began to shake soon after. Local tsunamis do not give people much time to reach safety.



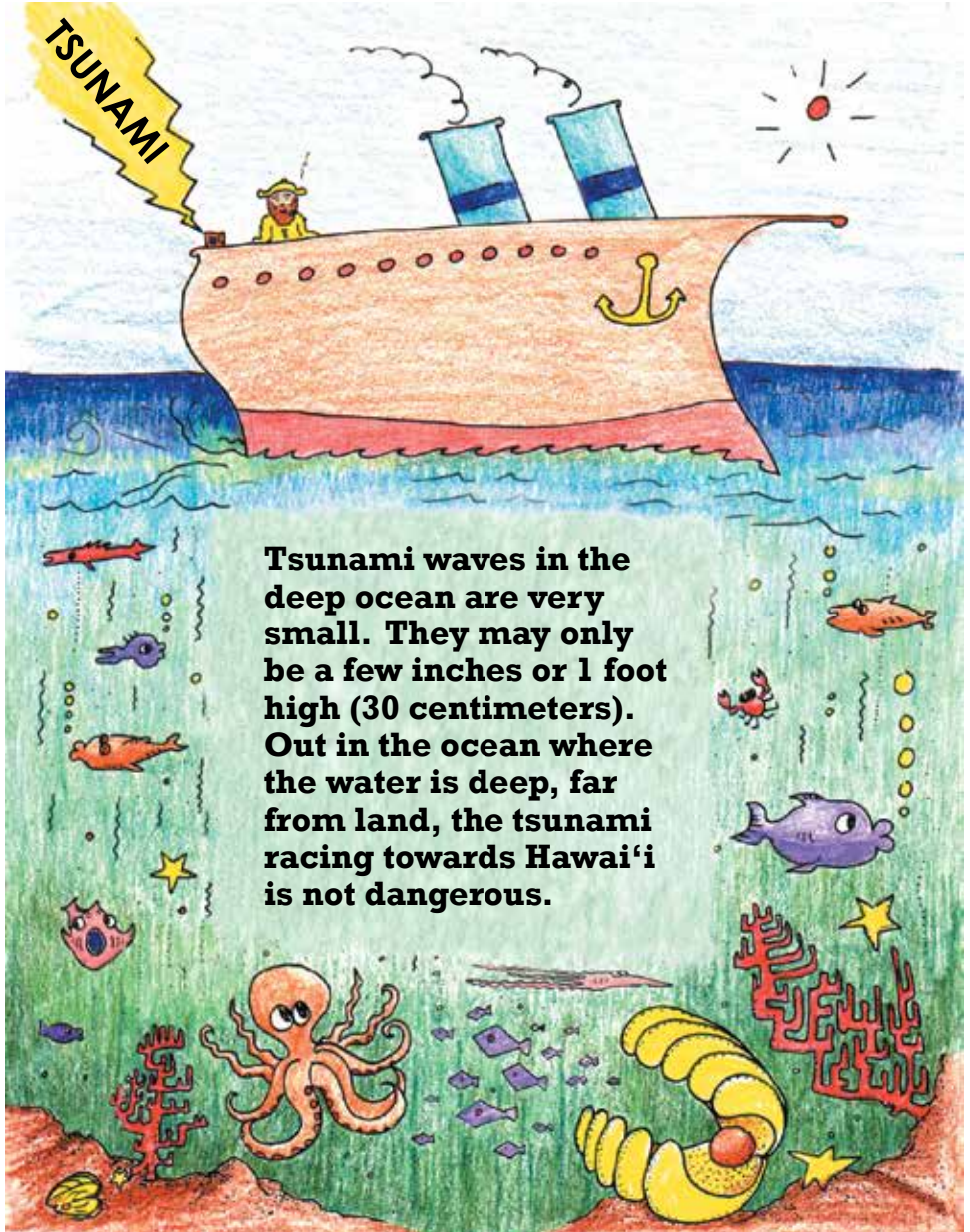
The tsunami that will hit Hawai'i is a distant one. It has to travel a long way across the Pacific. Scientists make a tsunami travel time map to show how long the tsunami will take to reach Hawai'i.

The tsunami that is on its way will give people in Hawai'i four to five hours to go safely to higher ground. A tsunami is made up of a series of very long waves. The individual waves can keep hitting the shore for hours.



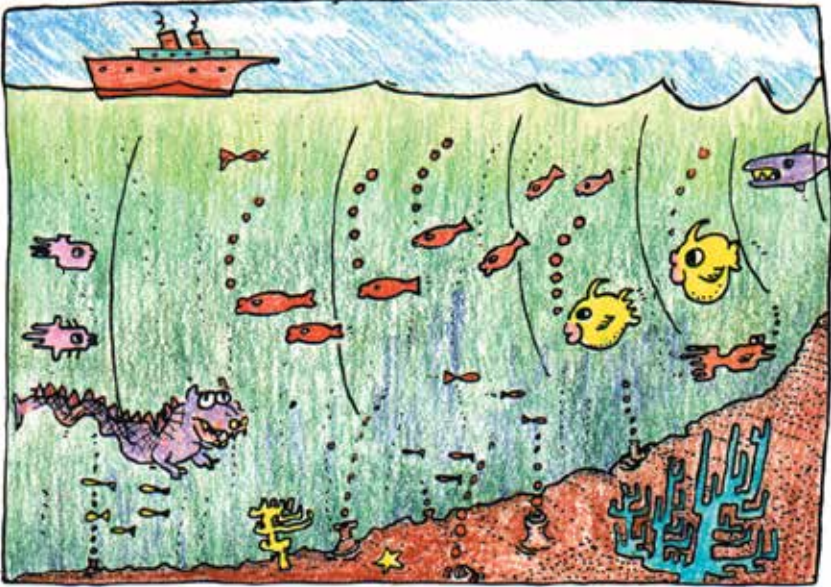
Waves can be up to 100 miles (160 kilometers) apart. The speed of the tsunami depends on the depth of the water. In very deep water, the waves travel as fast as a jet plane going up to 500 mph (800 km/h).

Tsunami waves cannot be felt or seen by ships at sea. The captain of the cruise ship has heard about the tsunami on his radio, but nobody on the ship can feel the waves as they pass under the ship. The tsunami cannot be seen by planes from the air.

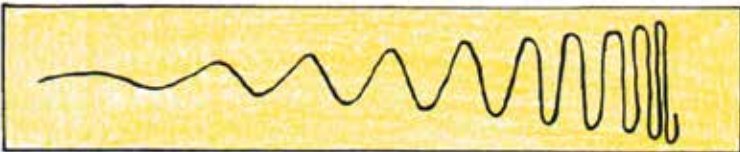


Tsunami waves in the deep ocean are very small. They may only be a few inches or 1 foot high (30 centimeters). Out in the ocean where the water is deep, far from land, the tsunami racing towards Hawai'i is not dangerous.

But as the tsunami approaches land, it becomes dangerous. The waves slow down when they hit shallow water.

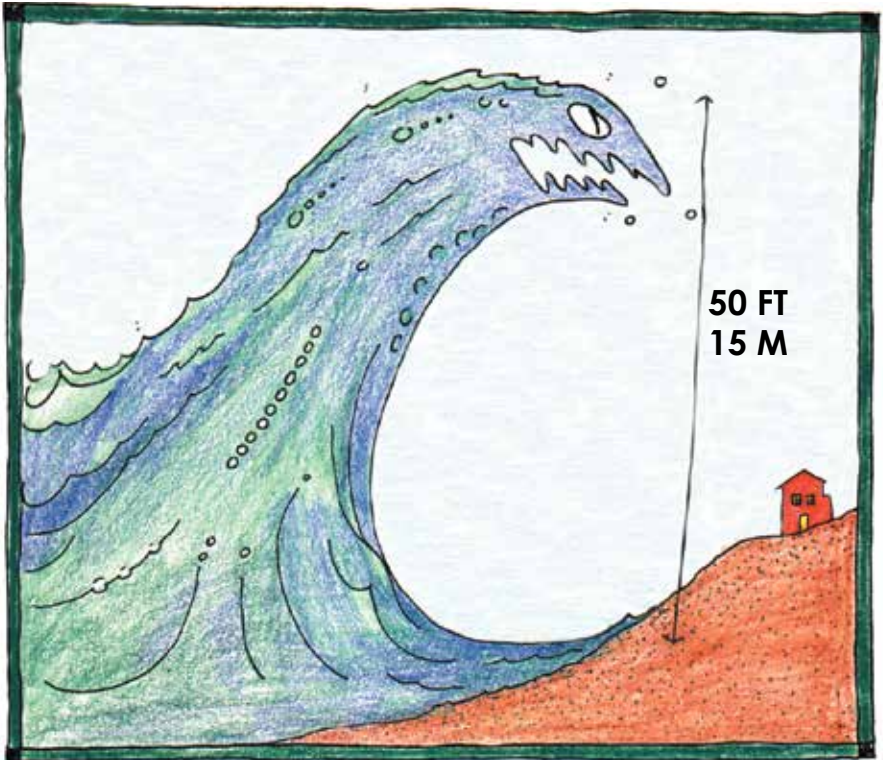


In 30 feet (9 meters) of water, a tsunami travels at 25 mph (40 km/h). That is the speed of a slow car but it is still faster than a person can run.

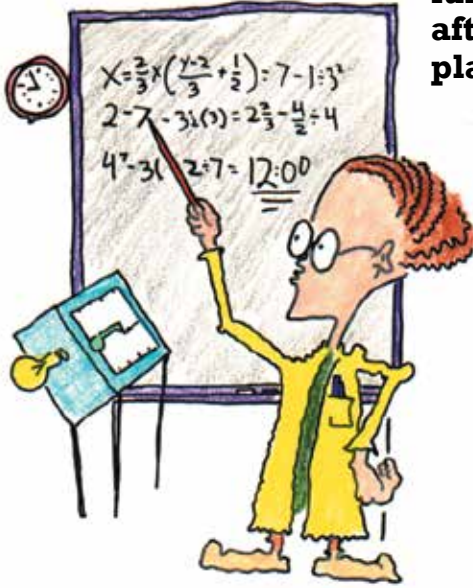


Although the first wave slows down when it enters shallow water, the second wave that is 10s of miles (or kilometers) away is still travelling faster. It catches up to the first wave. The result is that the distance between the waves gets smaller. The waves bunch up. This squashing together makes the waves even taller.

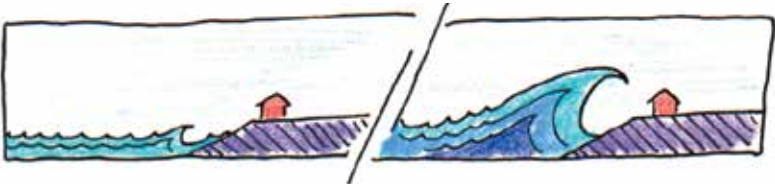
This is when the tsunami waves can become very dangerous. A small wave only 12 inches (30 centimeters) high in the deep ocean may grow into a monster wave 50 feet (15 meters) high as it sweeps over the shore.



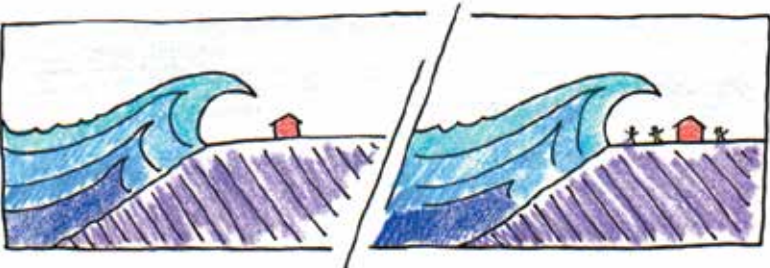
The scientists at the Pacific Tsunami Warning Center can calculate when the first wave of the tsunami will reach Hawai'i. It will reach Hawai'i at 12 o'clock lunchtime, nearly five hours after the earthquake took place in Alaska.



Although the scientists can tell when the tsunami will arrive, they cannot forecast exactly how big and how dangerous the waves will be.

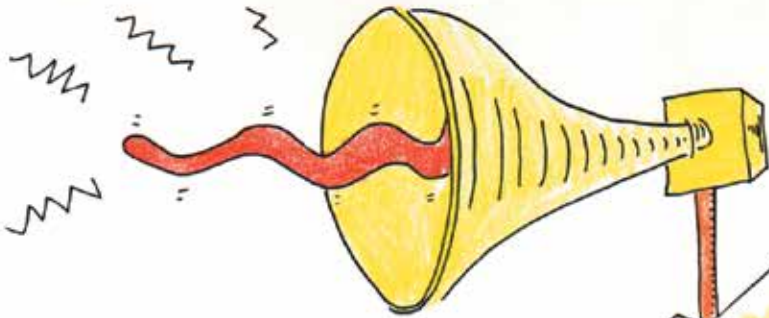


Along some coasts, waves could be small, and in some bays, waves could become gigantic.

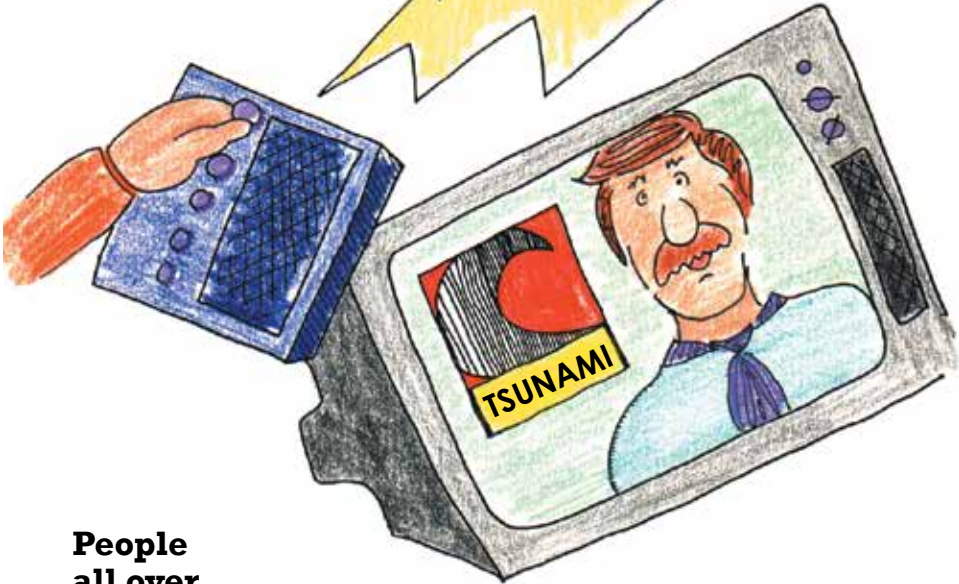
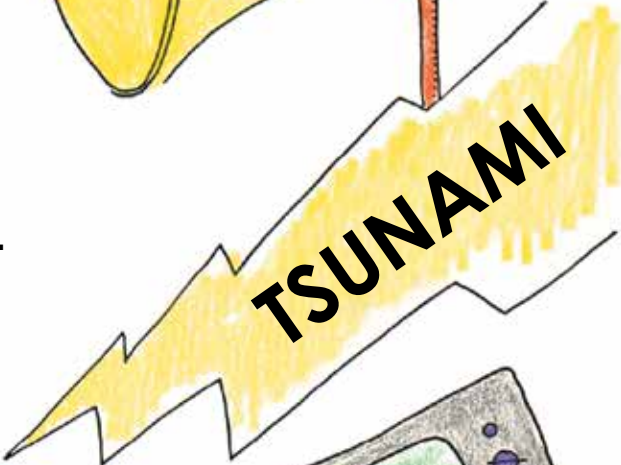


They could be harmless. They could be killers. People must be prepared for the worst and hope for the best.

At 9 o'clock, the Civil Defense sounds all the sirens in Hawai'i.

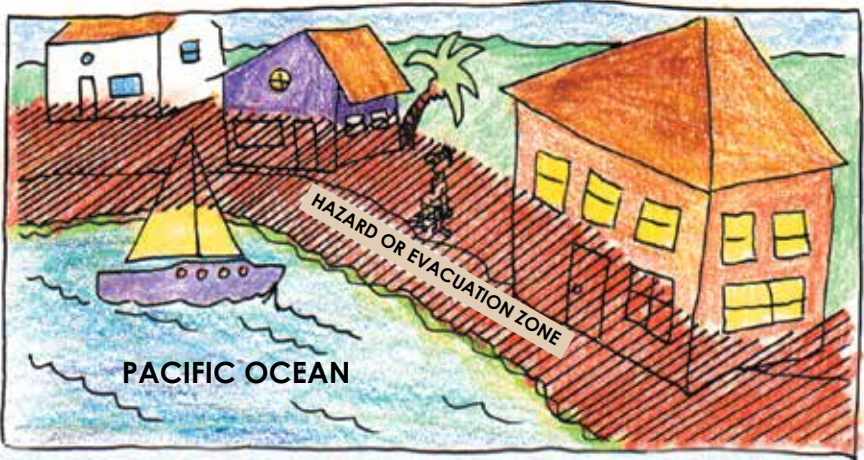


They wait for three minutes.

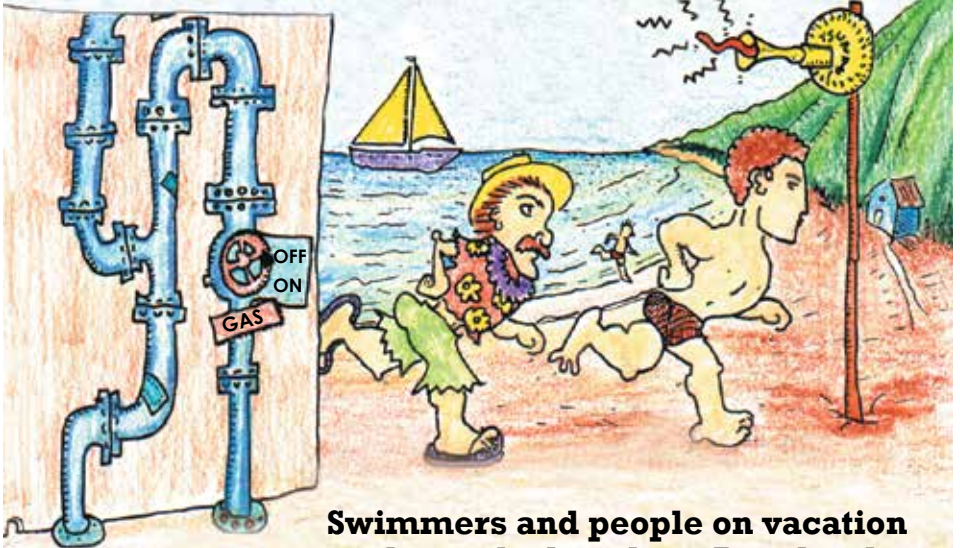


People all over the islands switch on their radios and televisions to listen to the latest news and learn what to do.

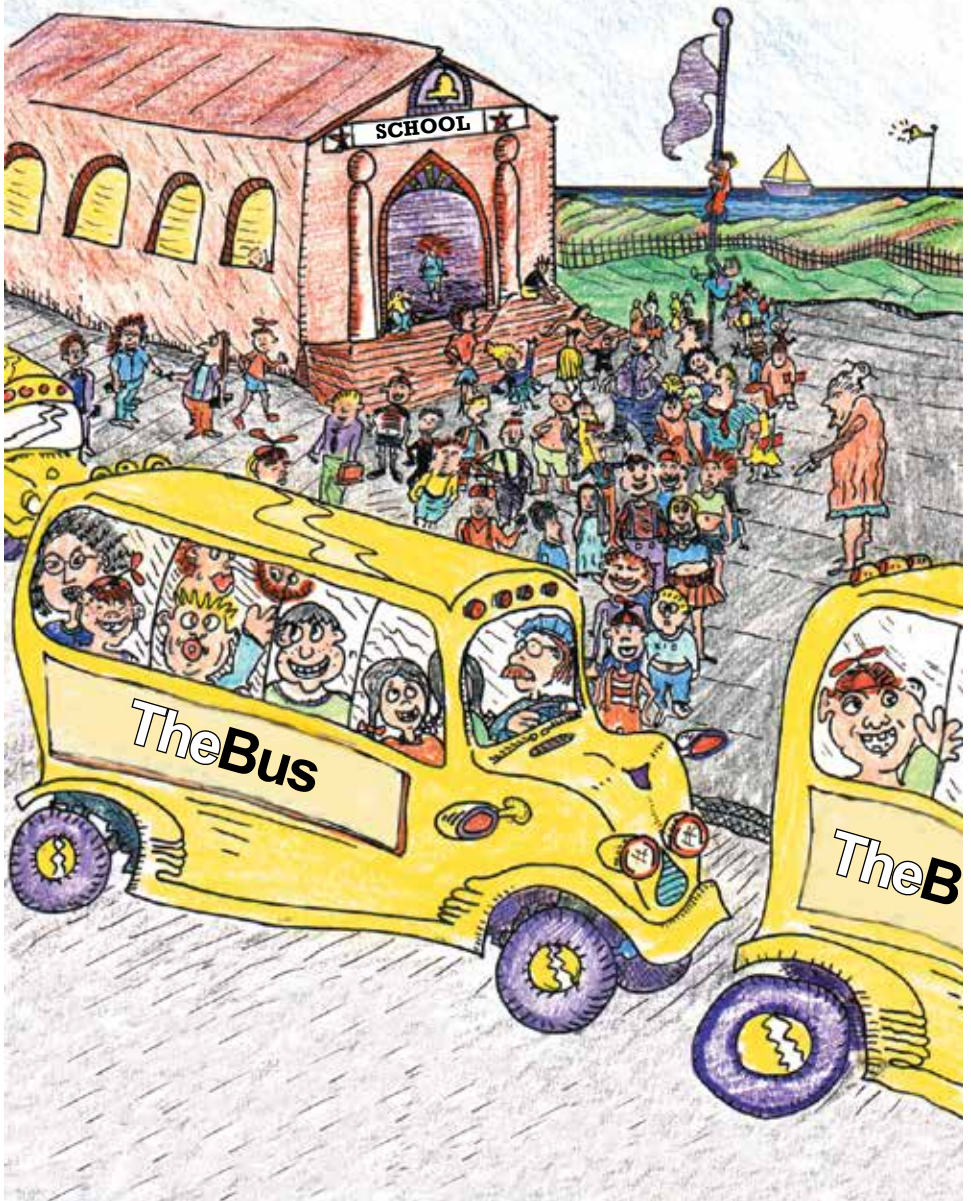
Beaches and low-lying areas along the coast that could get flooded are in the tsunami hazard zone.



These are the places where the tsunami may hit and cause flooding and damage.

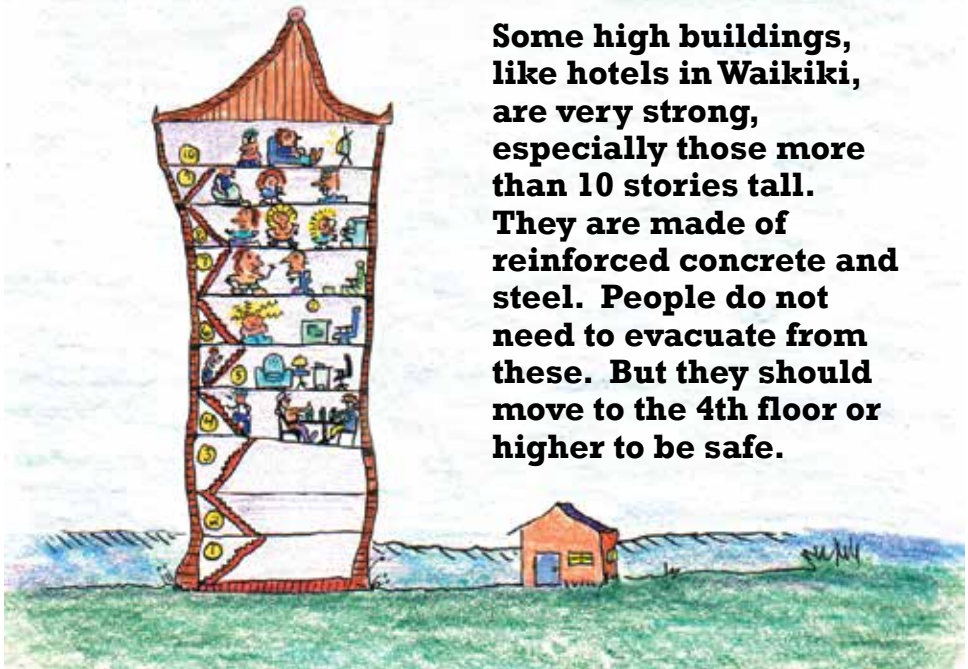
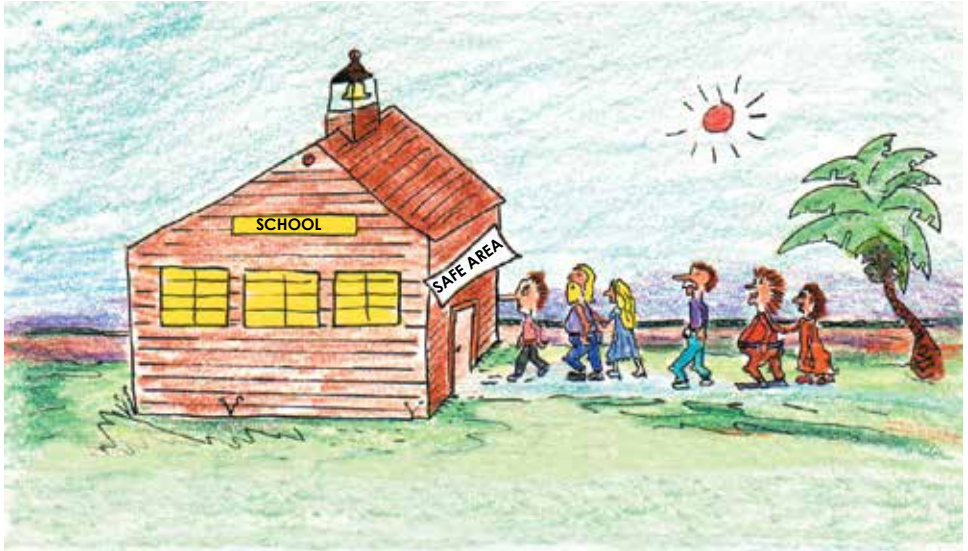


Swimmers and people on vacation start to leave the beaches. People who live in the hazard zones evacuate their homes. They switch off water, electricity and gas at the main valves. Hotel staff help their guests to evacuate their rooms. People in shops and offices in the hazard zones evacuate their places of work.



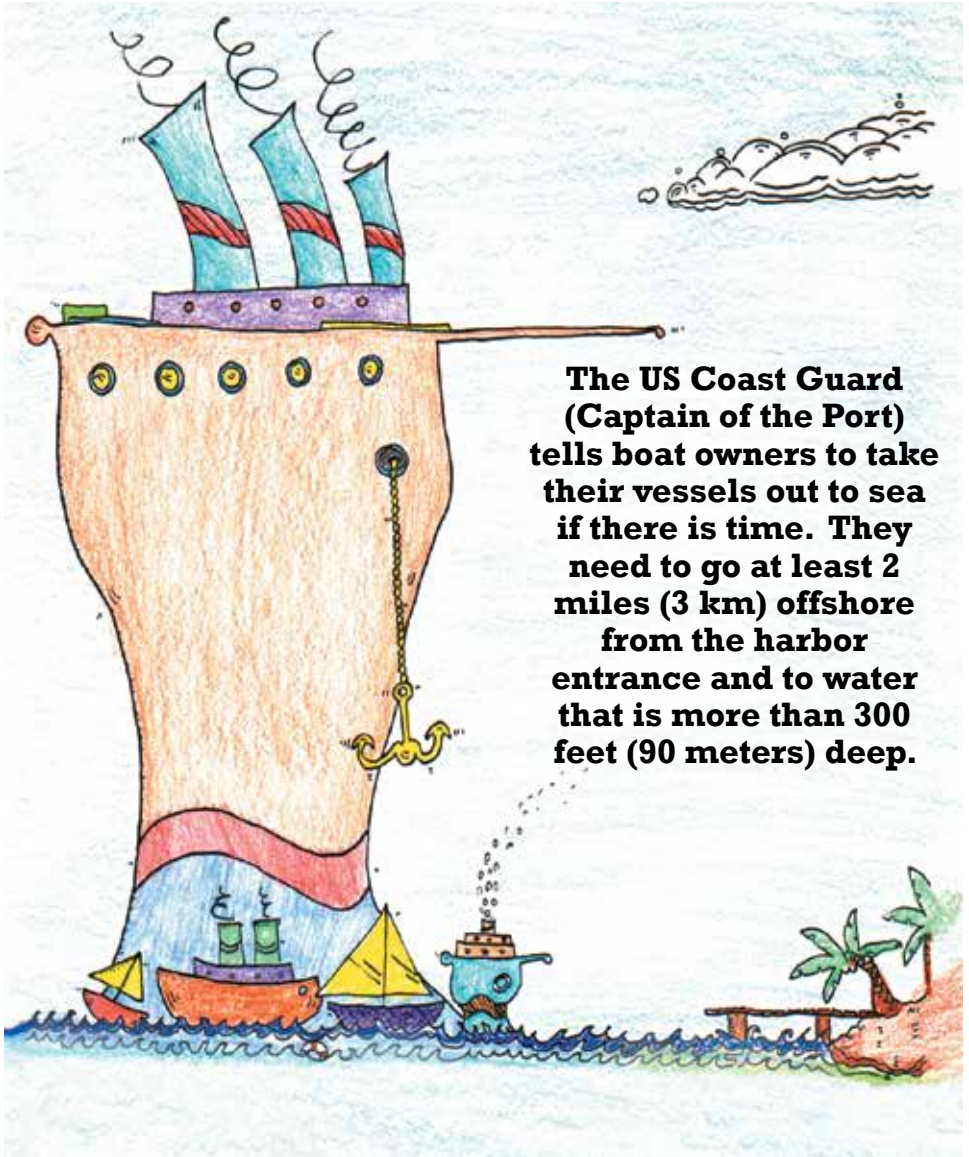
Some schools are in the tsunami hazard zones and must evacuate. Teachers will stay with the children. They evacuate by foot or bus to safe places. They will look after the children until the tsunami danger has passed. Then the parents will come to get their children.

People move from the hazard zones to safe assembly areas. Schools and open areas outside the danger areas are used as assembly areas. Anyone can go there to wait. People have left the dangerous areas and evacuated to safe places.



Some high buildings, like hotels in Waikiki, are very strong, especially those more than 10 stories tall. They are made of reinforced concrete and steel. People do not need to evacuate from these. But they should move to the 4th floor or higher to be safe.

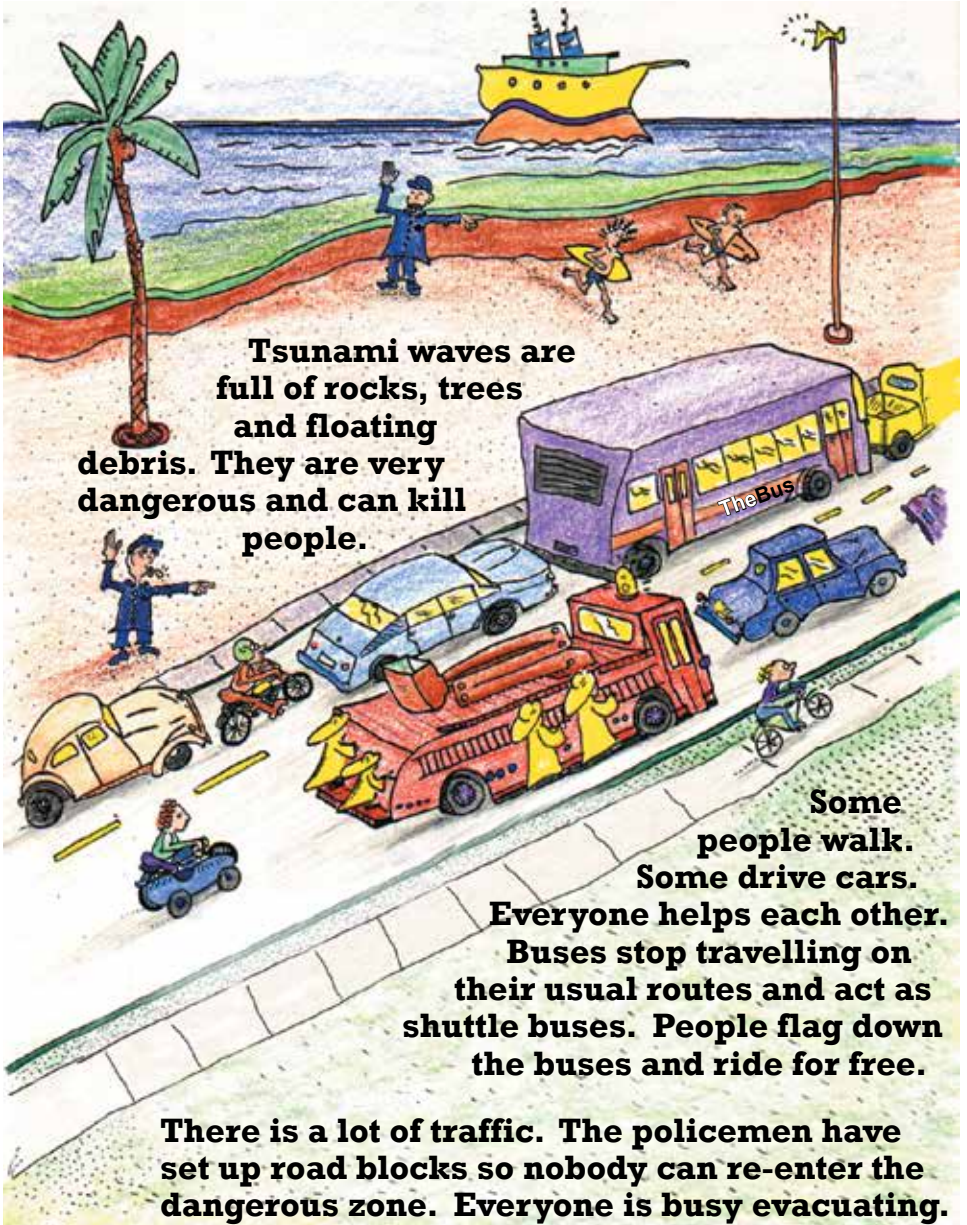
Cruise and cargo ships do not pull into the harbor at Honolulu. They will remain out on the ocean where it is safe.



The US Coast Guard (Captain of the Port) tells boat owners to take their vessels out to sea if there is time. They need to go at least 2 miles (3 km) offshore from the harbor entrance and to water that is more than 300 feet (90 meters) deep.

They won't be harmed there by the tsunami waves. Boats won't return until it is safe and until the the County Emergency Management Agency gives the "ALL-CLEAR" signal.

It is 10 o'clock. The tsunami will arrive in two hours. The sirens wail again as a warning. People are leaving the evacuation zones. Surfers get out of the water. They know tsunamis are not surfing waves. They are fast-moving walls of waters.



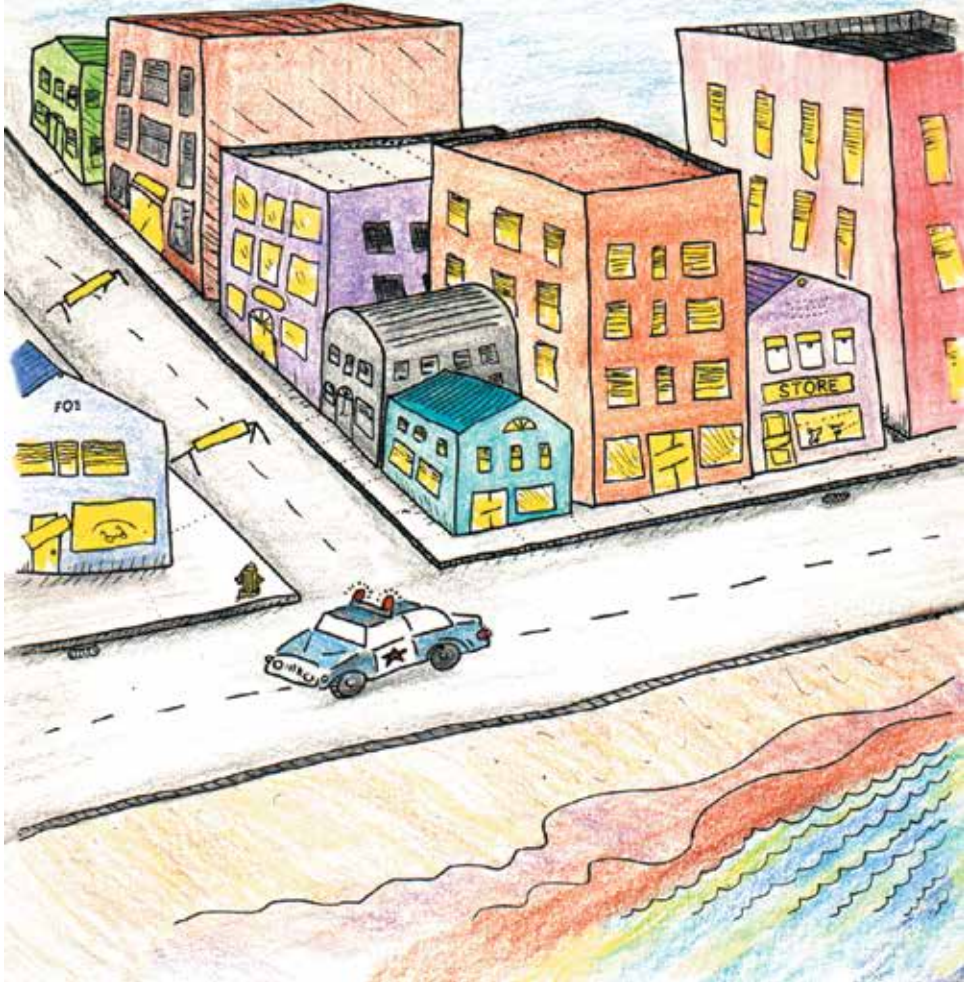
Tsunami waves are full of rocks, trees and floating debris. They are very dangerous and can kill people.

Some people walk. Some drive cars. Everyone helps each other. Buses stop travelling on their usual routes and act as shuttle buses. People flag down the buses and ride for free.

There is a lot of traffic. The policemen have set up road blocks so nobody can re-enter the dangerous zone. Everyone is busy evacuating.

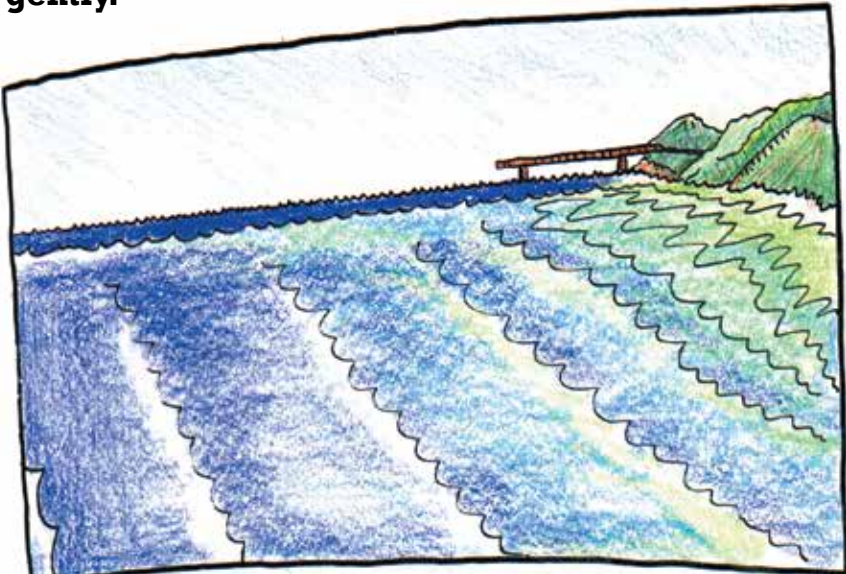
At 11 o'clock, the sirens wail again. The first tsunami wave is expected in less than one hour. Police are busy checking that everyone has evacuated.

They make sure no one has been left behind in the hazard zones.

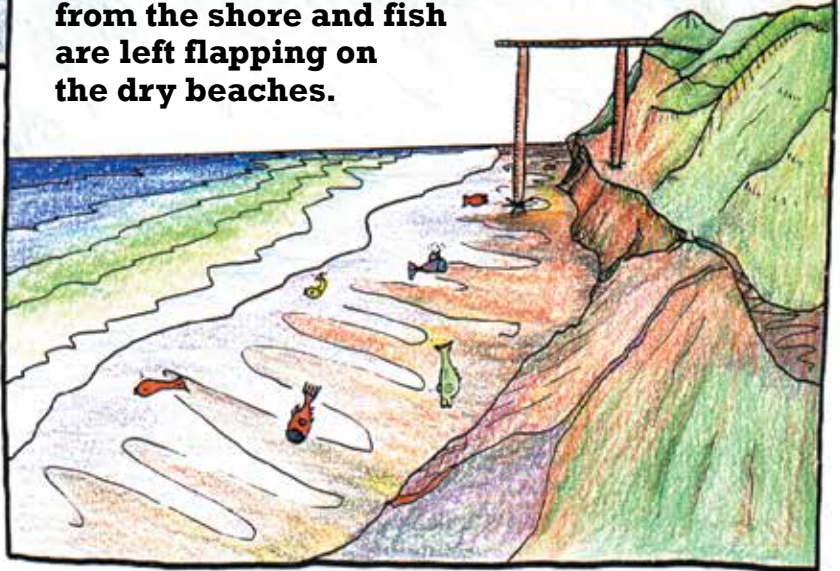


At 11:30 a.m., the sirens sound for the last time. The police also leave the danger area. There is nothing left to do but wait. Everyone expects the first wave to come soon.

A few minutes later something strange happens at the beaches. In some places, the sea is rising gently.



At others, the water is moving back from the shore and fish are left flapping on the dry beaches.

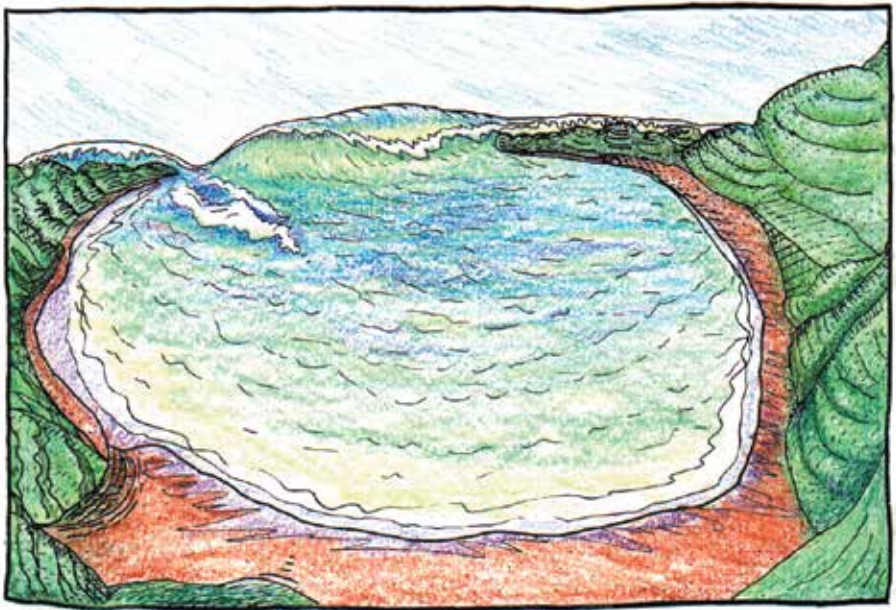


Both rising water and receding water are sure signs that a tsunami is arriving soon.

At 12 noon, the first tsunami wave arrives. Around some parts of Hawai'i, coral reefs help to break the force of the tsunami, but they won't stop the tsunami.

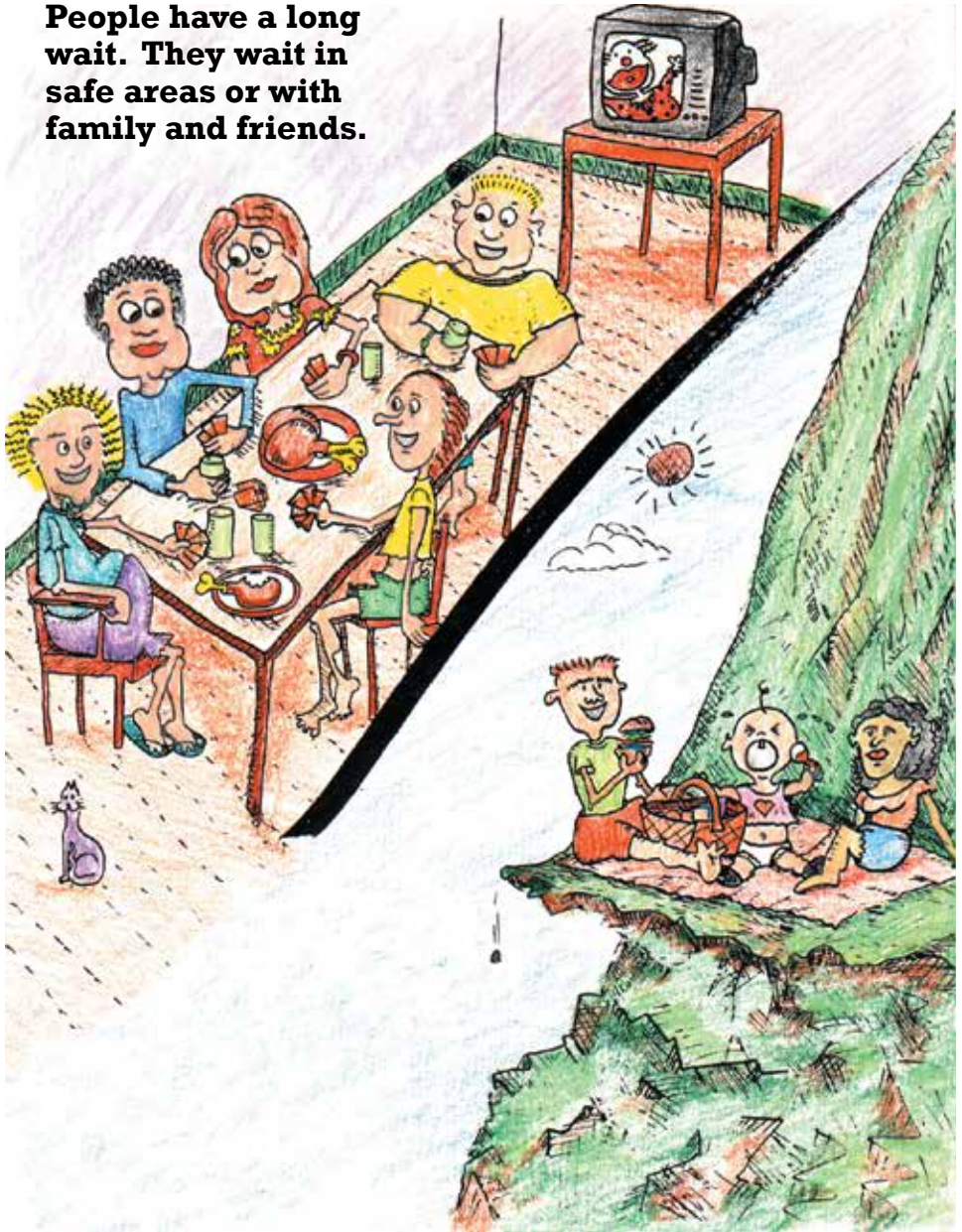


Some shores are protected by trees and mangrove forests which lessens the wave force even more. At bays, the waves in these areas can still be large and dangerous.



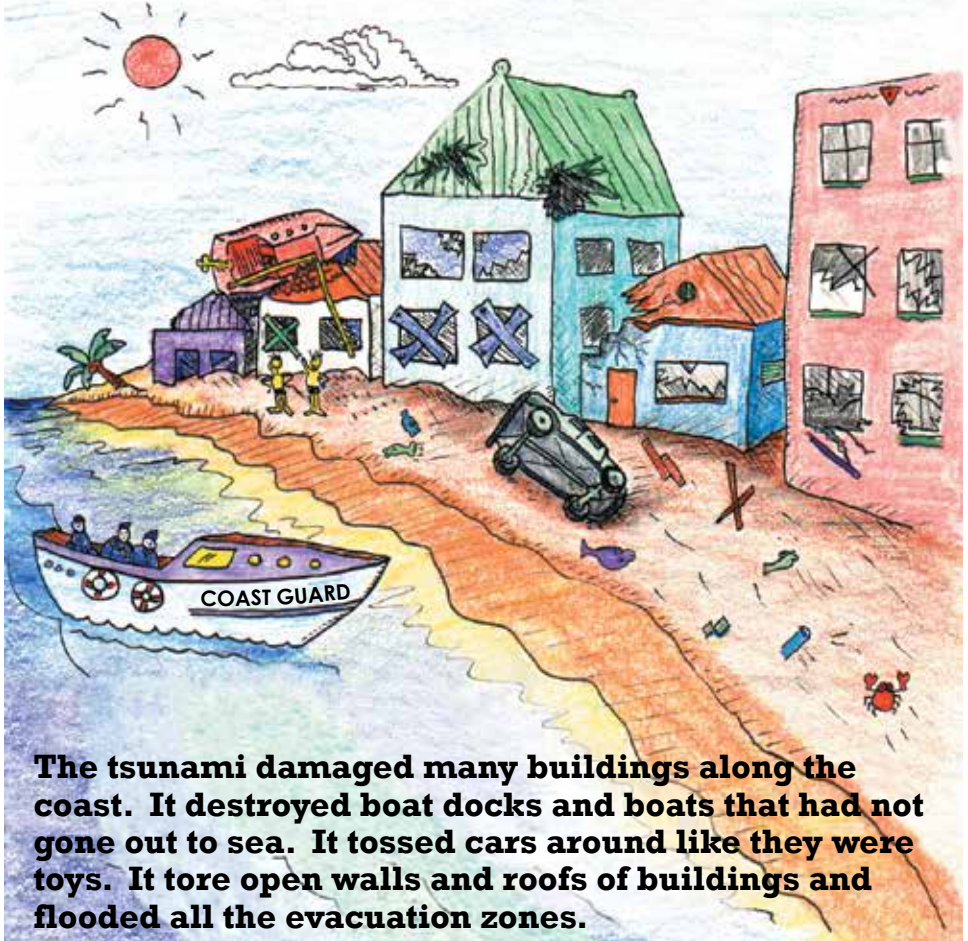
At bays, the waves can be very big because the sides of the bay shorten the length of the wave and push it upwards. There are six waves in this tsunami and they come every 10 to 40 minutes for the next 6 hours.

People have a long wait. They wait in safe areas or with family and friends.



Some have taken picnics to the mountains. People eat and drink, play games, read, watch television or listen to the radio. They wait anxiously to hear when it will be safe to return.

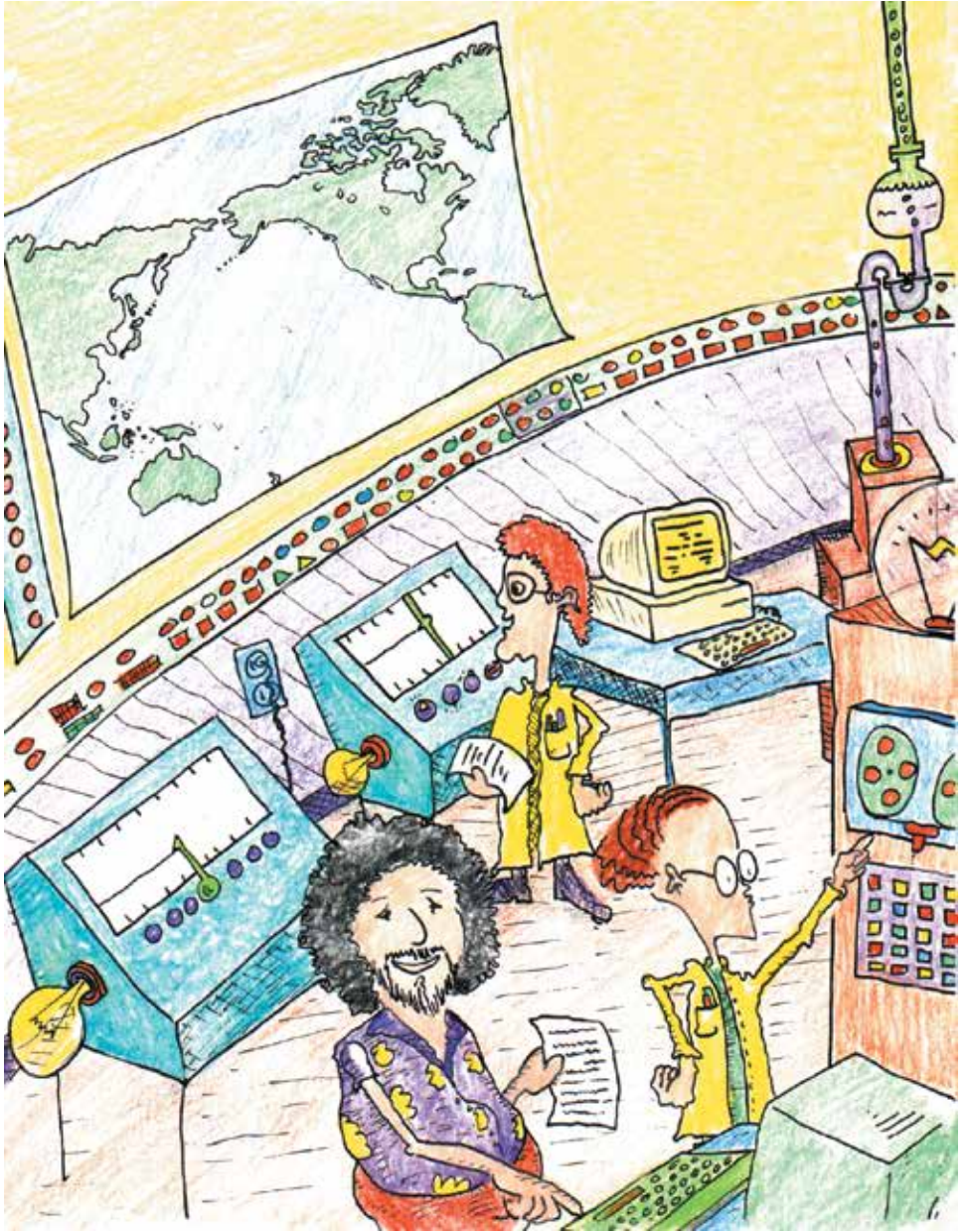
When the tsunami waves become small and do not cause any damage, the Pacific Tsunami Warning Center cancels the TSUNAMI WARNING. Everyone must still wait for their County Emergency Management and Civil Defense to sound the “ALL-CLEAR” signal on television or radio to tell everyone it is safe to return to their homes and offices.



The tsunami damaged many buildings along the coast. It destroyed boat docks and boats that had not gone out to sea. It tossed cars around like they were toys. It tore open walls and roofs of buildings and flooded all the evacuation zones.

Everyone was glad that no one was hurt. They were prepared and knew what to do. Everyone left the hazard zones when they heard the TSUNAMI WARNING. People now work to repair their buildings so life can return to normal.

It is nice to know that the scientists at tsunami warning centers are always on watch for the next sign of a tsunami to protect lives today and in the future.





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