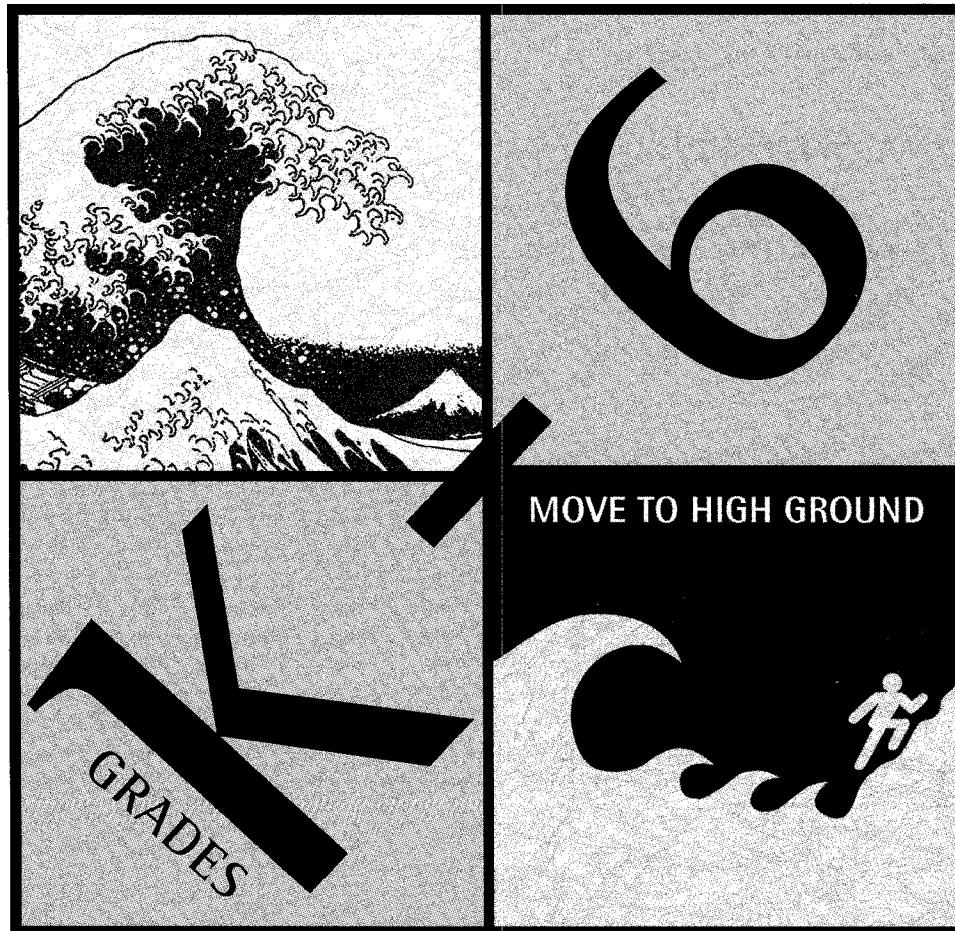


TSUNAMI



CURRICULUM



WASHINGTON MILITARY DEPARTMENT / EMERGENCY MANAGEMENT DIVISION

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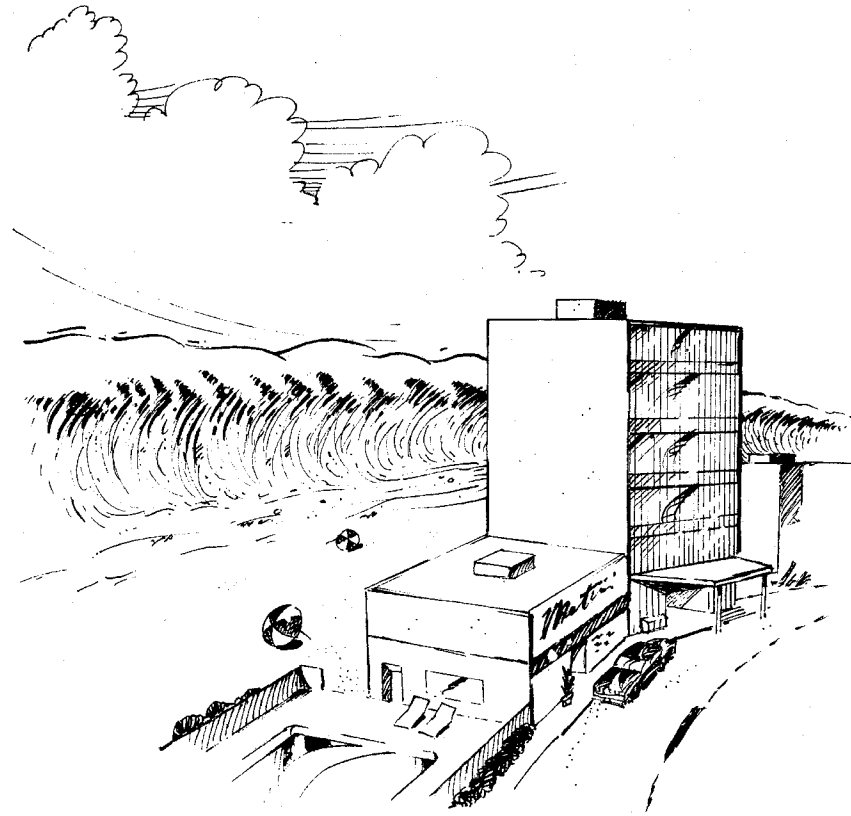
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Tsunami

Pronounced:

soo-NAH-mee

Noun: A Japanese word that means “wave in the harbor.”



Background Information for Teachers

Tsunamis are caused by earthquakes and other movements of the ocean floor, such as volcanic eruptions and landslides. These movements generate waves that travel at speeds up to 800 km (500 miles) per hour. A tsunami is not one wave, but a series of waves that arrive every 10 to 60 minutes. Often the first wave may not be the largest. The danger from a tsunami can last for several hours after the arrival of the first wave. Tsunamis can move faster than a person can run.

In deep water, on the open ocean, tsunamis cause no damage and are hardly noticed. When they meet shallow water, however, they can batter coastlines with waves as high as 60 meters, or 100 feet.

Tsunamis can occur at any time of the day or night, under any and all weather conditions, and in all seasons. Beaches open to the ocean, by bay

entrances or tidal flats, and the shores of coastal rivers are especially vulnerable to tsunamis.

Tsunami damage is very similar to the damage caused by hurricanes and other kinds of storm waves. Since 1946, nations in the Pacific region have shared data from the Tsunami Warning Center in Honolulu, through an international Seismic Sea Wave Warning System. This center sends out Pacific-wide warnings when an earthquake of tsunami potential occurs.

Tsunamis are often misnamed as tidal waves. This is incorrect because they have nothing to do with the tides, which are caused by the gravitational pull of the moon and sun.

In 1960 a large tsunami caused widespread death and destruction throughout the Pacific. The tsunami was generated by an earthquake located off the coast of Chile. It caused loss of life and property damage not only along the Chile coast but also in Hawaii and as far away as Japan.

The Great Alaskan Earthquake of 1964 produced deadly tsunami waves in Alaska, Oregon and California. In 1998 a 7.1 magnitude earthquake generated the Papua, New Guinea, tsunami. Waves were reported to be 24-30 feet high. At least 2,500 people were killed and 713 admitted to hospitals.

Sometimes tsunamis cause the water near the shore to recede, exposing the ocean floor. The force of tsunamis is enormous. Large rocks weighing several tons, along with boats and other debris, can be moved inland hundreds of meters by the tsunami wave activity. Homes and other buildings are destroyed. All of this material and water move with great force and can kill or injure people.

What To Do When a Tsunami Occurs

If you are in school and you hear there is a tsunami warning, you should follow the advice of school administration and your local emergency and law enforcement authorities..

If you are at home and hear there is a tsunami warning, you should make sure your entire family is aware of the warning. Your family should evacuate your house if you live in a tsunami evacuation zone. Move in an orderly, calm and safe manner to the evacuation site or to any place outside your evacuation zone.

If you are on the beach or near the ocean and you feel the earth shake, move immediately to higher ground. DO NOT wait for a tsunami warning to be announced. Stay away from rivers and streams that lead to the ocean just

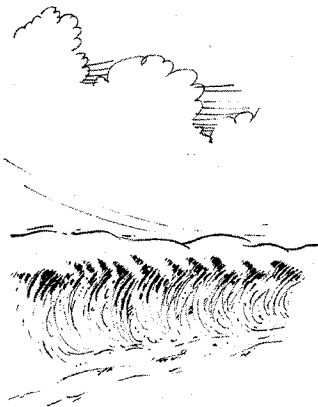
as you would a tsunami. A regional tsunami from a local earthquake could strike some areas before a tsunami warning could be announced.

High, multi-story, reinforced concrete hotels are located in many low-lying coastal areas. The upper floors of these hotels can provide a safe place to find refuge should there be a tsunami warning and you are unable to quickly move inland to higher ground.

If you are on a ship or in a boat do not return to port if you are at sea and a tsunami warning has been issued for your area. Tsunami wave activity is imperceptible in the open ocean, but tsunamis can cause rapid changes in the water level and dangerous currents in harbors and ports.

Teacher's Pre-assessment Survey

1. When do tsunamis occur?
 - a. Anytime of the year, day or night.
 - b. During the Winter.
 - c. During the Summer.
2. Where are tsunamis most likely to occur in the United State?
 - a. Hawaii
 - b. Alaska and the west coast
 - c. BOTH of the above; Hawaii and Alaska and the west coast.
3. If you feel a **STRONG** coastal earthquake that lasts 20 seconds or longer, you should:
 - a. Drop, cover and hold.
 - b. When the shaking stops, evacuate quickly.
 - c. BOTH of the above; drop, cover and hold, and evacuate quickly when the shaking stops.
4. A tsunami is a:
 - a. Tidal wave.
 - b. Series of sea waves.
 - c. The result of El Nino.
5. If an earthquake has generated a tsunami wave, what should you do?
 - a. Return home.
 - b. Wait until local officials tell you it is safe.
 - c. Go to the beach to inspect the effects of the tsunami.



RESOURCES



Tsunami Web-site Information

International Tsunami Information Center

<http://www.nws.noaa.gov/pr/itic/>

U.S. Geological Survey

<http://www.usgs.gov/>

National Oceanic & Atmospheric Administration

[www:/www.pmel.noaa.gov/tsunami-hazard](http://www.pmel.noaa.gov/tsunami-hazard)

The Tsunami Page

<http://www.geocities.com/CapeCanaveral/Lab/1029/TsunamiFAQ.html>

“Tsunami! An On-Line Interactive Resource of Tsunami Information,”
sponsored by the University of Washington

<http://www.geophys.washington.edu/tsunami>

Waves of Destruction: Tsunamis – a PBS Special

<http://www.pbs.org/wnet/savageearth/tsunami/index.html>

The International Journal of Tsunami Society - Tsunami Links

<http://www.ccalmr.ogi.edu/STH/links.html>

Western States Seismic Policy Council Tsunami Hazard Mitigation Committee

<http://www.wsspc.org/tsunami/tsunami.html>

Tsunami Video List

Aonae Tsunami Animation

Produced by Dr. Vasily Titov, NOAA/PMEL; can be downloaded from website:

<http://www.pmel.noaa.gov/tsunami-hazard/vasily.mpg>

Tsunami: Killer Waves

Extensive photos and footage documenting the disastrous results of lethal waves that struck Hawaii in 1946 and 1960, killing hundreds of people and causing hundreds of millions of dollars in damage. Available at the Channel Store, 800-408-4842 for \$19.95.

Killer Wave: Power of the Tsunami

Part of the 3-video set, “Nature Strikes,” including, “Volcano: Nature’s Inferno,” and “Asteroids: Deadly Impact.” The three-video set is available from the National Geographic Society Store at a cost of \$49.95.

<http://www.ngstore.com/ngstore/ngsstore.htm>

Waves of Destruction: Tsunamis

From remote Okushiri Island, off the coast of northern Japan, to Hawaii, survivors give first-hand reports of the devastating power of tsunami and tell how they managed to

Continued next page

escape. The final program of the PSB series "Savage Earth" is available for \$19.95 from WNET Video Distribution, PO Box 2284, South Burlington, VT 05407.
<http://www.pbs.org/wnet/savageearth/programs/html/videos.html>

Fire on the Rim, Episode 3 – the Prediction Problem

Available from Ambrose Video Publishing, 28 West 44th St., Suite 2100, New York, NY 10036. Phone 1-800-526-4663, Ext. 224, Fax 212-768-9282. Cost is \$99.95.
<http://www.ambrosevideo.com>



The Wave: A Japanese Folktale

Item PE 501 (Grades K-3), available from the Nature of the Northwest Information Center, 800 NE Oregon St., Suite 177, Portland, OR 97232. Phone 503-872-2750. Cost \$10.00 plus shipping.

Tsunami! Surviving the Killer Waves

Item PE 502 (Grades 4-12), produced by the Oregon Dept. of Geology and Miners, RT 13.35 min., available from the Nature of the Northwest Information Center, 800 NE Oregon St., Suite 177, Portland, OR 97232. Phone 503-872-2750. Item PE 503 (General Public), Cost \$10.00 plus shipping.

Raging Planet: Tidal Wave

Imagining an unstoppable wall of water, 500 mph, reaching heights of nearly 100 feet. Tidal Wave is the story of defiant humans. Join scientists who struggle to predict the unpredictable. RT 50 min. Item 707091, available from The Discovery Channel for \$19.95 plus shipping.
<http://shopping.discovery.com/product/70791.html>

Tsunami—Born of Fire

Available from NOAA/PMEL, 206-526-6810 for cost of duplication. RT 9:37 min., features tsunami destruction and fires on Okushiri Island, Japan. Good graphics, explanations and safety information.

Sea Tek: Tsunami

Excerpt from Sea Tek TV series produced in 1996. Includes historic tsunami footage, inundation, and damage scenes from Peru, Alaska, and Japan. Information: Eddie Bernard, 206-526-6800.

Raging Sea

Thirty minute special on tsunami preparedness focused in Hawaii; produced by KGMB TV. Information: Delores Clark, 808-532-6411.

Tsunami

B-roll showing Papua New Guinea simulations and tsunami buoy deployment. Cost is \$9-\$25, depending on format. Available from Video Transfer, 301-881-0270. Email: vidtans@erols.com.

International Tsunami Information Center

Two videos available, each with multiple tsunami sections. These videos can be used for educational purposes. Contact VideoLab, 401 Kamakee St., 3rd Floor, Honolulu, HI 96814. Phone 808-593-0400, Fax 808-593-1841. Cost is \$15.00, plus Blue Label shipping, approx. \$15.00.

TSUNAMI AND EARTHQUAKE CURRICULUM***Essential Academic Learning Requirements and Components***

Upon completion of the following curriculum the following Essential Academic Learning Requirements and Components (EALRS) will have been covered.

Reading

1. The student understands and uses different skills and strategies to read.
To meet this standard, the student will:
 - 1.1 Use word recognition and word meaning skills to read and comprehend text
 - 1.2 Build vocabulary through reading
2. The student understands the meaning of what is read.
To meet this standard, the student will:
 - 2.1 Comprehend important ideas and details
 - 2.2 Expand comprehension by analyzing, interpreting, and synthesizing information and ideas
3. The student reads different materials for a variety of purposes.
To meet this standard, the student will:
 - 3.1 read to learn new information

Writing

1. The student writes clearly and effectively.
To meet this standard, the student will:
 - 1.1 develop concept and design
2. The student writes in a variety of forms for different audiences and purposes.
To meet this standard, the student will:
 - 2.1 write for different audiences



Communication

1. The student uses listening and observation skills to gain understanding.
To meet this standard, the student will:
 - 1.1 focus attention
 - 1.2 listen and observe to gain and interpret information
 - 1.3 check for understanding by asking questions and paraphrasing
2. The student communicates ideas clearly and effectively
To meet this standard, the student will:
 - 2.2 develop content and ideas
3. The student uses communication strategies and skills to work effectively with others.
To meet this standard, the student will:
 - 3.1 Use language to interact effectively and responsibly with others
 - 3.2 work cooperatively as a member of a group

Mathematics

3. The student uses mathematical reasoning.
To meet this standard, the student will:
 - 3.1 analyze information
4. The student communicates knowledge and understanding in both everyday and mathematical language.
To meet this standard, the student will:
 - 4.1 gather information
 - 4.2 organize and interpret information
 - 4.3 represent and share information
5. The student understands how mathematical ideas connect within mathematics, to other subject areas, and to real-life situations.
To meet this standard, the student will:
 - 5.3 relate mathematical concepts and procedures to real-life situations

Science

2. The student knows and applies the skills and processes of science and technology.
To meet this standard, the student will:
 - 2.2 apply science knowledge and skills to solve problems or meet challenges

Social Studies: Geography

1. The student uses maps, charts, and other geographic tools to understand the spatial arrangement of people, places, resources, and environments on Earth's surface.

To meet this standard, the student will:

- 1.1 use and construct maps, charts, and other resources

3. The student observes and analyzes the interaction between people, the environment and culture.

To meet this standard, the student will:

- 3.2 analyze how the environment and environmental changes affect people

Arts

1. The student acquires the knowledge and skills necessary to create, to perform, and to respond effectively to the arts.

To meet this standard, the student will:

- 1.2 organize arts elements into artistic compositions

4. The student understands how the arts connect to other subject areas, life, and work.

To meet this standard, the student will:

- 4.1 use arts skills and knowledge in other subject areas



UNIT 1***Defining an Earthquake***

An earthquake is a natural phenomenon like rain. Earthquakes have occurred for billions of years. Descriptions as old as recorded history show the significant effects they have had on people's lives. Long before there were scientific theories for the cause of earthquakes, people around the world created folklore to explain them. In simple terms, earthquakes are caused by the constant motion of Earth's surface. This motion creates buildup and release of energy stored in rocks at and near the Earth's surface. Earthquakes are the sudden, rapid shaking of the Earth as this energy is released.

Grades K-2**Unit Content Concepts:**

1. An earthquake is a sudden, rapid shaking of the Earth caused by the release of energy stored in rocks.
2. Legends are traditional narrative explanations of natural phenomena that evolve when scientific explanations are not available.

Objectives:

Students will:

- Describe any personal experiences with earthquakes.
- Define the term *legend*, and listen to the legend.
- Write and illustrate original legends.
- Observe effects of a simulated earthquake.
- Suggest possible causes of earthquakes.
- Draw pictures to illustrate their ideas about the Earth's interior.

Vocabulary:

tremble vibrate earthquake legends

Grades K-2**Activity 1****Earthquake Legends****Materials:**

- The Turtle Tale (Illustration P)
- Earthquake Legends (Illustrations D1-D20)

Procedure:

1. Start by reading *The Turtle Tale* aloud to the group.
2. Students are asked to form groups of 3 or 4 and select a legend from a number of earthquake legends provided. The group will be given a few minutes to work up a skit depicting their legend. Each group is asked to perform their skit while the remainder of the students guess which story they are telling.

3. Discuss the story:

Did you enjoy the story? Why or why not?

Do you think the story is true? Why or why not?

(Students will give a variety of reasons why the story is not true: Turtles are not that big. Turtles are not that strong. Turtles can't talk.)

Why do you think the Native Americans developed this story?

(When an earthquake or any other frightening event occurs, people want to understand what causes it. Understanding helps them to be less afraid.)

Have you ever asked an older person to explain something that frightened you, and felt better afterwards?

4. Distribute the turtle dot-to-dot exercise and allow time for the students to complete it. (Illustration C)

Discussion:

All cultures develop frameworks to explain their natural surroundings. For many, it is in the form of an oral tradition of story telling and legends. Earthquake tales are included in nearly all cultures, even those that are seismically quiet.

Grades K-2 and Grades 3-4**Activity 2:****Draw and Write****Materials:**

- Earthquake Legends (Illustration D)
- The Turtle Tale (Illustration B)
- Drawing paper, crayons, colored markers, etc.
- Scissors
- Writing paper and pencil

Procedure:

1. Review the turtle legend with the students to recall how some people have explained earthquakes.
2. Invite the students to share what they think causes earthquakes, or rapid vibrations of the Earth. Ask: What could possibly be going on with the Earth that would cause it to shake or vibrate?
3. Ask students to create their own legends to explain earthquakes. If turtles don't make the Earth shake, what does? Have them draw or write their stories.
4. Next, ask each student to draw a large circle representing the Earth and to draw a picture of what there might be inside to make it move.
5. Create a class mural by directing the students to cut out their drawings and paste them to a large piece of paper. The explanations students have written may be displayed by the drawings.
6. Share all the student stories and the legends. Accept all ideas without evaluation. End the lesson without providing any further information as to the actual causes of earthquakes. Direct curious students to the children's encyclopedias, internet, or other classroom or library reference materials.

Grades 3-4

Unit Content Concepts:

1. An earthquake is a sudden, rapid shaking of the Earth caused by the release of energy stored in rocks.
2. Legends are traditional narrative explanations of actual phenomena that evolve when scientific explanations are not available.
3. Earthquake energy is released in the form of waves.

Objectives:

Students will:

- Describe personal experiences with earthquakes.
- Write and illustrate a paragraph about what they think causes earthquakes.
- Read and illustrate earthquake legends.
- Observe the effects of a simulated earthquake.

Vocabulary:

earthquake legend culture

Grades 3-4**Activity 1:****"Tasty Quake"****Materials:**

- Recipe for gelatin dessert (see below).
- One pan of prepared gelatin dessert.
- Clear plastic wrap.
- Sugar cubes or dominoes.
- Spoon for serving the dessert.
- Paper cups and spoons for individual portions.

Procedure:

1. Prepare gelatin dessert in advance and refrigerate. These ingredients will make one pan. Prepare more if you wish to have several small groups performing the demonstration simultaneously. The recipe for the gelatin dessert is as follows:

Two (6-oz.) boxes of red or purple gelatin dessert

Two one-serving envelopes of unflavored gelatin

Four cups boiling water

One 9x12 METAL baking pan

Empty gelatin dessert and the unflavored gelatin into the METAL baking pan. Add the boiling water and stir until all the powder is dissolved, then add the cold water and stir to mix. Chill in refrigerator at least three hours or until set.

2. Write the definition of an earthquake on the board.
3. Explain that under the soil there are rock layers. These layers are under stress because of activity within the Earth.
4. Explain that when these rocks are under extreme stress they react more like a plastic material, such as silicone putty, than like the hard rock we see above the ground.
5. Explain that when rocks break in this sudden way energy is released in the form of waves. We can simulate this release of energy by watching what happens to a pan of gelatin.

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Grades 3-4**Activity 1 continued:**

6. Gently tap the side of the pan of gelatin, while holding the pan firmly with the other hand. Students should be able to see the waves traveling through the gelatin. Compare the gelatin to the ground, the tap of your hand to the rock breaking, and the waves in the gelatin to earthquake waves.
7. Ask the students to predict what will happen when you tap the pan with more force. Tap the pan harder. Is their prediction confirmed? Repeat these two steps several times, and be sure that all the students have a chance to see the waves.
8. Cover the gelatin with plastic wrap so it will be clean enough to eat later. Be sure the wrap touches the gelatin. Ask the students what they think happens to buildings during an earthquake. Then let them distribute sugar cubes or domino pieces over the plastic wrap to represent buildings.
9. Replace any buildings that are knocked over during the first trial. Allow students to construct different kinds of buildings and predict their resistance to the "earthquake," then test their predictions.
10. Remove the plastic wrap and serve the gelatin to the students.

Grades 5-6**Unit Concepts:**

1. Earthquakes result from the buildup and release of energy stored in rocks.
2. Earthquakes occur over much of the world, including the United States.
3. Various societies have produced earthquake legends to explain these natural occurrences.

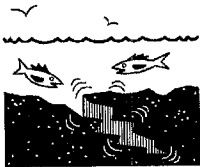
Objectives:

Students will:

- List some events that occur during an earthquake.
- Locate their own state on an outline map of the United States.
- Determine from the study of epicenter maps if their local area and state have experienced earthquakes.
- Read and discuss earthquake legends.
- Locate the place where each legend originated on an outline map of the world

Vocabulary:

earthquake legend epicenter

Activity 1:**Visual Vocabulary****Materials:**

- Movie clip, video clip, slides, filmstrip, or written eyewitness accounts of earthquakes.
- Transparency of earthquake terms.
- Colored pencils.

Procedure:

1. Ask class members who have experienced an earthquake to describe that event to the class.
2. Use one of the media listed above (movie clip, video, etc.) to give the class a common earthquake experience.
3. Brainstorm with the class to create a list of things that happen during an earthquake (rumbling noises, swaying trees, etc.).

Grades 5-6**Activity 2:****Local Legends****Materials:**

- Handouts or transparency view of World Map. (Illustration F)
- Handouts or transparency view U.S. Map with Epicenters. (Illustration I)
- Booklet of earthquake legends. (Illustration D)

Procedure:

1. Using the U.S. Map with Epicenters ask the students the following questions:
 - According to this map, which of the states experience a lot of earthquakes?
 - Which states experience few or no earthquakes?
 - Where is our state on this map?
 - Does our state experience a small, medium or large number of earthquakes?
2. Have students read some of the earthquake legends out loud in class. Locate the origin of each on the world map.
3. Ask students to keep a scrapbook of earthquake reports from newspapers and magazines. The class will periodically locate the epicenters of recent earthquakes on a world map and mark them with pushpins.



UNIT 2

Defining a Tsunami

Tsunamis are a series of ocean waves created by the sudden displacement of water by seismic movement of the ocean floor.

Grades 3-6

Unit Content Concepts:

1. How are tsunamis generated?
2. Do earthquakes occur underwater?

Objectives:

Students will be able to:

1. Generate a tsunami and observe the results on a model shoreline.
2. Relate the analogy of the motion of the lid to the motion of the ocean floor during an earthquake as a means of water displacement and subsequent tsunami generation.
3. Explain that not all underwater earthquakes will generate a tsunami.

Activity 1:

Tsunami in a Box!

Materials:

- Glass or metal baking pan or plastic shoe box
- One liter of water
- Plastic lid of the type used to re-close coffee or margarine containers
- Punching tool or drawing compass
- Scissors
- String
- Sand
- Erasers, toothpicks, popsicle sticks, and other small object to represent shore-line features
- Book or block of wood to serve as a wedge
- Metric ruler

Procedure:

1. Explain to the students:

All tsunamis are generated by a sudden displacement of water. Landslides, submarine slumps, or earthquakes can displace water. It usually requires an earthquake with a magnitude greater than 7 on the Richter scale to generate a significant tsunami. Tsunamis travel from the point of origin at a speed of 300-350 miles an hour. Earthquake (seismic) waves travel 50 times faster than tsunamis, thus seismographs would provide a warning of a potential tsunami within minutes after a large earthquake occurred. This often gives time to prepare for a tsunami after the tsunami warning has been issued.
2. Ask the students:
 - a. Do earthquakes occur underwater? (Yes.)
 - b. How could earthquakes under the ocean ever affect people?
(Accept all reasonable answers.)
 - c. What is a tsunami?
3. Begin the class discussion with what the students have already learned from the tsunami curriculum.
4. Divide the students into groups, distribute materials, and give the following directions:
 - a. Use the wedge to tilt the box or pan at an angle of about 20 degrees.



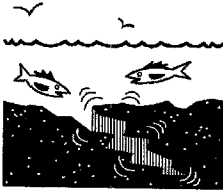
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- b. Pour water into the box or pan to cover the lower end, leaving about a third of the box or pan at the upper end dry.
- c. Pack a layer of sand 2-3cm thick on the dry end of the container to simulate a beach. Use your hands to mold dunes or drifts. Draw roads parallel to the shore. Build docks and other small, lightweight structures to complete the shore environment. Be creative.
- d. Punch the plastic lid on one end near the rim to make a hold, and thread it with a piece of string 20cm long. Tie knots to hold the string in place.
- e. Gently (in order not to make waves) place the plastic onto the bottom at the deep end of the box or pan. Trim to fit if necessary. The string should be next to the low side of the box or pan.
- f. Have one student use several fingers to hold the plastic down tightly on the shallow end, while another student pulls the string up at the deep end with a rapid movement. Tsunami!

Conclusion:

Ask the students:

1. What does the sudden motion of the lid represent? (The sudden motion of the ocean floor.)
2. Using the lid as an analogy, explain that like the lid, a sudden release of energy as the upward motion of the ocean floor literally pushes the water away in the form of waves, thus a tsunami.
3. Remember that not all earthquakes generate tsunamis, only those that significantly displace the ocean floor.

UNIT 3**Recognizing An Earthquake**

Scientists cannot accurately predict when and where an earthquake will occur. We teach students what to expect, however, and how to protect themselves. Earthquakes are relatively brief, but their effects range far and wide. Aftershocks may spread over days or even months. The impact of the quake may be felt hundred of miles from its epicenter.

A severe quake may trigger a chain of events, such as landslides, fires, floods, and pollution, that extend the damage and add to the panic and the casualties.

Even near the epicenter of a disastrous quake, much of the damage that occurs is due to secondary events. An earthquake may trigger landslides, fires, floods, chemical spills, and the release of nuclear wastes and other dangerous wastes. It may cause train wrecks and collisions of other vehicles. Power sources and water supplies may fail.

Earthquakes on the ocean bottom may result in the up- or down-shifting of large blocks of the crust. Such motion can generate a special kind of ocean wave called a tsunami. A series of these waves may travel at speeds up to 800 km/hr in the deep ocean, where they are too small to be seen. But when they reach land, they mount to heights of tens of meters and break against the shore and its buildings. Low coastal areas can be flooded, and much loss of life can result.

Grades K-2 and Grades 3-4

Unit Content Concepts:

1. Earthquakes and earthquake activity are relatively unpredictable.
2. You might feel, see, hear, and smell the signs of an earthquake.
3. Earthquakes affect people in different ways.

Objectives:

Students will:

- Identify events that occur during an earthquake.
- Identify hazards caused by earthquakes.
- Demonstrate safe behavior during an earthquake simulation.

Vocabulary

epicenter emergency landslide tsunami
“Drop, Cover, and Hold”

Activity 1:

Know What Might Happen During an Earthquake

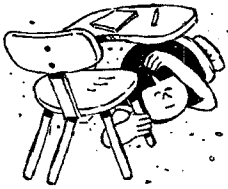
Materials:

- Transparencies
- Handouts of the transparencies
- Video: “Drop, Cover and Hold”
- Overhead projector
- Glue
- Scissors
- Crayons

Procedure:

1. Display transparency “Where Earthquakes Happen.”
2. Have students cut out and paste the sentences to match the appropriate pictures, then color the pictures. (Grades K-2 only.)
3. Tell students that earthquakes can shake, damage, or destroy buildings. Earthquakes can cause emergencies where many people are injured and killed, and their homes and towns destroyed. However, the earth does not split open and swallow people and homes. Point out that we can avoid or reduce our chances of being hurt if we know what to expect and what to do during an earthquake.

Continued next page



4. Ask students to describe what they think they would see, hear, feel, and smell if an earthquake occurred nearby. Use the transparencies of the living room, bedroom, neighborhood, tsunami and landslide to stimulate the discussion.
5. Explain that you are going to talk the students through an imaginary earthquake to help them understand what might happen during a real one. Practice the drop, cover and hold drill. Use the video provided to teach the students the proper way to perform the procedure.

Grades 5-6

Unit Concepts

1. Earthquakes and earthquake activity are relatively unpredictable.
2. Earthquakes on the ocean floor sometimes cause giant seismic sea waves, or tsunamis.

Objectives

Students will:

- Review the events of an earthquake.
- Demonstrate safe behavior during a quake simulation.
- Identify tsunamis as an earthquake event, and demonstrate their mechanism and effects on shorelines.

Vocabulary

tsunami

Grades 5-6

Activity 1

"Quake Events"

Materials:

- Eyewitness accounts of an earthquake, film footage, or similar materials.
- Earthquake simulation script.
- Drop, Cover and Hold transparency. (Illustration L)
- Earthquake "Drop, Cover and Hold" video.
- Handouts of script.

Procedure

1. Tell the students that you are going to simulate an earthquake and practice what they would do if an earthquake occurred while they were in school.

Activity 2

Tsunami

Materials:

- Tsunami transparency.
- Handout "Tsunami Facts."
- The book, "Tsunami, the Great Wave."

Procedure:

1. Assign the reading of "Tsunami, the Great Wave."
2. Assign the reading of "Tsunami Facts."
3. From "Tsunami, the Great Wave" discuss:
 - What causes tsunami?
 - How we save lives
 - What you should do

Activity 3



Japanese Tsunami Folktale

Materials:

Video: "The Wave"

Procedure:

1. View the video or read the story, "The Wave." The story and animated video recounts a Japanese folktale. The elder recognizes the link between large earthquakes and local tsunamis and devises a unique way to warn the people in his community.
2. Questions for discussion:
 - Why did Ojiisan set the rice on fire?
 - How did Ojiisan know that there would be a tsunami?
 - What are some of the symbols within this story?
 - Are there lessons within this story other than what to do in a tsunami?
 - Where should you go to be safe from a tsunami?
 - What does this story tell you about Japan and Japanese culture at the time?
 - In the story a bell was constructed for future use as a tsunami warning. Does your community have a tsunami warning system?
 - Does your community have any sort of emergency warning system?
 - Describe the warning system.

UNIT 4***Tsunami Preparedness:
Move to Higher Ground*****Grades K-6****Life saving knowledge — What you should know**

- If you think a tsunami may be coming, the ground shakes under your feet, or you hear there is a warning, tell your relatives and friends and move quickly to higher ground.
- Tsunamis consist of a series of waves. Often the first wave is not the largest. It is important to remember that a tsunami can last for several hours after the arrival of the first wave. Tsunamis can move faster than a person can run. Remember, the force of the tsunami is enormous
- Tsunamis can occur at any time, day or night. The following are preparedness facts that everyone should know.

If you are at school

- Schools in Washington State have emergency evacuation plans. If you are at school and hear there is a tsunami warning, you should follow the advice of teachers and other school personnel. You will be directed to a place of safety.

If you are at home

- If you are at home and hear there is a tsunami warning, you should make sure your entire family is aware of the warning. Your family should evacuate your house if you live in a tsunami evacuation zone. Move in an orderly, calm and safe manner to the evacuation site or to any safe place outside your evacuation zone. Follow the advice of local emergency law enforcement authorities.

If you are at the beach

- If you are at the beach or near the ocean and you feel the earth shake, move immediately to higher ground. DO NOT wait for a tsunami warning to be announced. Stay away from rivers and streams that lead to the ocean, as you would stay away from the beach and ocean if there were a tsunami.

Continued next page



If you are on a ship or boat

- Since tsunami wave activity is imperceptible in the open ocean, do not return to port if you are at sea and a tsunami warning has been issued for your area.

Plan ahead of time for earthquakes and tsunamis

What you can do ahead of time to protect yourself and family in an earthquake or tsunami?

- Make disaster plans beforehand. Be prepared to be on your own, without outside assistance, for at least three days. Contact your local emergency management office to find out what areas are vulnerable to tsunami hazards, and which routes have been designated as evacuation routes. Discuss the earthquake hazard in your community and have a plan ahead of the quake.
- Create a disaster plan. Meet with your family and discuss why you need to prepare for disaster. Discuss the dangers of an earthquake and/or tsunami. Learn earthquake safe procedures, especially the "Drop, Cover and Hold" procedure. Discuss the approved evacuation route for your area. Establish an out-of-area phone contact, and don't forget to make plans for your pets, they are family too!
- Put your plan into action. Take a first aid class. Prepare your disaster supply kit. Have a kit available in your car, at home and at work. Your kit should include a portable radio with extra batteries, water (1 gallon per person per day), first aid supplies, flashlight, with extra batteries, non-perishable food, your prescription medications, copies of your insurance papers, a small amount of cash, extra clothing, heavy duty gloves, heavy shoes, sanitation supplies, and tools, such as a non-electric can opener and utensils.
- Practice and maintain your plan. Review your plan every six months. Conduct drills with your family on a regular basis. Replace water and food in your disaster kit every six-months.

Continued next page

BE PREPARED**Three Day Supply Kit**

Assemble a 3-day minimum supply for your home. Modify this list for for your car and office.

Medical and special needs equipment

- First aid handbook
- First aid kit: gauze, bandages, aspirin, tape, scissors, disinfectants, antiseptics, and non-prescription medications
- Medications for at least 7 days.
- Personal hygiene supplies
- Plastic zip-close bags, chlorine

Household inventory and important documents

- Copies of important documents
- Household inventory, pictures of contents
- List of credit cards and account numbers
- Banking information
- Wills, durable power of attorney, legal documents
- Copy of driver's licenses
- Photos of household members
- School emergency information

Food and water

- Non-perishable food for 3 days
- Special dietary needs
- 1 gallon of water per person per day
- Manual can opener
- Cooking utensils

Safety equipment

- Fire extinguisher
- Smoke detectors and fire alarm
- Whistle
- Tools

Special equipment

- Dust masks and eye protection
- Masking tape to seal areas
- Plastic wrap to protect equipment
- Battery-operated radio
- Extra batteries
- Flashlights
- Cleaning supplies
- Small amount of cash
- Quiet games and activities for children

Miscellaneous

- Tent and waterproof tarp
- Extra blankets
- Warm clothing
- Sturdy shoes
- Work gloves
- Infant specialty items
- Items for the elderly
- Pet items – medicines, food and water

Life saving facts

- Protect yourself during the earthquake. “Drop, Cover and Hold” until the earth stops shaking. Remember, an earthquake is a natural tsunami warning.
- Move to higher ground immediately. Leave everything behind you. A tsunami may be coming in minutes. Go on foot if at all possible. If there is no high ground, move inland away from the coastline.
- If you feel the ground shake, DO NOT wait for an official warning. Move to higher ground immediately.
- Listen to your radio for information from the emergency authorities. Use a NOAA Weather Radio with a tone-alert feature to keep you informed of local watches and warnings. The tone alert feature will warn you of potential danger even if you are not currently listening to local radio or television stations.
- Stay away from the coast. Remember, there may be more than one wave. The later wave may be higher than the first! Damaging waves may continue to arrive even hours later.
- Listen to your radio. Wait for an official “all clear” signal before returning to low-lying areas.
- Never go to the coast to watch for a tsunami if you hear that a warning has been issued. Tsunamis move quicker than a person can run.
- Talk to your insurance agent. Homeowner policies do not cover flooding from a tsunami. Ask about the National Flood Insurance Program.
- Remember that tsunamis are very rare. Washington coast are certainly vulnerable but tsunamis are infrequent. It is important to understand the hazard and learn how to protect yourself, but don’t let the threat of tsunamis ruin your enjoyment of the beach.



Evacuation signs, what they mean

- Tsunami evacuation routes were developed to assist coastal residents and visitors find safer locations in case of an earthquake and tsunami. Evacuation signs have been placed along roadways to indicate the direction inland or to higher ground. In some places, there may be more than one direction available to reach safer areas. These routes may be marked with several signs showing additional options for evacuation. You will need to know the evacuation routes for your area.

Continued next page

Community plans

- Every attempt has been made by local Emergency Management offices to locate evacuation routes and public congregation areas that are safe, within a reasonable distance for foot or vehicle traffic, and accessible within a short period of time. These are difficult criteria to meet in some geographic areas, primarily as a result of private property issues. For that reason, residents who may be impacted by tsunami activity, but do not have an “official” route or congregation area within a reasonable distance, are urged to work together to develop an evacuation plan within their neighborhood or community. A plan should address property access issues, evacuation routes, and what might be expected in terms of numbers of people needing to access a locally organized congregation area.

What to do after a tsunami

- Continue listening to a NOAA Weather Radio, Coast Guard emergency frequency station, or other reliable sources for emergency information. The tsunami may have damaged roads, bridges, or other places that may be unsafe.
- Help injured or trapped persons. Give first aid where appropriate. Call for help. Do not move seriously injured persons unless they are in immediate danger of further injury.
- Help a neighbor who may require special assistance – infants, elderly people, and people with disabilities. Elderly people and people with disabilities may require additional assistance. People who care for them or who have large families may need additional assistance in emergency situations.
- Use the telephone only for emergency calls. Telephone lines are frequently overwhelmed in disaster situations. They need to be clear for emergency calls to go through.
- Stay out of buildings if waters remain around them. Tsunami waters, like flood waters, can undermine foundations, causing buildings to sink, floors to crack, or walls to collapse.
- When re-entering buildings or homes, use extreme caution. Tsunami-driven flood waters may have damaged buildings where you least expect it. Carefully watch every step you take.
- Wear sturdy shoes. The most common injury following a disaster is cut feet.

Continued next page

- Use battery-powered lanterns or flashlights when examining buildings. Battery-powered lighting is the safest and easiest, preventing fire hazard for the user, occupants, and building.
- Examine walls, floors, doors, staircases, and windows to make sure that the building is not in danger of collapsing.
- Inspect foundations for cracks or other damage. Cracks and damage to a foundation can render a building uninhabitable.
- Look for fire hazards. There may be broken or leaking gas lines, flooded electrical circuits, or submerged furnaces or electrical appliances. Flammable or explosive materials may come from upstream. Fire is the most frequent hazard flowing floods.
- Check for gas leaks. If you smell gas or hear a blowing or hissing noise, open a window and quickly leave the building. Turn off the gas using the outside main valve if you can, and call the gas company from a neighbor's home. If you turn off the gas for any reason, it must be turned back on by a professional.
- Look for electrical system damage. If you see sparks or broken or frayed wires, or if you smell burning insulation, turn off the electricity at the main fuse box or circuit breaker. If you have to step in water to get to the fuse box or circuit breaker, call an electrician first for advice. Electrical equipment should be checked and dried before being returned to service.
- Check for sewage and water line damage. If you suspect sewage lines are damaged, avoid using the toilets and call a plumber. If water pipes are damaged, contact the water company and avoid using water from the tap. You can obtain safe water from undamaged water heaters or by melting ice cubes.
- Use tap water if local health officials advise it is safe.
- Watch out for animals. Use a stick to poke through debris. Tsunami flood waters flush snakes and animals out of their homes.
- Watch for loose plaster, drywall, and ceilings that could fall.
- Take pictures of the damage, both of the building and its contents, for insurance claims.

Grades 3-6**Unit Concept:**

Students will consider the range of their needs and the state of their personal preparedness for an emergency.

Objectives:

Students will:

- Distinguish between luxuries and necessities.
- Describe their own experience with natural disasters, and how they and their families fared.
- Explain why preparedness can help individuals and families cope effectively in the event of a tsunami or other natural disaster.

Activity 1**Could It Happen Here?****Materials:**

- Chart paper
- Felt markers
- Student copies of the "Three-Day Survival Pack"

Procedure:

- Ask the students to consider which of all the things they use and consume every day are really essential to their survival. Discuss, and develop a class listing on chart paper. (Answers may include variations on water, food, clothing, and shelter.)
- Ask the students how do they meet the needs listed above? (Answers will include faucets, restaurants, grocery stores, the refrigerator, school cafeterias, clothing stores, parents' home.) Now ask them to name some natural occurrences that could cut them off from these sources, and describe their own experiences with natural disasters. Beyond their own experiences, what events of this type have they heard or read about in the last two years? Develop a list of events.

Continued next page

- Elicit a definition of natural hazards from the class. Emphasize that earthquakes, volcanoes, tsunamis, and similar events are the result of natural processes in the life of our dynamic Earth. Be sure students understand the difference between natural events and those caused by human activity.
- Ask: If a natural disaster occurs in an uninhabited region, and has no impact on human beings or human property, is it a disaster? (Not for humans but it may be for farm animals, wildlife, and other life forms.)
- Are we able to control natural events, or accurately predict when they will occur? (No, we cannot accurately predict earthquakes, but we can issue warnings for tsunamis.)
- Ask students how they and their families coped with any destructive events they have experienced. Were their homes equipped with everything they needed? Did they have to leave their homes? Were the roads open? Were the stores open? Who provided help? (If personal experiences are lacking, discuss recent news accounts of earthquakes, tsunamis, etc.)
- Look at the list of vital necessities and widen the discussion to include the needs of communities as well as individuals. Ask: If a tsunami occurred in or near your community, what necessities would have to be added to the first list? (Answers may include medical care, electrical power and other utilities, and essential transportation – for hospital workers, police, firefighters, and people who supply food, water, and other necessities.)
- Emphasize that a major tsunami would disrupt all or most of the communities lifelines – its supplies of water and power and its transportation and communications systems. Emergency services, such as police, fire departments, and emergency medical technicians, would be severely taxed and unable to answer all calls for assistance. For this reason, individuals, families, and neighborhoods must be prepared to be self-sufficient for at least three days.

Conclusion:

- Distribute copies of the “Three-Day Survival Pack.” Explain that the Federal Emergency Management Agency (FEMA) recommends that every family assemble a pack and keep it handy in their home for emergencies, checking it periodically to keep it up to date (batteries may need replacing, family needs may change). Compare this list with the lists students have developed.
- Ask the students to encourage their families to prepare a Three-Day Survival Pack. Remember the goal is to be prepared to be on your own for at least three days.

Tsunami Curriculum Illustrations

The following pages contain illustrations that may be used to enhance learning about tsunamis, earthquakes, and how to be prepared for these events.

These illustrations may be duplicated on copy machines for classroom distribution or displayed on overhead projectors for class discussions.

Illustration A

Tsunami!

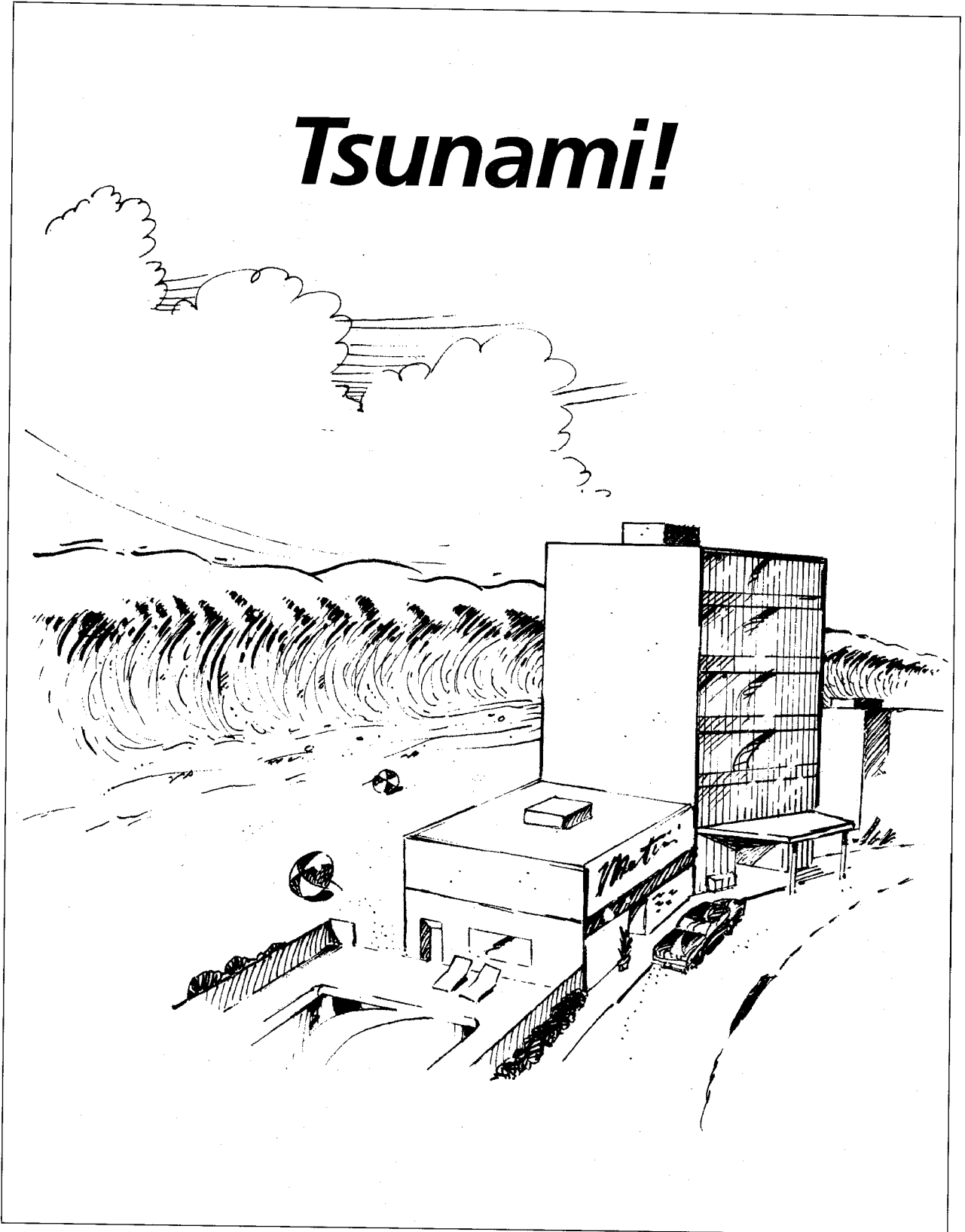


Illustration B

The Turtle Tale

Long, long ago, before there were people, there was hardly anything in the world but water. One day, Great Spirit looked down from heaven. He decided to make a beautiful land. But where could he begin? All he saw was water. Then he spotted a giant turtle. Great Spirit decided to make the beautiful land on the turtle's back.

But one turtle was not big enough. The land Great Spirit wanted to make was very large. So he called out, "Turtle, hurry and find your six brothers."

Turtle swam to find them. It took her a whole day to find the first. It took another day to find the next. After six days, turtle had found her six brothers. "Come," she said, "Great Spirit wants us."

Great Spirit called down. "Turtles! Form a line, all of you – head to tail, north to south. Umm – you three on the south, please move a little to the east. Hmmm. Yes, that's just right. What a beautiful land you turtles will make! Now listen! It is a great honor to carry this beautiful land on your backs. So you must not move!"

The turtles stayed very still. Great Spirit took some straw from his supply in the sky. He spread it out on the turtles' backs. Then he took some soil and patted it down on top of the straw.

Great Spirit cleaned his hands on a fluffy white cloud. Then he went to work, shaping mountains and valleys and lakes and rivers. When he was finished he looked at the beautiful land he had made. Great Spirit was very pleased. But soon trouble came. The giant turtles grew restless. They wanted to stretch their legs.

"I want to swim east," said one. "This beast goes east."

"West is best. I'll swim toward the setting sun," said another.

The turtles began to argue. They could not agree which way to move. One day, four of the turtles began to swim east. The others began to swim west. The Earth shook! It cracked with a loud noise. But after a minute, the shaking stopped. The turtles had to stop moving because the land on their backs was so heavy. They had only been able to swim a little way from each other. When they saw that they could not swim away, they stopped arguing and made up.

Every once in a while, though, the turtles argue again. Each time they do, the Earth shakes.

HELP: Hands-on Earthquake Learning Package, 1983. California Edition. Environmental Volunteers, Inc.

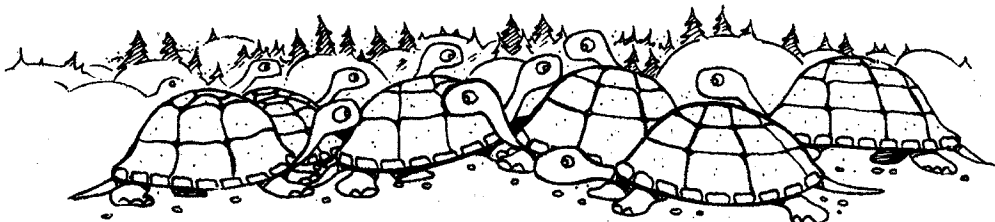


Illustration C

Turtle Dot-to-Dot

Your Name: _____

I heard a legend from the San Gabrielino Indians.

The Indians thought that big turtles carried the land on their backs. They thought that an earthquake happened when the turtles moved in different directions.

1. Connect the dots in this illustration.
2. Color the turtle carrying land on its back.

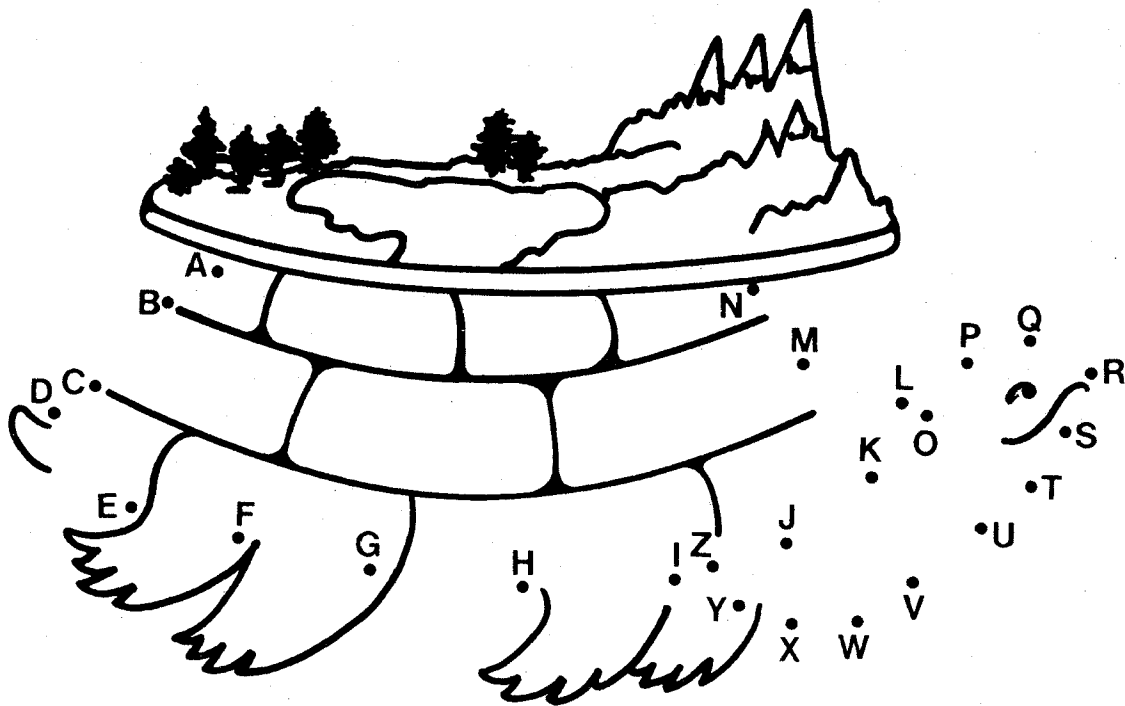


Illustration D

Earthquake Legends



Earthquake Legends from Around the World

Illustration D-1

1. India

The Earth is held up by four elephants that stand on the back of a turtle. The turtle is balanced in turn on a cobra. When any of these animals move, the Earth will tremble and shake.

Illustration D-2

2. Assam

(Located between Bangladesh and China)

There is a race of people living inside the Earth. From time to time they shake the ground to find out if anyone is still living on the surface. When children feel a quake, they shout “Alive, alive!” so the people inside the earth will know they are there and stop the shaking.

Earthquake Legends from Around the World

Illustration D-3

3. Mexico

El Diablo, the devil, makes giant rips in the Earth from the inside. He and his devilish friends use the cracks when they want to come and stir up trouble on Earth.

Illustration D-4

4. Siberia

The Earth rests on a sled driven by a god name Tuli. The dogs that pull the sled have fleas. When they stop to scratch, the Earth shakes.

Earthquake Legends from Around the World

Illustration D-5

5. Japan

A great catfish, or namazu, lies curled up under the sea with the islands of Japan resting on his back. A demigod, or daimyojin, holds a heavy stone over his head to keep him from moving. Once in a while, though, when the daimyojin is distracted, the namazu moves and the Earth trembles.

Illustration D-6

6. Mozambique

The Earth is a living creature, and it has the same kinds of problems people have. Sometimes it gets sick, with fever and chills, and we can feel its shaking.

Earthquake Legends from Around the World

Illustration D-7

7. Greece

According to Aristotle (and also to Shakespeare, in the play called *Henry IV, Part I*), strong, wild winds are trapped and held in caverns under the ground. They struggle to escape, and earthquakes are the result of their struggle.

Illustration D-8

8. Belgium

When people on Earth are very, very sinful, God sends an angry angel to strike the air that surrounds our planet. The blows produce a musical tone which is felt on the Earth as a series of shocks.

Earthquake Legends from Around the World

Illustration D-9

9. Tennessee, USA

Once a Chickasaw chief was in love with a Choctaw princess. He was young and handsome, but he had a twisted foot, so his people called him Reelfoot. When the princess' father refused to give Reelfoot his daughter's hand, the chief and his friends kidnapped her and began to celebrate their marriage.

The Great Spirit was angry, and stomped his foot. The shock caused the Mississippi to overflow its banks and drown the entire wedding party. (Reelfoot Lake, on the Tennessee side of the Mississippi, was actually formed as a result of the New Madrid earthquake of 1812).

Earthquake Legends from Around the World

Illustration D-10

10. West Africa

The Earth is a flat disk, held up on one side by an enormous mountain and on the other by a giant. The giant's wife holds up the sky. The Earth trembles whenever he stops to hug her.

Illustration D-11

11. Mongolia

The gods who made the Earth gave it to a frog to carry on his back. When this huge frog struts, the Earth moves directly above the part of him that moves: hind foot, head, shoulder, or whatever.

Earthquake Legends from Around the World

Illustration D-12

12. India

Seven serpents share the task of guarding the seven sections of the lowest heaven. The seven of them also take turns holding up the Earth. When one finishes its turn and another moves into place, people on Earth may feel a jolt.

Illustration D-13

13. Latvia

A god named Drebkuhls carries the Earth in his arms as we walks through the heavens. When he's having a bad day, he might handle his burden a little roughly. Then the Earth will feel the shaking.

Earthquake Legends from Around the World

Illustration D-14

14. Colombia

When the Earth was first made it rested firmly on three large beams of wood. But one day the god Chibchacum decided that it would be fun to see the plain of Bogota under water. He flooded the land, and for his punishment he is forced to carry the world on his shoulders. Sometimes he's angry and stomps, shaking the Earth.

Illustration D-15

15. Scandinavia

The god Loki is being punished for the murder of his brother, Baldur. He is tied to a rock in an underground cave. Above his face is a serpent dripping poison, which Loki's sister catches in a bowl. From time to time she has to go away to empty the bowl. Then the poison falls on Loki's face. He twists and wiggles to avoid it, and the ground shakes up above him.

Earthquake Legends from Around the World

Illustration D-16

16. New Zealand

Mother Earth has a child within her womb, the young god Ru. When he stretches and kicks as babies do, he causes earthquakes.

Illustration D-17

17. East Africa

A giant fish carries a stone on his back. A cow stands on the stone, balancing the Earth on one of her horns. From time to time her neck begins to ache, and she tosses the globe from one horn to the other.

Earthquake Legends from Around the World

Illustration D-18

18. Central America

The square Earth is held up at its four corners by four gods, the Vashakmen. When they decide the Earth is becoming overpopulated, they tip it to get rid of surplus people.

Illustration D-19

19. Romania

The world rests on the divine pillars of Faith, Hope, and Charity. When the deeds of human beings make one of the pillars weak, the Earth is shaken.

Earthquake Legends from Around the World

Illustration D-20

20. West Africa

A giant carries the Earth on his head. All the plants that grow on the Earth are his hair, and people and animals are the insects that crawl through his hair. He usually sits and faces the east, but once in a while he turns to the west (the direction earthquakes come from in West Africa), and then back to the east, with a jolt that is felt as an earthquake.

Illustration F

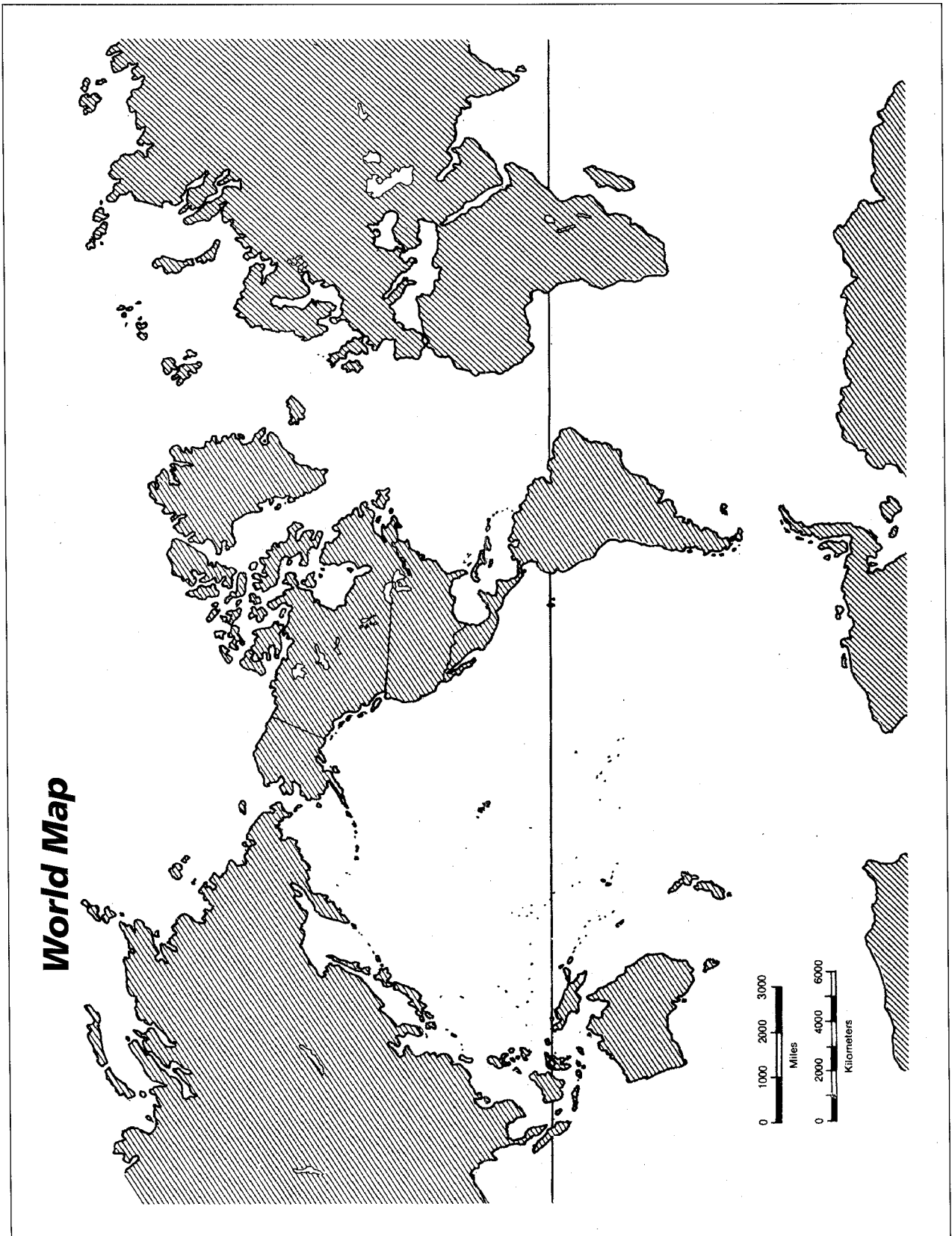


Illustration G

World Map with Epicenters

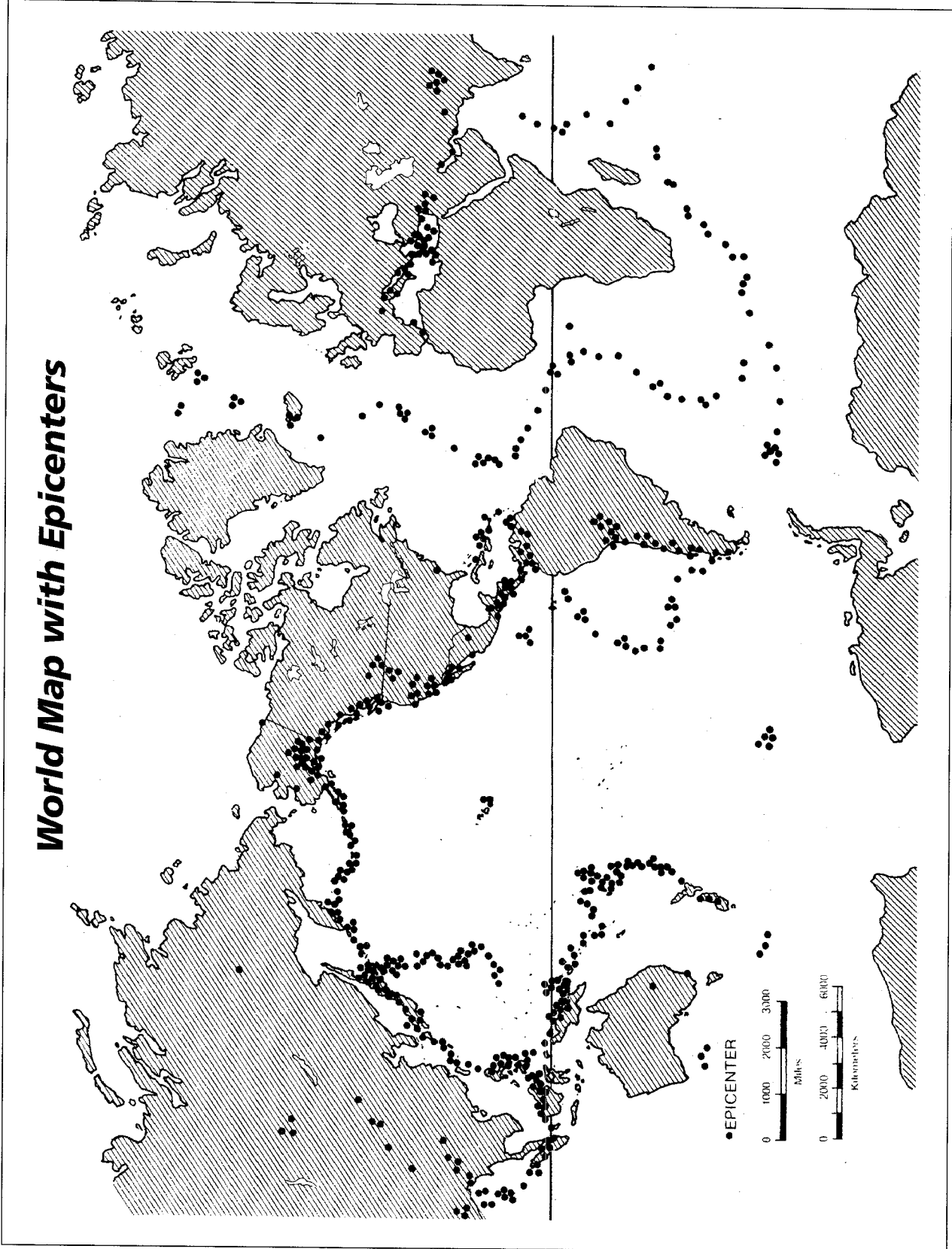


Illustration H

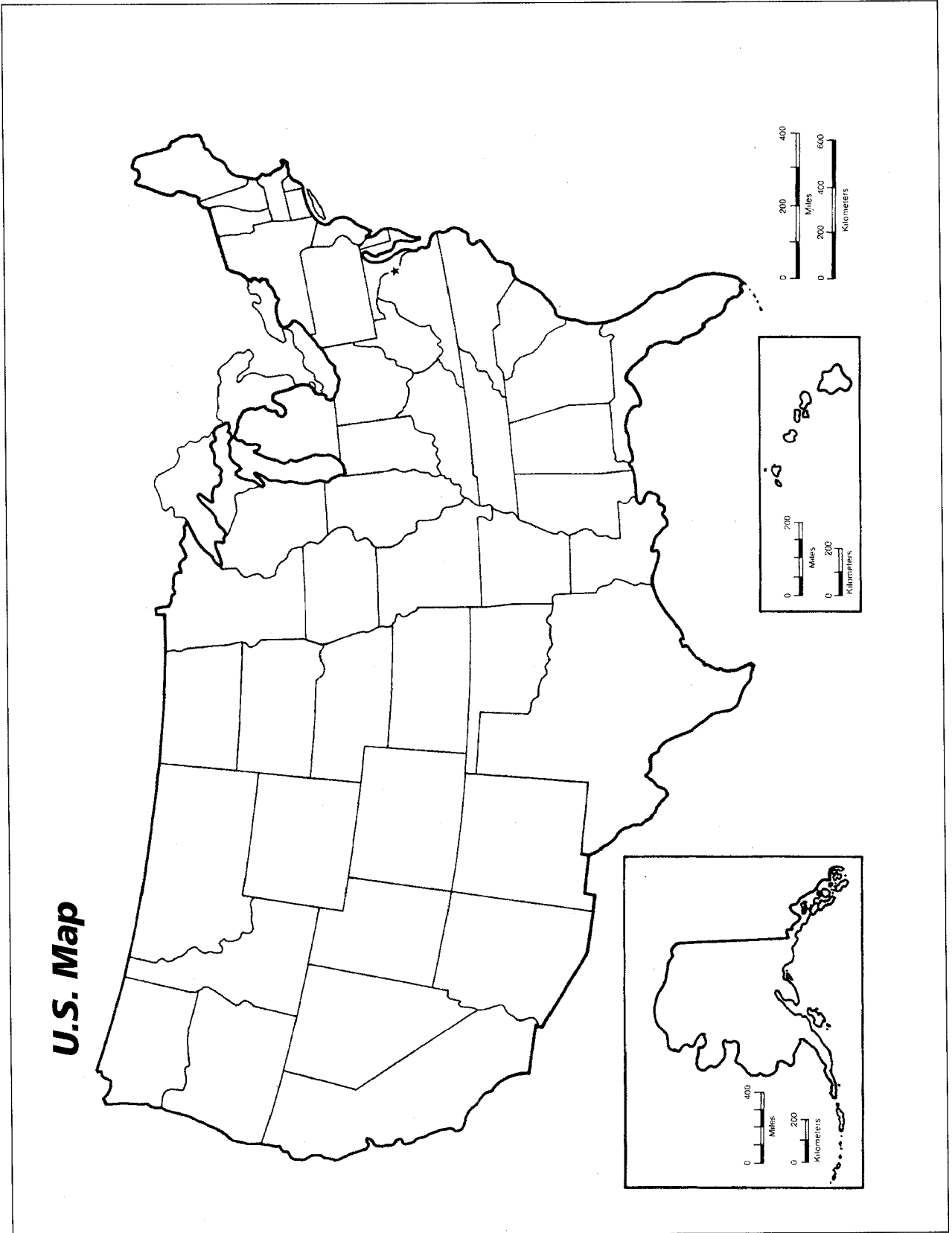
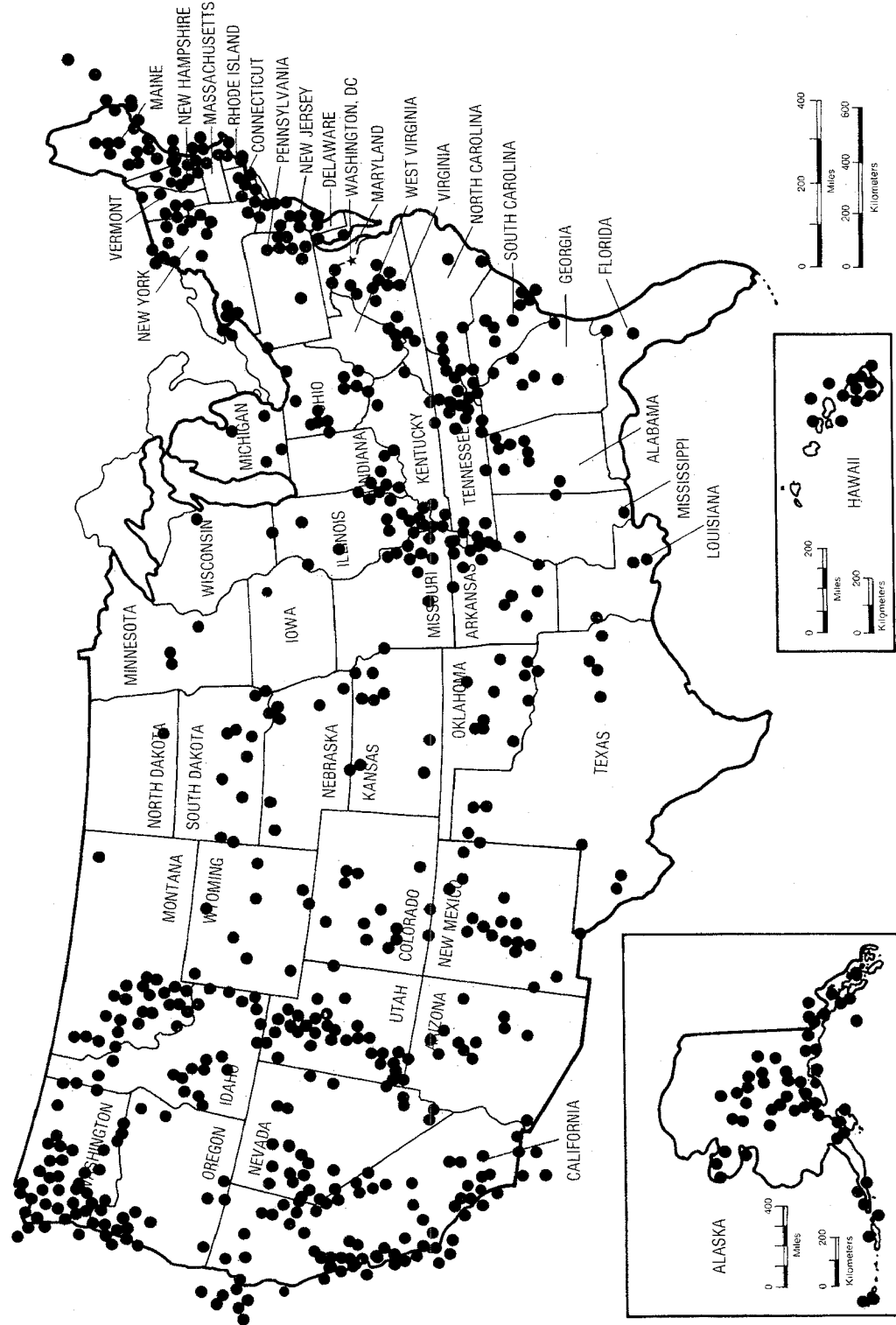


Illustration J

U.S. Map with Epicenters



• Epicenter (Modified Mercalli V and above)

Illustration L

Feelings About Earthquakes

Some of the letters below contain stars. Color the letters with the stars to see some ways people might feel after an earthquake.



Your Name: _____



Illustration E

World Map with Legend Sites

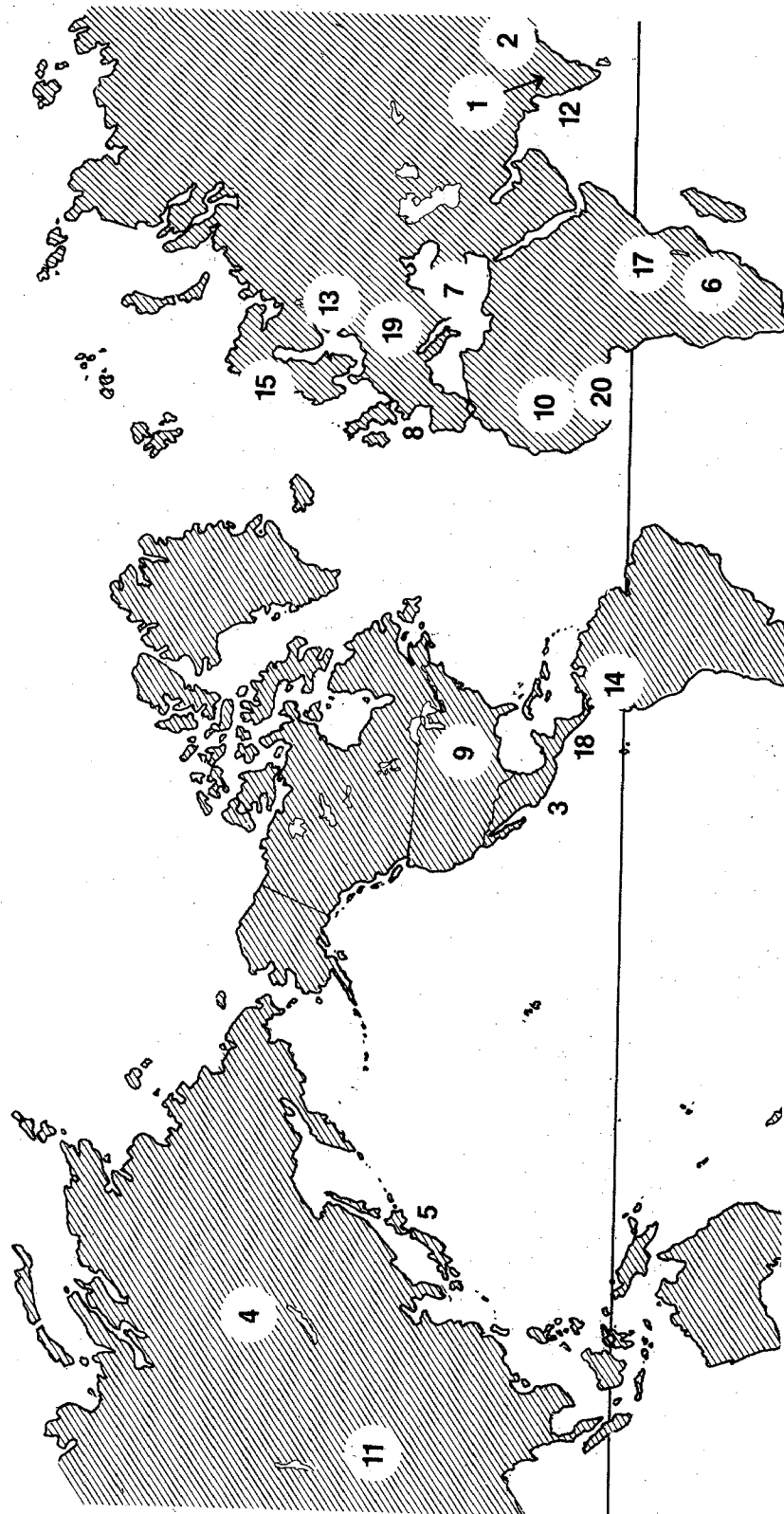


Illustration I

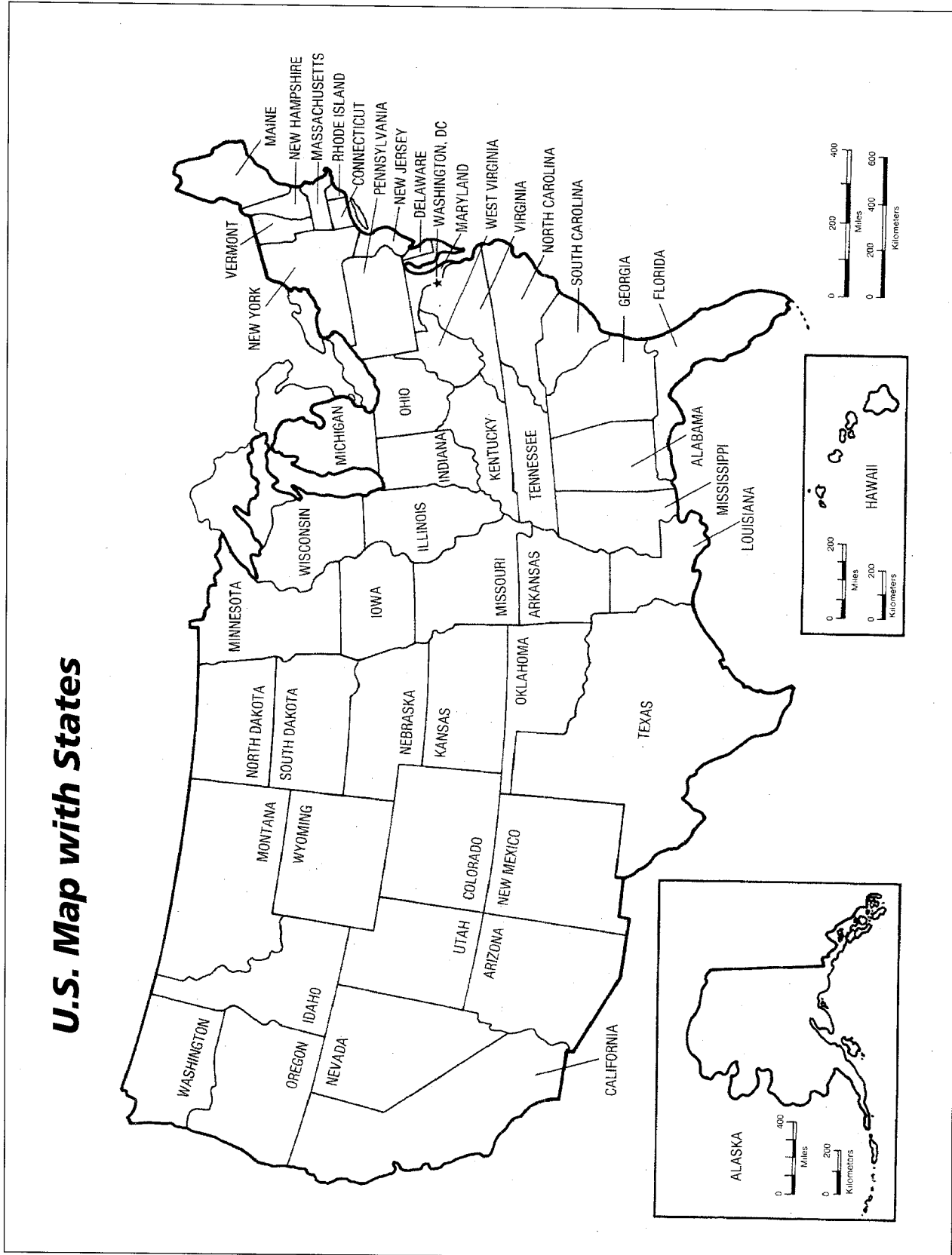


Illustration K

Earthquake Risk Map in U.S.

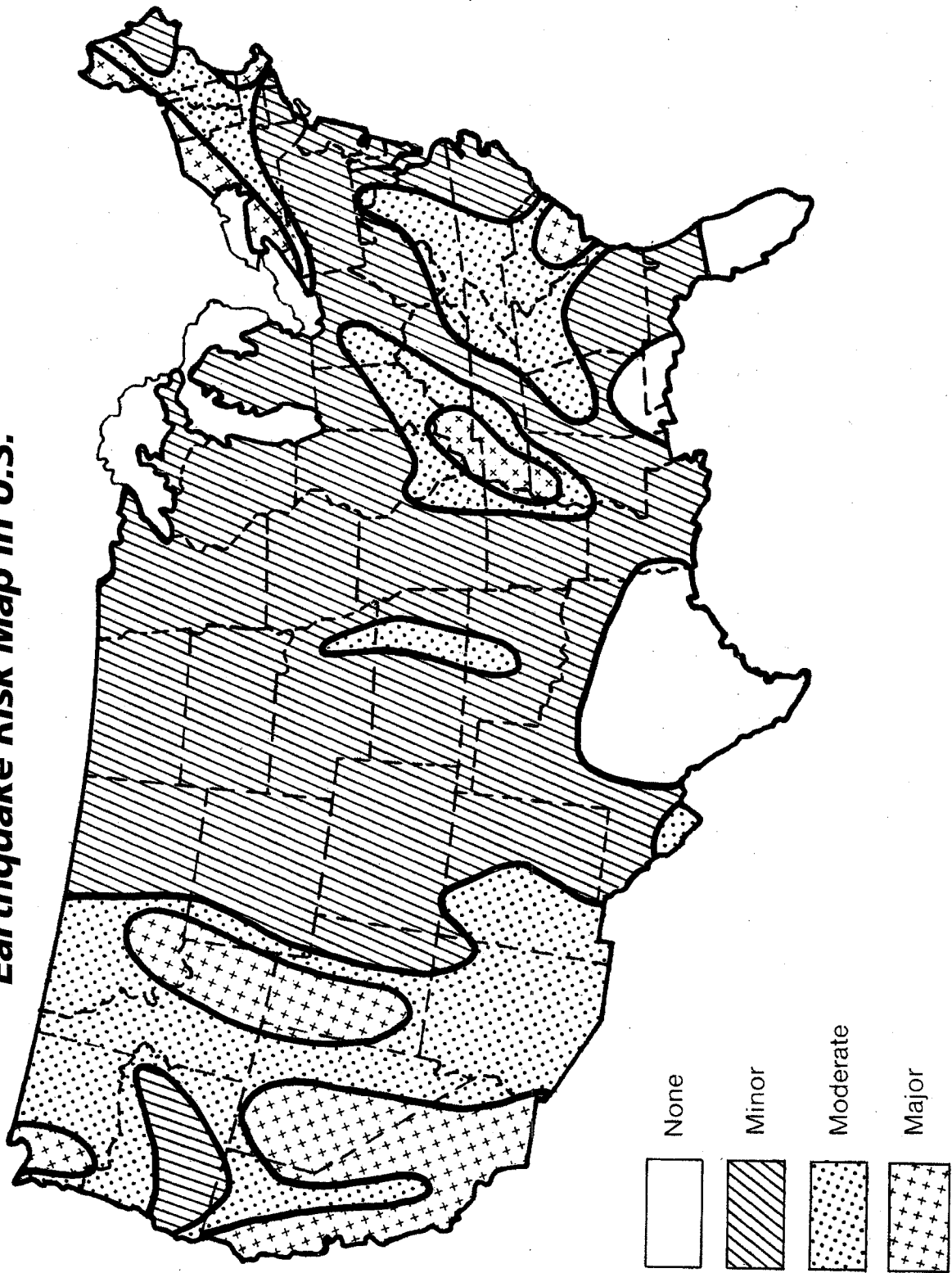


Illustration M

Drop, Cover and Hold

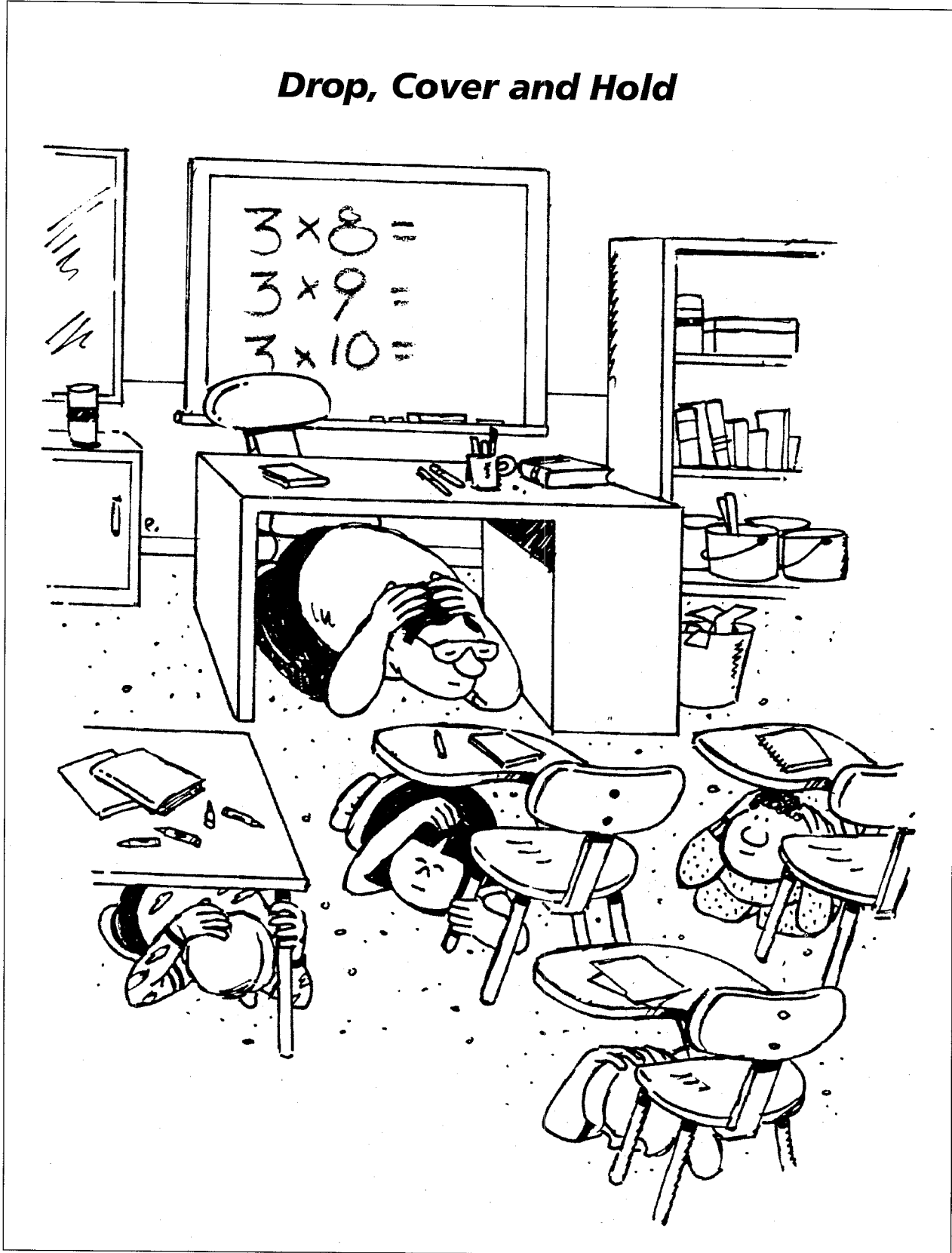
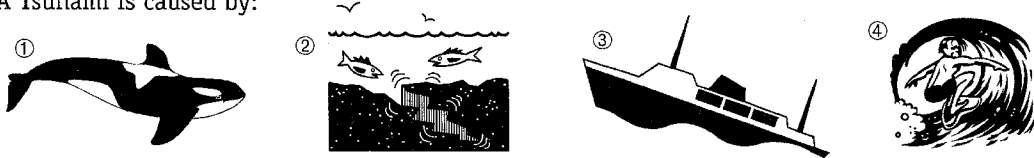


Illustration N

TSUNAMI TRIVIA

(soo-nam-ee)

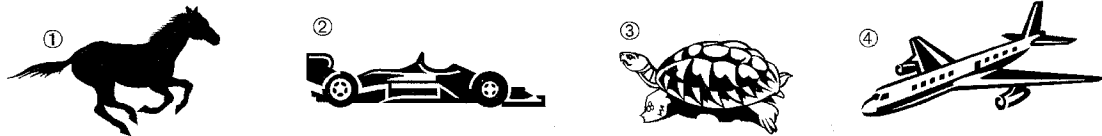
Circle the correct answer(s):
A Tsunami is caused by:



Circle the official tsunami warning sign.



Circle the picture which travels about the same speed as a tsunami.



Circle the states that can experience a tsunami.



Test your detective skills.

Circle the words listed below in the word search puzzle.

- Beach
- Earthquake
- Fast
- Geology
- Giant wave
- Ocean
- Run uphill
- Safe area
- Sand
- Tsunami
- Warning
- Water

H	A	V	E	E	F	G	R
T	S	U	N	A	M	I	U
W	A	T	E	R	U	A	N
A	G	N	A	T	T	N	U
R	E	T	S	H	H	T	P
N	O	E	A	Q	S	W	H
I	L	B	F	U	A	A	I
N	O	N	E	A	N	V	L
G	G	E	A	K	D	E	L
A	Y	C	R	E	H	T	O
D	A	<u>B</u>	<u>E</u>	<u>A</u>	<u>C</u>	<u>H</u>	Y
B	Y	F	A	S	T	O	E

List the 25 unused letters to decode the message

Illustration O

Selections from
THE WAVE

By Pearl S. Buck

KINO lived on a farm. The farm lay on the side of a mountain in Japan. The fields were terraced by walls of stone, each one of them like a broad step up the mountain. Centuries ago Kino's ancestors had built the stone walls that held up the fields.

Above all the fields stood the farmhouse that was Kino's home. Sometimes he felt the climb was a hard one, especially when he had been working in the lowest field and he wanted his supper. But after he had eaten at night and in the morning, he was glad that he lived so high up because he could look down on the broad blue ocean at the foot of the mountain.

The mountain rose so steeply out of the ocean that there was only a strip of sandy shore at its foot. Upon this strip was the small fishing village where Kino's father sold his vegetables and rice and bought his fish. From the window of his room Kino looked down upon the few thatched roofs of the village, running in to uneven lines on both sides of a cobbled street. These houses faced one another, and those that stood beside the sea did not have windows toward it. Since he enjoyed looking at the waves, Kino often wondered why the village people did not, but he never knew until he came to know Jiya, whose father was a fisherman.

Jiya lived in the last house in the row of houses toward the ocean, and his house did not have a window toward the sea either.


"Why not?" Kino asked him. "The sea is beautiful."

"The sea is our enemy" Jiya replied.


"How can you say that?" Kino asked. "Your father catches fish from the sea and sells them and that is how you live."

Jiya only shook his head. "The sea is our enemy," he repeated. "We all know it."

It was very hard to believe this. On hot sunny days, when he had finished his work, Kino ran down the path that wound through the terraces and met Jiya on the breach.



They threw off their clothes and jumped into the clear sea water and swam far out toward a small island which they considered their own. Actually it belonged to an old gentleman whom they had never seen, except at a distance. Sometimes in the evening he came through the castle gate and stood looking out to sea. Then they could see him, leaning on his staff, his white beard blowing in the wind. He lived inside his castle behind a high fence of woven bamboo, on a knoll outside the village. Neither Kino or Jiya had ever been inside the gate, but sometimes when it was left open they had peeped into the garden. It was beautiful beyond anything they could imagine. Instead of grass the ground was covered with deep green moss shaded by pine trees and bamboo, and every day gardeners swept the moss with bamboo brooms until it was like a velvet carpet. They saw Old Gentleman walking under distant trees in a silver-gray robe, his hands clasped behind his back, his white head bent. He had a kind, wrinkled face, but he never saw them.



“We must learn to live with danger,” said Kino’s father.

“Do you mean the ocean and the volcano cannot hurt us if we are not afraid?” Kino asked.

“No,” he father replied. “I did not say that. Ocean is there and volcano is there. It is true that on any day ocean may rise into storm and volcano may burst into flame. We must accept this fact, but without fear. We must say, “Someday we shall die, and does it matter whether it is by ocean or volcano, or whether I grow old and weak?”

“I don’t want to think about such things,” Kino said.

“It is right for you not to think about them,” his father said. “Then do not be afraid. When you are afraid, you are thinking about them all the time. Enjoy life and do not fear death — that is the way of a good Japanese.”

There was much in life to enjoy. Kino had a good time every day. In the winter he went to a school in the fishing village, and he and Jiya shared a seat. They studied reading and arithmetic and all the things that other children learn in school. But in the summer Kino had to work hard on the farm, for his father needed help. Even Setsu and the mother helped when the rice seedlings had to be planted in the flooded fields on the terraces, and they helped, too, when the grain was ripe and had to be cut into sheaves and threshed. On those days Kino could not run down the mountainside to find Jiya. When the day was over he was so tired he fell asleep over his supper.

But there were days when Jiya also was too busy to play. Word came in from the fishermen up the coast that a school of fish was passing through the channels and then

every fishing boat made haste to sail out of the bays and inlets into the main currents of the sea. Early in the morning, sometimes so early that the light was still that of the setting moon, Jiya and his father sailed their boat out across the silvery sea to let down their nets at dawn. If they were lucky the nets came up so heavy with fish that it took all their strength to haul them up, and soon the bottom the boat was flashing and sparkling with the wriggling fish.

Sometimes, if it were not seedtime or harvest, Kino went with Jiya and his father. It was an exciting thing to get up in the night and dress himself in his warm padded jacket tied round his waist. Even in summer the wind was cool over the sea at dawn. However early he got up, his mother always got up, too, and gave him a bowl of hot rice soup and some bean curd and hot tea before he started. Then she packed his lunch in a clean little wooden box, cold rice and fish and a bit of radish pickle.

Down the stone steps of the mountain path Kino ran straight to the narrow dock where the fishing boats bobbed up and down on the tide. Jiya and his father were already there, and in a few minutes the boat was nosing its way between the rocks out to the open sea. Sails set and filling with the wind, they sped straight into the dawn-lit sky. Kino couched down on the floor behind the bow and felt his heart rise with joy and excitement. The shore fell far behind them and the boat took on the deep swell of the ocean. Soon they came to a whole fleet of fishing boats, and then together they flew after the schools of fish. It was like being a bird in a flock, flying into the sky. How exciting it was, too, to pull up the fish! At such times Kino felt Jiya was more lucky than he. Fish harvest was much easier than rice harvest.

"I wish my father were a fisherman," he would tell Jiya. "It is stupid to plow and plant and cut the sheaf, when I could just come out like this and reap fish from the sea."

Jiya shook his head. "But when the storms come, you wish yourself back upon the earth," he said. Then he laughed. "How would fish taste without rice? Think of eating only fish!"

"We need both farmers and fisherman," Jiya's father said.

On days when the sky was bright and the winds mild the ocean lay so calm and blue that it was hard to believe that it could be cruel and angry. Yet even Kino never quite forgot that under the warm blue surface the water was cold and green. When the sun shown the deep water was still. But when the deep water moved and heaved and stirred, ah, then Kino was glad that his father was a farmer and not a fisherman.

And yet, one day, it was the earth that brought the big wave. Deep under the deepest part of the ocean, miles under the still green waters, fires raged in the heart of the earth. They icy cold of the water could not chill those fires. Rocks were melted and boiled under the crust of the ocean's bed, under the weight of the water, but they could not break through. At last the steam grew so strong that it forced its way through to the



mouth of the volcano. That day, as he helped his father plant turnips, Kino saw the sky overcast halfway to the zenith.

"Look, Father!" he cried. "The volcano is burning again!"

His father stopped and gazed anxiously at the sky. "It looks very angry," he said. "I shall not sleep tonight."

All night while the others slept, Kino's father kept watch. When it was dark, the sky was lit and red and the earth trembled under the farmhouses. Down at the fishing village lights in the little houses showed that other fathers watched, too. For generations fathers had watched earth and sea.

Morning came, a strange fiery dawn. The sky was red and gray, and even here upon the farms cinders and ash fell from the volcano. Kino had a strange feeling when he stepped barefoot upon the earth, that it was hot under his feet. In the house the mother had taken down everything from the walls that could fall or be broken, and her few good dishes she had packed into straw in a basket and set outside.

"Shall we have an earthquake, Father?" Kino asked as they ate breakfast.

"I cannot tell, my son," his father replied. "Earth and sea are struggling together against the fires inside the earth."

No fishing boats set sail that hot summer morning. There was no wind. The sea lay dead and calm, as though oil had been poured upon the waters. It was a purple gray, suave and beautiful but when Kino looked at it he felt afraid.

"Why is the sea such a color?" he asked.

"Sea mirrors sky," his father replied. "Sea and earth and sky – if they work together against man, it will be dangerous indeed for us."

"Where are the gods at such a time?" Kino asked, "Will they not be mindful of us?"

"There are times when the gods leave man to take care of himself," his father replied. "They test us, to see how able we are to save ourselves."

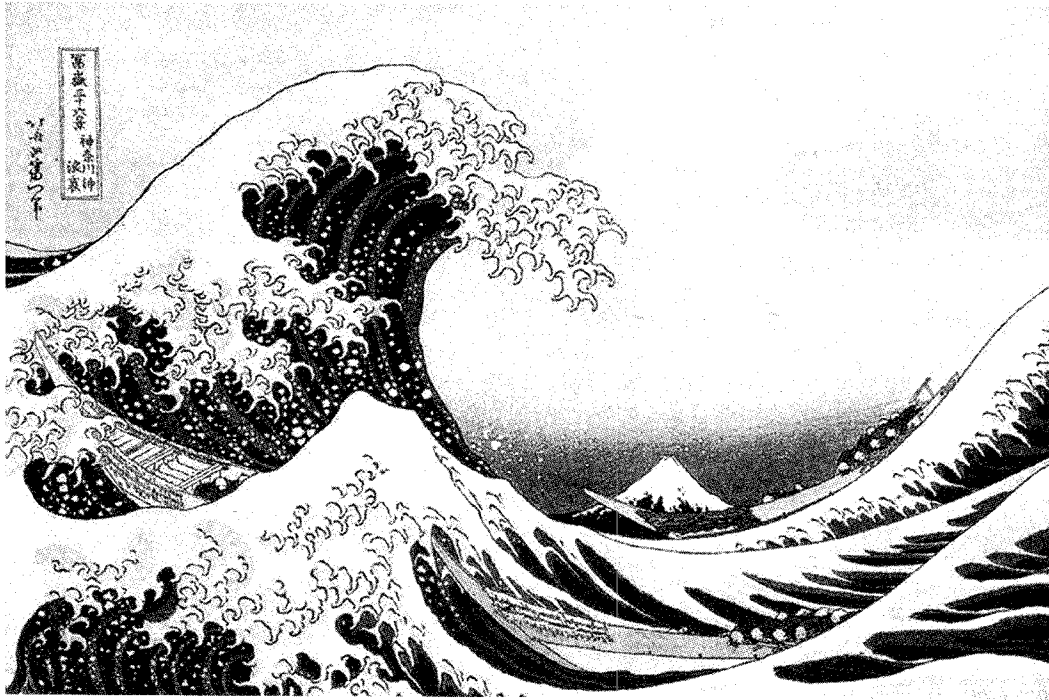
"And if we are not able?" Kino asked.

"We must be able," his father replied. "Fear alone makes man weak. If you are afraid, your hands tremble, your feet falter, and your brain cannot tell hands and feet what to do."

No one stirred from home that day. Kino's father sat at the door, watching the sky and the oily sea, and Kino stayed near him. He did not know what Jiya was doing but he imagined that Jiya, too, stayed by his father. So the hours passed until noon.

At noon his father pointed down the mountainside. "Look at Old Gentleman's castle," he said.

Halfway down the mountainside on the knoll where the castle stood, Kino now saw a red flag rise slowly to the top of a tall pole and hang limp against the gray sky.



“Old Gentleman is telling everyone to be ready,” Kino’s father went on. “Twice have I seen that flag go up, both times before you were born.”

“Be ready for what?” Kino asked in a frightened voice.

“For whatever happens,” Kino’s father replied.

At two o’clock the sky began to grow black. The air was as hot as though a forest fire were burning, but there was no sign of such a fire. The glow of the volcano glared over the mountaintop, blood-red against the black. A deep-toned bell tolled over the hills.

“What is that bell?” Kino asked his father. “I never heard it before.”

“It rang twice before you were born,” his father replied. “It is the bell in the temple inside the walls of Old Gentleman’s castle. He is calling the people to come up out of the village and shelter within his walls.”

“Will they come?” Kino asked.

“Not all of them,” his father replied “Parents will try to make their children go but the children will not want to leave their parents. Mothers will not want to leave fathers, and the fathers will stay by their boats. But some will want to be sure of life.”

The bell kept on ringing urgently, and soon out of the village a trickling stream of people, nearly all of them children, began to climb toward the knoll.

“I wish Jiya would come,” Kino said. “Do you think he will see me if I stand on the edge of the terrace and wave my white girdle cloth?”



"Try it," his father said.

"Come with me," Kino begged.

So Kino and his father stood on the edge of the terrace and waved. Kino took off the strip of white cloth from about his waist that he wore instead of a belt and he waved it, holding it in both hands, high above his head.

Far down the hill Jiya saw the two figures and the waving strip of white against the dark sky. He was crying as he climbed, and trying not to cry. He had not wanted to leave his father, but because he was the youngest one, his older brother and his father and mother had all told him that he must go up the mountain. "We must divide ourselves," Jiya's father said. "If the ocean yields to the fires you must live after us."

"I don't want to live alone," Jiya said.

"It is your duty to obey me, as a good Japanese son," his father told him.

Jiya had run out the house, crying. Now when he saw Kino, he decided that he would go there instead of to the castle, and he began to hurry up the hill to the farm. Next to his own family he loved Kino's strong father and kind mother. He had no sister of his own and he thought Setsu was the prettiest girl he had ever seen.

Kino's father put out his hand to help Jiya up the stone wall and Kino was just about to shout out his welcome when suddenly a hurricane wind broke out of the ocean. Kino and Jiya clung together and wrapped their arms about the father's waist.

"Look—look—what is that?" Kino screamed.

The purple rim of the ocean seemed to lift and rise against the clouds. A silver-green band of bright sky appeared like a low dawn above the sea.

"May the gods save us," Kino heard his father mutter. The castle bell began to toll again, deep and pleading. Ah, but would the people hear it in the roaring wind? Their houses had no windows toward the sea. Did they know what was about to happen?

Under the deep waters of the ocean, miles down under the cold, the earth had yielded at last to the fire. It groaned and split open and the cold water fell into the middle of the boiling rocks. Steam burst out and lifted the ocean high into the sky in a big wave. It rushed toward the shore, green and solid, frothing into white at its edges. It rose, higher and higher, lifting up hands and claws.

"I must tell my father!" Jiya screamed.

But Kino's father held him fast with both arms. "It is too late," he said sternly. And he would not let Jiya go.

In a few seconds, before their eyes the wave had grown and come nearer and nearer, higher and higher. The air was filled with its roar and shout. It rushed over the flat still waters of the ocean and before Jiya could scream again it reached the village and covered it fathoms deep in swirling wild water, green laced with fierce white foam. The wave ran up the mountainside, until the knoll where the castle stood was an

island. All who were still climbing the path were swept away — black, tossing scraps in the wicked waters. The wave ran up the mountain until Kino and Jiya saw the wavelets curl at the terrace walls upon which they stood. Then with a great sucking sigh, the wave swept back again, ebbing into the ocean, dragging everything with it, trees and stones and houses. They stood, the man and the two boys, utterly silent, clinging together, facing the wave as it went away. It swept back over the village and returned slowly again to the ocean, subsiding, sinking into a great stillness.

Upon the beach where the village stood not a house remained, no wreckage of wood or fallen stone wall, no little streets of shops, no docks, not a single boat. The beach was as clean of houses as if no human beings had ever lived there. All that had been was now no more.

Jiya gave a wild cry and Kino felt him slip to the ground. He was unconscious. What he had seen was too much for him. What he knew, he could not bear. His family and his home were gone.

Kino began to cry and Kino's father did not stop him. He stooped and gathered Jiya into his arms and carried him into the house, and Kino's mother ran out of the kitchen and put down a mattress and Kino's father laid Jiya upon it.

"It is better that he is unconscious," he said gently. "Let him remain so until his own will wakes him. I will sit by him."

"I will rub his hands and feet," Kino's mother said sadly.

Kino could say nothing. He was still crying and his father let him cry for a while. Then he said to his wife:

"Heat a little rice soup for Kino and put some ginger in it. He feels cold."

Now Kino did not know until his father spoke that he did feel cold. He was shivering and he could not stop crying.