Unit 7

Learning Activities

Learning activities created for a broad range of student interests and abilities.

Earthquake learning activities for elementary school students

Please refer to Units 1 through 6 for background information.

Activity 1

Know What Might Happen During an Earthquake

Materials:

- Transparencies
- Handouts of the transparencies
- 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.
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.
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.

Activity 2

Have student create a "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.
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.

Activity 2 continued

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.

Activity 3

Have students discuss "Quake Events"

Materials:

- Eyewitness accounts of an earthquake, film footage, or similar materials.
- Earthquake simulation script.
- Drop, Cover and Hold Worksheet D, (see page 76).
- 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.

Tsunami learning activities for elementary school students

Please refer to Units 1 through 6 for background information.

Activity 1

Have students read, "How the Smart Family Survived a Tsunami"

Available online at www.emd.wa.gov/publications/pubed/how_the_smarts_survived_tsunami_book.pdf

Procedure:

Have students form groups and discuss the following questions:

1. What's the right thing to do when the ground shakes?
2. If you're on the **beach** and feel the ground shake, what should you do?
3. Why did the Smart Family have a NOAA Weather Radio?
4. What do you think should be in a disaster supply kit?
5. Did you enjoy the story? Why or why not?

Activity 2

Watch the video, "Run to High Ground"

Procedure:

1. Discuss the video:

   Did you enjoy the story? Why or why not?

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

   What did Obi's father do in the village? Canoe carver.

   What was Obi afraid of? Animals in the woods.

   How did the other children react to him? Laughed at him.

   What did Obi's father warn him about? When you hear bear howl, and the earth shakes, run to high ground because a big wave is coming.

   How did the canoe end up in the trees? A big wave came and threw it there.

   What did Obi do when he heard bears howling? He ran to warn the village.

   Did his father believe him? No. **Why not?** Because Obi always freezes at any loud animal noise so how could he run to warn them?

   Where did the villagers go when they were warned? Top of the hill.

   Who did Obi help on the way up? A little girl who fell.

   What did Obi receive as a result of his heroism? A new name.

   What do you do when the ground shakes? Drop, cover, and hold.

   If you're on the coast, what do you do after the ground stops shaking? Run inland and head for high round.

Activity 3

Have students create a 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 shoreline 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, which includes landslides, submarine slumps, and earthquakes. Significant tsunamis are usually created by an earthquake with a magnitude greater than 7 on the Richter scale. Tsunamis travel from the point of origin at speeds 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 discussion with what the students have already learned.

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.
   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!

Activity 4

Tsunami

Materials:

- The book, "Tsunami, The Big Wave."

Procedure:

1. Assign the reading of "Tsunami, The Big Wave." (See page 78)
2. From "Tsunami, The Big Wave" discuss:

   What causes a tsunami

   How we save lives

   What you should do

Activity 5

Could It Happen Here?

Materials:

- Chart paper
- Felt markers
- Copies of the "Three-Day Survival Pack" (see page 93)

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.
- 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.)

Activity 5 continued

- 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.

Preparing for tsunamis

- 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.

Worksheet A

Turtle Dot-to-Dot

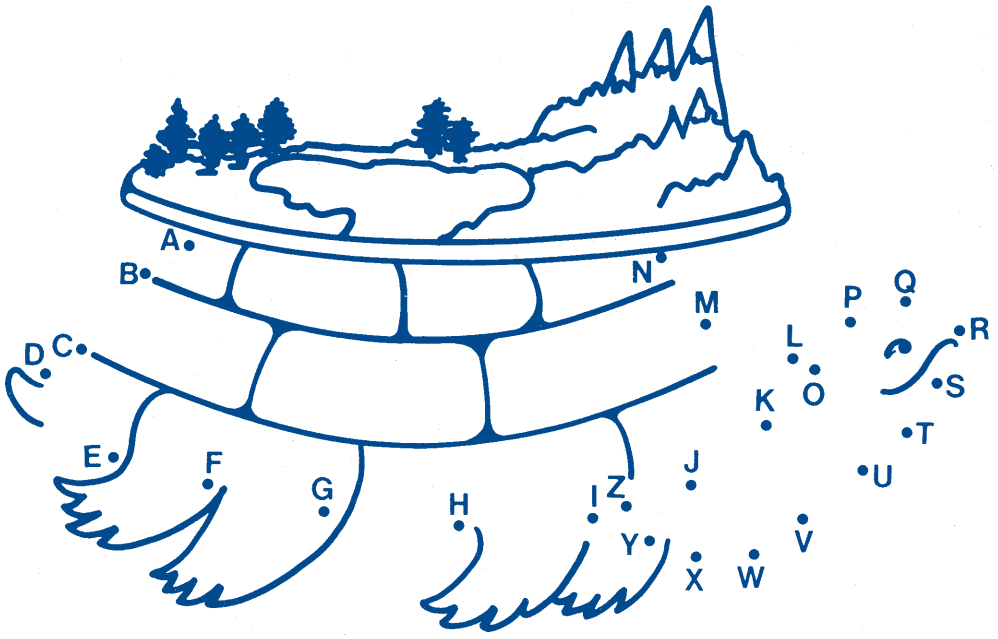
Your Name: _____

I heard a legend from the San Gabrielino Indians.

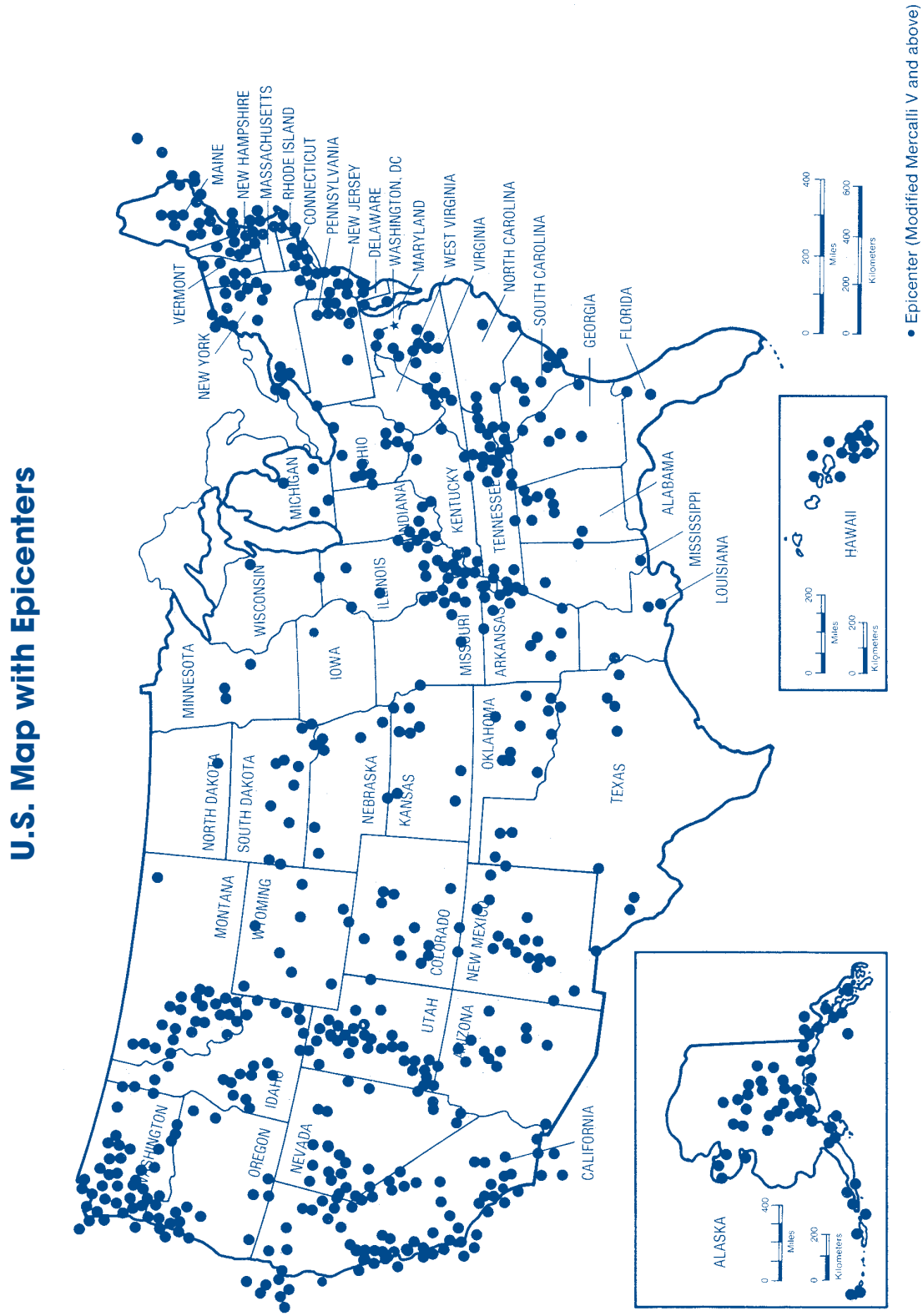
The Indians thought that big turtles carried the land on their backs. They thought that an earthquake happened when the turtles moved in different directions.

1. Connect the dots in this illustration.

2. Color the turtle carrying land on its back.



Worksheet B


U.S. Map with Epicenters
VERMONT
MAINE
NEW HAMPSHIRE
MASSACHUSETTS
RHODE ISLAND
CONNECTICUT
PENNSYLVANIA
NEW JERSEY
DELAWARE
WASHINGTON, DC
MARYLAND
WEST VIRGINIA
VIRGINIA
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
FLORIDA
NEW YORK
MICHIGAN
OHIO
INDIANA
KENTUCKY
TENNESSEE
ALABAMA
MISSISSIPPI
LOUISIANA
WISCONSIN
ILLINOIS
MISSOURI
ARKANSAS
MINNESOTA
IOWA
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MONTANA
WYOMING
COLORADO
NEW MEXICO
UTAH
ARIZONA
WASHINGTON
OREGON
IDAHO
NEVADA
CALIFORNIA
ALASKA
HAWAII
Miles
Kilometers
• Epicenter (Modified Mercalli V and above)

Worksheet C

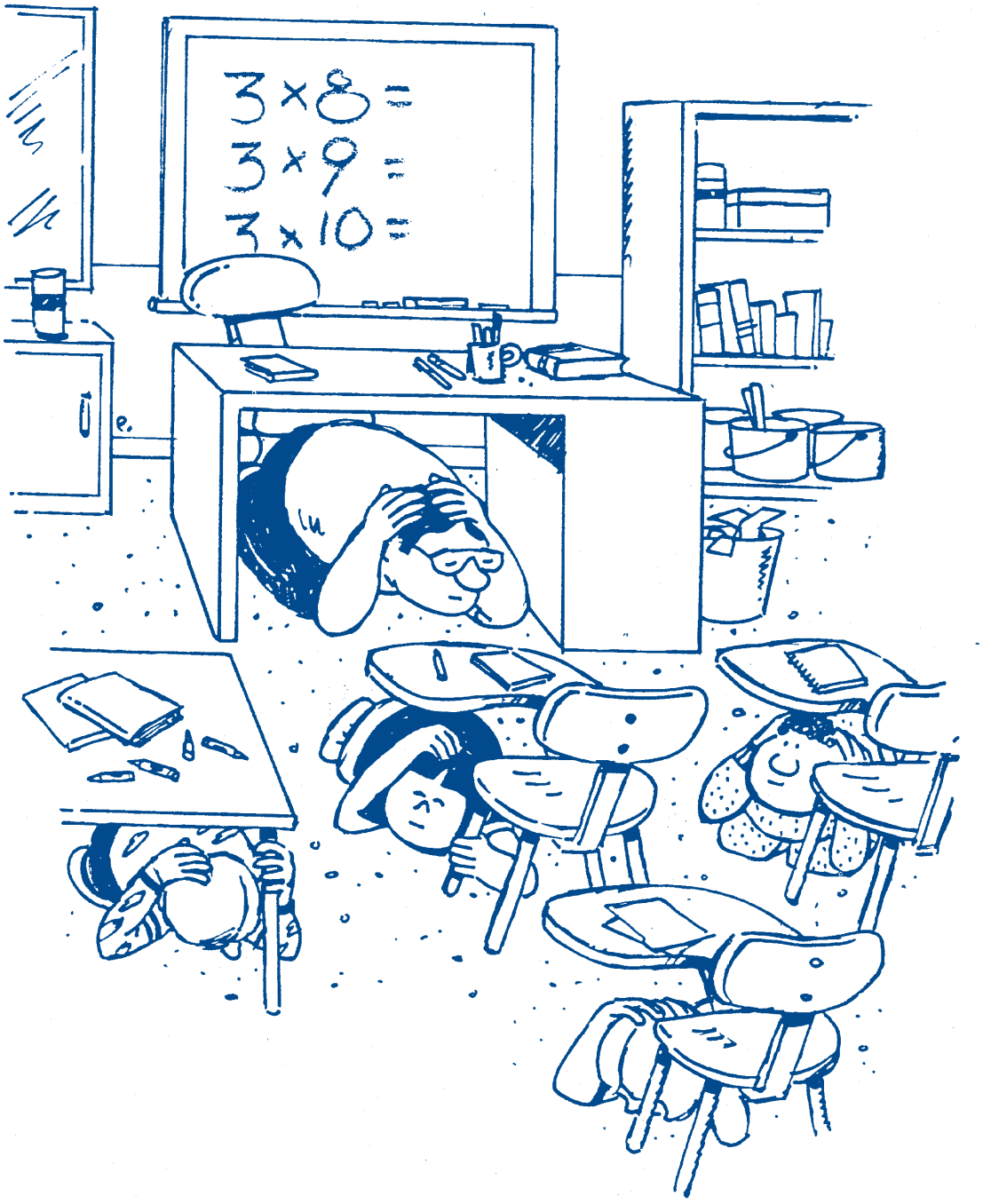
Feelings About Earthquakes

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: _____

Worksheet D

Drop, Cover and Hold



Worksheet E

TSUNAMI TRIVIA

(soo-nam-ee)

Circle the correct answer(s):

A Tsunami is caused by:

① 

② 

③ 

④ 

Circle the official tsunami warning sign.

① 

② 

③ 

④ 

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

① 

② 

③ 

④ 

Circle the states that can experience a tsunami.

① 

② 

③ 

④ 

⑤ 

Test your detective skills.

Circle the words listed below in the word search puzzle.

Beach	Run uphill
Earthquake	Safe area
Fast	Sand
Geology	Tsunami
Giant wave	Warning
Ocean	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	B	E	A	C	H	Y
B	Y	F	A	S	T	O	E

List the **25** unused letters to decode the message

_ _

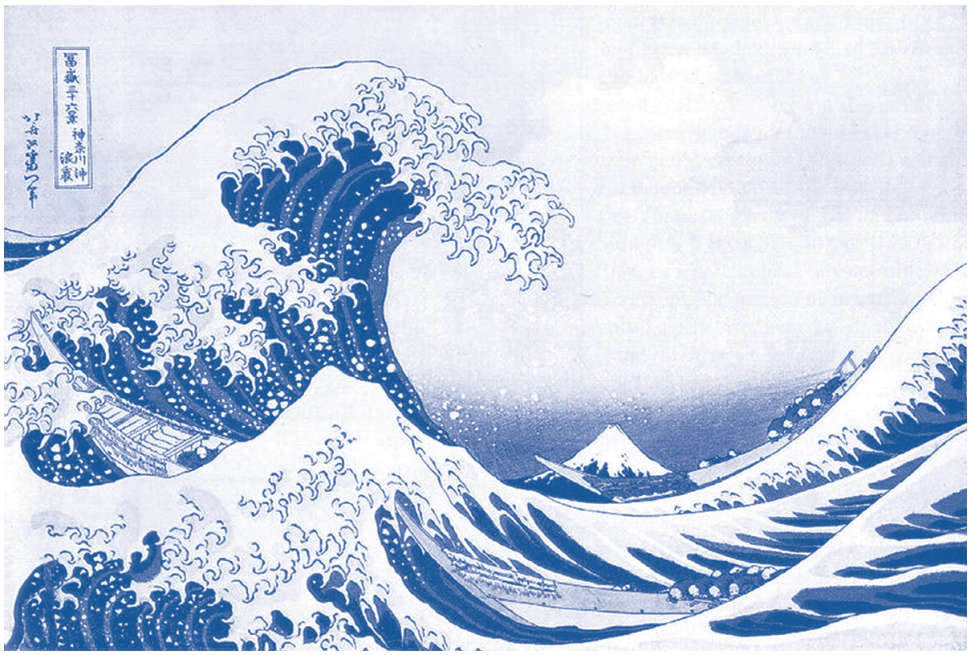
Answers: 1) ② 2) ② 3) ④ 4) ① ② ③ ⑤ Puzzle: HAVE FUN AT THE BEACH TODAY BYE

Worksheet F. Reading Material

This classic story of a Japanese boy who must face life after escaping the tidal wave destruction of his family and village is excellent background reading for grade level 2 and up, and can be incorporated into a group reading experience or individual study.

The Big Wave

By Pearl S. Buck



The Great Wave Off Kanagawa (Japan) by Katsushika Hokusai (1760-1849)

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 he 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 down. 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 keep 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 is 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.

Tsunami learning activities for junior-senior high school students

Please refer to Units 1 through 6 for background information.

Activity 1

What Do You Know About Tsunamis?

Rationale

This pre-assessment activity is designed to focus your students on what they are about to learn, assess their current knowledge, and later provide them and you with a gauge of what they have learned from this tsunami curriculum.

Focus

What do you know about tsunamis?

Objectives

Students will:

1. Use various writing styles to describe a hypothetical tsunami.
2. Anticipate what they will learn from this study of tsunamis.

Materials

- Writing Paper
- Student copies of Writing Outlines (see page 86)
- Pictures or slides of tsunami damage

Procedure

Introduction

Show students images of tsunami damage. Tell students they are going to imagine themselves in a tsunami. Distribute copies of the writing outline. Ask students to note the date and time of their tsunami, its location, how much damage it caused and other basic information at the top of the page.

Lesson Development

Tell the students that they are to write about his or her hypothetical tsunami from three different points of view: that of a news reporter, a scientist, and an individual directly affected by the tsunami. The three accounts will describe the same tsunami, but the styles will vary.

News Reporter: A short, article describing the who, what, where, and when of the tsunami. Provide information the public needs.

Activity 1 continued

Include:

- A lead sentence — must be catchy, attention-grabbing.
- Rest of paragraph — answer what, where, when, who and how many were affected.
- One or more body paragraphs — provide background.
- Final sentence — the clincher; end the story with a punch.

Scientist: A scientific account stating what is objectively known about the tsunami, its causes, its effects, its magnitude and/or intensity, and the likelihood of its recurrence.

Include:

- Lead paragraph — answer what, where, when and who was affected. May be heavy with data.
- Body paragraph or paragraphs — provide background and analysis.

Eyewitness: A personal letter to a friend telling about being in the tsunami. Describe what happened to buildings, your family, friends, pets and your home. Describe any preparedness activities you had taken before the tsunami, and what you wish you had done. The student should keep the facts accurate from story to story.

Include:

- Informal account intended for a friend. May include humor or exaggeration.
- Write in letter format.

Conclusion

Ask students to talk about the experience of writing the accounts.

Ask:

- Did you feel you had enough information to do the job in each case?
- Was one point of view more comfortable than the others?

Worksheet G

Writing Outline

Name: _____

Just the Facts — Use these same facts in each of the variations.

Date and time of the hypothetical tsunami:

_____

_____

_____

Location (city, state, country):

_____

_____

_____

Size of the wave:

_____

_____

_____

Deaths:

_____

_____

_____

Injuries:

_____

_____

_____

Amount of property damage:

_____

_____

_____

Activity 2

Tsunami Waves Research

Rationale

Underwater earthquakes can cause powerful seismic sea waves commonly called tsunamis. These waves can devastate a coastal community because of the tremendous amount of energy they carry.

Focus

- How do earthquakes cause seismic sea waves?
- What precautions can people take to limit tsunami damage?

Objectives

Students will:

- Prepare and present a class report that reflects their own research on tsunamis.
- Describe, through research, the characteristics of an average tsunami wave in terms of speed, wavelength, and period, and predict its effects on a coastal community.

Procedure

Invite students to do some research on actual tsunamis. Hand out one Seismic Sea Waves Research and Report form to every two students. Explain that each team is to research a specific topic and report what they learn to the class. Two students may research and report on a specific tsunami, two others on tsunami warning systems, others preventive measure that can be taken to minimize tsunami damage, etc.

Conclusion

Students will present their reports.

Worksheet H

Seismic Sea Wave Research and Report

Name _____ **Date** _____

Event: _____

_____

_____

Cause: _____

_____

_____

Characteristics of the tsunami: _____

_____

_____

Damage: _____

_____

_____

What could have been done to prevent the damage?: _____

_____

_____

_____

Information Source:

Title: _____

Author: _____

Publisher and place of publication: _____

Internet Site: _____

Other: _____

Date: _____

Activity 3

Tsunami in a Box!

Rationale

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

Focus

- How are tsunamis generated?
- 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.

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 shoreline 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?

Activity 3 continued

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.
   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 box or pan to simulate a beach or coastline. Use your hands to mold dunes or drifts. Draw roads parallel to the shore with a stick or your fingers. 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.

Activity 4

Could It Happen Here?

Rationale

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

Focus Questions

- What do people need to survive?
- What kinds of natural events can prevent people from meeting their basic needs?

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.

Materials

- Chart paper
- Felt markers
- Student copies of the "Three-Day Supply Kit" (see page 93)

Procedure

Introduction

- 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 they would meet the needs listed above? (Answers will include faucets, restaurants, grocery stores, the refrigerator, school cafeterias, clothing stores, parents' home.)

Lesson Development

1. Elicit a definition of natural hazards from the class. Emphasize that earthquakes, volcanoes, tsunamis, and similar events are the result of natural processes. Be sure students understand the difference between natural events and those caused by human activity.
2. 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.)

Activity 4 continued

3. 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.).
4. 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 these reasons, individuals, families, and neighborhoods must be prepared to be self-sufficient for at least three days.

Conclusion

- Distribute copies of the "Three-Day Supply Pack". Explain that the Federal Emergency Management Agency (FEMA) recommends that every family assemble a pack like this 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 have changed.) Compare this list with the lists students have developed.
- Ask the students to take the supply list home and encourage their families to prepare a container with supplies in it. Remember the goal is to be prepared to be on your own for at least three days.

Activity 5

Three Day Supply Kit

Build a 3-day supply kit for your home. Modify this list for your car and office. Remember to include supplies for family members with special needs, including your pets.

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

Activity 6

Hey, Look At Me Now!

Rationale

This activity is designed to serve students and teachers as a gauge of what they have learned from this curriculum.

Focus Question

- What have you learned about tsunami preparedness?
- What will you do differently as a result of these lessons?

Objective

Students will correct, elaborate, and refine their earlier writings by applying information they have gained from this curriculum.

Materials

- Writing paper and pens or computers and printers.

Procedure

Introduction

- Students are urged to draw upon what they have learned from this activity. Remind the students to focus on how their new knowledge has changed their way of thinking about tsunami preparedness.

Lesson Development

- Students will assume the roles of:

  News Reporter: A short, concise article describing the who, what, where, why, and when of the tsunami.

  Scientist: A scientific account stating what is objectively known about the tsunami.

  Eyewitness: A personal story or letter to a friend telling about being in a tsunami. This will describe what happened during the tsunami to the student, his or her family, pet, home, school, etc. Describe what you had done before the tsunami to be prepared, how effective your preparations were, and what you would do differently in preparation for the next tsunami. Also describe what life was like in the two weeks following the tsunami.

Conclusion

At the conclusion of this activity, allow time for a class discussion of the activity.

Activity 7

Simulation and Role play

Putting Plans Into Action — Group Activity

Rationale

When natural disasters occur, coordinated planning is essential if the stricken community is to return to a normal state of affairs. Each community should have a comprehensive emergency management plan to direct their planning, mitigation, response and recovery efforts.

Focus Question

What information needs to be in place to serve a community in the event of a natural disaster?

Objectives

Students will:

- Recognize the importance of advance planning for a community's emergency response.
- Understand how a community government works and how it responds to emergencies.
- Evaluate their locality's tsunami preparedness plan.
- Suggest changes in their existing emergency preparedness plan to reflect what has been learned.
- Develop a personal tsunami emergency response.

Guest Emergency Management Director/Coordinator

Invite the county or city emergency management director or coordinator to the classroom to address the class and participate in the simulation and debriefing.

Materials

- Map of their community (see sample next page)
- Tsunami Scenario
- Job descriptions for simulation
- Self-adhesive name tags, for each student to designate position
- Transparencies
- Color markers

Tsunami Scenario

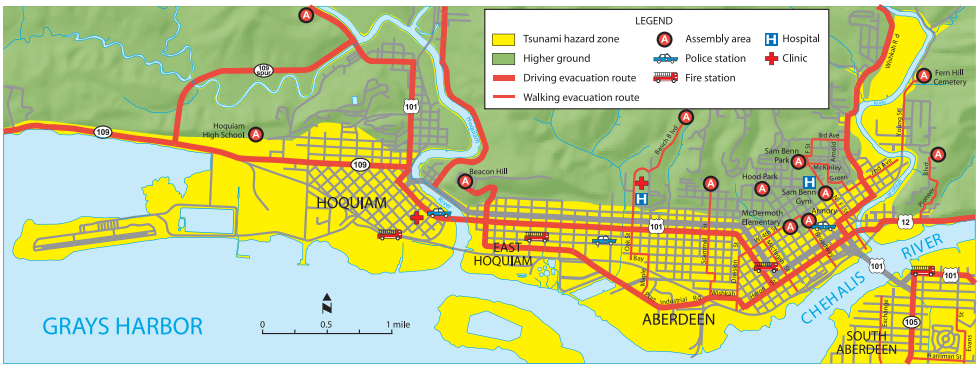
It is 10:00 a.m. in the morning in Evergreen County, and school is in session. Approximately 20 minutes earlier, Cape Hazard experienced an earthquake, magnitude 8.6. An official tsunami warning was issued warning that waves were expected to reach Sandy Pointe Beach approximately 3 hours following the earthquake. Coastal sirens along the beach were sounded immediately and continued to sound intermittently for 20 minutes. Just north of Sandy Pointe Beach, the tsunami waves reached Evergreen Beach 15 minutes following the first waves to reach Sandy Pointe.

1. The first wave arrived and was only a few feet high. Many citizens of Sandy Pointe thought the danger was passed and went back into their homes and businesses. Approximately 30 minutes later the highest wave of the tsunami reached Sandy Pointe. Many people had not observed the warning and 32 were killed along with extensive property damage. The downtown area was hardest hit, as it is closest to the ocean.

Illustration 11

Washington Tsunami Evacuation Maps

Washington state agencies, in cooperation with local emergency management offices, developed evacuation routes away from shorelines subject to tsunami flooding. To review all tsunami inundation maps, visit:
www.emd.wa.gov/hazards/haz_tsunami.shtml



2. The hospital reports flooding and a major crack in its foundation. There is disruption of power to the hospital. At the time of the tsunami there were 152 people in the hospital — 126 patients and 26 staff members. The hospital is at 50% operational capacity.
3. One of the three fire stations have remained operational. The downtown fire station is destroyed and the equipment is trapped inside.
4. Water mains are broken, power is out to a large part of the city, utility lines are down, sewers are backing up, and animals run throughout the streets. Ambulances are having difficulty moving through the streets.

Procedure

Introduction — Group Discussion

Begin by asking the students what they would do if a tsunami struck the area where their school was located. Help them recognize that the most important immediate response is not to panic and to follow the directions of emergency and school authorities.

Now expand the discussion to determine what students think would happen in their community if the tsunami was powerful enough to cause both loss of life and major property damage. (Draw on the knowledge of the emergency manager who is present).

- How would the community respond?
- Who would be in charge of managing the rescue operation?
- Who would be in charge of managing long-term recovery?
- What plans are already in place to assure that the emergency would be responsibly managed?

Lesson Development

1. Explain the purpose of the simulation and tell students that they will be playing the roles of community leaders charged with developing an outline for emergency management in the event of a disaster resulting from a natural or man-made hazard. They are meeting to develop a system to manage the effects of an emergency (tsunami), preserve life and minimize damage, provide necessary assistance, and establish a recovery system in order to return the city to its normal state of affairs as quickly as possible. Their plan must define clearly who does what, when, where, and in what order to deal with the community crisis.
2. Each student will assume a role in county government. Distribute job descriptions listed below.
3. Governmental positions for a fictitious "Evergreen County" include:

   Chief of Police: The police chief is responsible for protecting lives and property in the area served. Specific responsibilities include preserving the peace, preventing criminal acts, enforcing the law, and arresting violators. The chief is under oath to uphold the law 24 hours a day. He or she makes many of the final decisions dealing with budgets and services provided by the police force.

   Fire Chief: This official is responsible for protecting lives and property from the hazards of fire. Responsibilities include fighting fires, rescuing trapped individuals, conducting safety inspections, and conducting fire drills and fire safety education. The fire chief also assists in other types of emergencies and disasters in community life. He or she makes many of the final decisions dealing with budgets and services provided by the fire department. The fire chief usually comes through the ranks, starting as a firefighter.

   Director of Public Works: This official is responsible for the maintenance of systems built at public expense for the common good, such as highways and dams. In some communities these responsibilities may be dealt with separately by officials responsible for highway safety and community transportation services, water and sewage, and other areas; in some, they may be combined in one office.

   Director of Health: This official, usually a physician, is responsible for controlling the spread of communicable disease in the community and for mitigating any threats to the public safety, such as the contamination of public water supplies. He or she also engages in proactive education and advocacy to encourage positive behaviors, such as proper nutrition, and discourage negative ones, such as smoking and the abuse of alcohol and other drugs.

   Coordinator of Community Transportation Services: This official is responsible for the safety of public transportation and both public and private vehicles. He or she arranges for registration, licensing, and state inspections. The coordinator inspects public vehicles and coordinates operation and maintenance of equipment, storage facilities, and repair facilities. She or he directs the recording of expenses and controls purchasing and repair spending. This official also helps plan and direct transportation safety activities.

Public Information Officer: This official supervises a staff of public relations workers, directs publicity programs designed to inform the public, and directs information to appropriate groups. He or she clarifies the local government's points of view on important issues to community or public interest groups and responds to requests for information from new media, special interest groups, and the general public. In an emergency, this function assumes added importance.

Superintendent of Schools: This official is responsible for managing the affairs of an entire public school district. He or she oversees and coordinates the activities of all the schools in the district in accordance with standards set by the board of education. Responsibilities include selecting and hiring staff, negotiating contracts with union employees and settling labor disputes. He or she creates and implements plans and policies for educational programs, and, when necessary, interprets the school system's programs and policies. The superintendent is also responsible for the development and administration of a budget, the maintenance of school buildings, and the purchase and distribution of school supplies and equipment, and oversees the school's transportation system and health services.

City Manager or Mayor: This professional in public administration has general responsibility for the overall operation of the city. All department heads answer to this official, who serves as the city's chief executive officer. A city manager is hired by the city council and serves at its discretion. A mayor is elected by the voters, but holds many of the same responsibilities.

Emergency Management Director: The emergency management director is responsible for coordinating the plans and operations of the various components of the emergency management system — fire and police, emergency medical services, public works, volunteers, and other groups contributing to the management of emergencies. The director manages the application of resources during a disaster. The director must balance the duties authorized and required by law with the moral obligation of the public employee to do everything possible to protect and preserve the safety of citizens, and protect property within the jurisdiction.

Members of the City Council (as many as are needed): Each member determines the needs of the ward or district he or she represents by seeking out interviews, responding to constituents' phone calls and letters, and referring persons to specific agencies for services. The member speaks before neighborhood groups to establish communication and rapport between the members of the community and the service agencies available. The members of the council also have the responsibility to help resolve problems facing the community at large, in such areas as housing, urban renewal, education, welfare, unemployment, disaster response, and crime prevention.

4. Display the county map and discuss or have the guest emergency manager describe vulnerable areas within the county and what can be expected when a tsunami hits.

5. Have the student playing the role of city manager mark the transparency as indicated, using a different color for each type of information.
   - Areas where you can expect the tsunami to come ashore.
   - Area where you expect concentrated building damage, both commercial and residential.
   - Major facilities, such as hospitals, schools, government buildings, etc.
   - Highway roads, bridges and overpasses that might be impassable.

   Ask each student to assume the role they have been assigned.
6. Have the city manager or mayor convene the Evergreen County Emergency Management Planning Committee and call the meeting to order. The city manager will remind the group that every plan must have three parts:
   - Before: preparations to be made before an emergency strikes, such as purchasing safety equipment, upgrading building codes, and educating the public.
   - During: strategies for emergency response during a tsunami or other crisis. Lines of communication will be particularly critical in this phase.
   - After: recovery plans for returning the community to conditions as normal as possible.

   Have the students discuss these three areas and determine what they would find in each area.
7. Students work together to formulate an emergency management plan for Evergreen County.
8. When the group has completed its emergency management plan, provide time for students to report the details of their plan. Help them to evaluate their plan by asking these questions:
   - Is the plan realistic and timely?
   - Is it comprehensive?
   - Is it cost-effective?
   - Do we have the resources to implement it? If not, how might we obtain additional resources?
   - Does the plan address tsunami as well as other hazards in Evergreen County?

Conclusion

Discuss the plan with the guest emergency management director and see how their plan compares to the actual Comprehensive Emergency Management Plan for the county the guest emergency management director represents.

Designate someone in the class to prepare a thank you letter to be sent to the emergency management director from their jurisdiction.

Glossary of Earthquake and Tsunami Terms

Arrival Time:
Time of arrival, usually of the first wave, of the tsunami at a particular location.

Bore:
A traveling wave with an abrupt vertical front or wall of water. Under certain conditions, the leading edge of a tsunami wave may form a bore as it approaches and runs onshore. A bore may also be formed when a tsunami wave enters a river channel, and may travel upstream penetrating to a greater distance inland than the general inundation.

Horizontal Inundation Distance:
The distance that a tsunami wave penetrates onto the shore.

Inundation:
The depth, relative to a stated reference level, to which a particular location is covered by water.

Inundation Area:
An area that is flooded with water.

Local/Regional Tsunami:
A local- or near-field tsunami has a very short travel time (30 minutes or less). A regional or mid-field tsunami has travel times of between 30 minutes and 2 hours.

NOAA — National Oceanic and Atmospheric Administration:
The Federal Agency responsible for tsunami warnings and monitoring.

NWS — National Weather Service:
A branch of NOAA that operates the tsunami warning centers and disseminates tsunami warnings.

PTWC — Pacific Tsunami Warning Center:
Consists of Hawaii, other U.S. interests in the Pacific Basin, countries participating in the Tsunami Warning System in the Pacific, and Indian Ocean and Caribbean Sea countries.

Period:
Amount of time that a tsunami wave takes to complete a cycle. Tsunami periods typically range from five minutes to two hours.

Runup:
The maximum height of the water onshore.

Seiche:
A standing wave oscillating in a partially or fully enclosed body of water.

Teletsunami:
Also referred to as a distant-source or far-field tsunami. Travel time is greater than 2 hours.

Tidal Wave:
Common, although incorrect, term for tsunami. Tides, caused by the gravitational attractions of the sun and moon, may increase or decrease the impact of a tsunami, but have nothing to do with their generation or propagation.

Travel-time:
The time it takes for a tsunami to travel from the source to a particular location.

Tsunami:
A Japanese term; "tsu" meaning harbor, and "nami" meaning wave. A series of traveling ocean waves of extremely long length generated by disturbances associated primarily with earthquakes occurring below or near the ocean floor.

WC/ATWC
West Coast/Alaska Tsunami Warning Center area-of-responsibility (AOR) consists of Canadian coastal regions, Puerto Rico, the Virgin Islands, and the ocean coasts of all U.S. States except Hawaii.

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www.clallam.net

Grays Harbor County
www.co.grays-harbor.wa.us/info/DEM

Jefferson County
www.jeffcoeoc.org

Pacific County
www.co.pacific.wa.us/pcema

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www.emd.wa.gov/plans/documents/ehmp_5.8_tsunami.pdf

Advances in Geoscience
Jansa, A., Monserrat, S., and Gomis, D.: The rissaga of 15 June 2006 in Ciutadella (Menorca), a meteorological tsunami, Adv. Geosci., 12, 1–4, 2007.
http://www.adv-geosci.net/12/1/2007/

National Geophysical Data Center Historical Tsunami Database
www.ngdc.noaa.gov/hazard/tsu.shtml

NOAA Tsunami – The Tsunami Story
http://www.tsunami.noaa.gov/tsunami_story.html

National Tsunami Hazard Mitigation Program
A compendium of tsunami education resources developed as part of NOAA's National Tsunami Education and Outreach Plan for use in schools to educate students about tsunamis and related natural hazards. It includes award-winning *Tsunami K-6 Curriculum* and the *Tsunami 7-12 Curriculum* produced by George Crawford and Barbara Everette Thurman for the Washington Emergency Management Division.
http://www.tsunami.gov/

Thunderbird and Whale Stories
www.pnsn.org/HIST_CAT/STORIES/legend.html

Tsunami Evacuation Brochures and Maps:
http://www.dnr.wa.gov/ResearchScience/Topics/GeologyPublicationsLibrary/Pages/tsuevac.aspx

Understanding Local and Distant and Tsunamis (Video)
www.emd.wa.gov/hazards/haz_video_tsunami_types.shtml

UNESCO/IOC ITIC, Tsunami, The Great Waves
Revised Edition, Intergovernmental Oceanographic Commission, Paris, UNESCO, 16 pp., illus. IOC Brochure 2008-1, 2008
http://ioc3.unesco.org/itic/files/great_waves_en_2006_small.pdf

The story that saved the lives of the people of Simeuleu, Indonesia
Usapdin, T.P., A. Soemantri, and V. Agustin, December 19, 2005
www.ifrc.org/docs/News/05/05121901/index.asp

Washington Tsunami Inundation Maps
www.dnr.wa.gov/Publications/ger_tsunami_inundation_maps.pdf

Washington Tsunami Modeling of Cascadia Modeling Tsunami Inundation from a Cascadia Subduction Zone Earthquake for Long Beach and Ocean Shores, NOAA Technical Memorandum OAR PMEL-137
www.pmel.noaa.gov/pubs/PDF/vent2949/vent2949.pdf

PREPAREDNESS AND RESPONSE

Home Preparedness
www.emd.wa.gov/preparedness/prep_home.shtml

How the Smart Family Survived a Tsunami (PDF)
www.emd.wa.gov/publications/pubed/how_the_smarts_survived_tsunami_book.pdfhttp://www.emd.wa.gov/publications/pubed/how_the_smarts_survived_tsunami_book.pdf

Map Your Neighborhood
www.emd.wa.gov/myn/index.shtml

Media Tsunami Volcano Guidebook (PDF)
www.emd.wa.gov/hazards/documents/

NOAA Weather Radio
http://www.nws.noaa.gov/nwr/

http://www.emd.wa.gov/publications/pubed/noaa_weather_radio.shtml

Pet Preparedness
www.emd.wa.gov/preparedness/prep_pets.shtml

Preparing Your Emergency Evacuation Kit (Video)
www.emd.wa.gov/hazards/haz_video_emergency_kit.shtml

Preparing Your Evacuation Routes (Video)
www.emd.wa.gov/hazards/haz_video_evacuation_routes.shtml

TsunamiReady Program
www.tsunamiready.noaa.gov/

Tsunami Survival Challenge Game for Kids
http://www.emd.wa.gov/preparedness/videos/TsunamiGame.swf

Understanding Tsunami Warnings (Video)
www.emd.wa.gov/hazards/haz_video_tsunami_warnings.shtml

UNESCO/IOC, TsunamiTeacher, IOC Manuals and Guides, 47, 2006 (DVD and online)
http://ioc3.unesco.org/TsunamiTeacher/

TSUNAMI INFORMATION

International Journal of Tsunami Society
http://www.tsunamisociety.org/

International Tsunami Information Center
http://itic.ioc-unesco.org/index.php

National Oceanic & Atmospheric Administration
http://www.tsunami.noaa.gov/

National Tsunami Hazard Mitigation Program
http://nthmp.tsunami.gov

Tsunami! Past and Present. Sponsored by University of Washington
http://www.geophys.washington.edu/tsunami

U.S. Geological Survey
http://www.usgs.gov

Waves of Destruction: Tsunamis — a PBS Special
http://www.pbs.org/wnet/savageearth/tsunami/index.html

Western States Seismic Policy Council, Tsunami Hazard Mitigation Committee

http://www.wsspc.org/about/tsunami.shtml

TSUNAMI VIDEOS

Aonae Tsunami Animation

Produced by Dr. Vasily Titov, NOAA/PMEL; can be downloaded from website: http://www.pmel.noaa.gov/tsunami-hazard/vasily.mpg

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

How the Smart Family Survived a Tsunami

The booklet was developed to help children prepare for disasters. Knowledge is power, and knowing what to expect and what to do will increase their confidence when disasters occur. Available online at www.emd.wa.gov/publications/pubed/how_the_smarts_sur

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. vived_tsunami_book.pdf.

Killer Wave: Power of the Tsunami

Part of a 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

Raging Planet: Tidal Wave

Imagining an unstoppable wall of water, 500 mph, reaching heights of nearly 100 feet. Tidal Wave is the store 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

Raging Sea

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

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.

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

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.

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.

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.

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.

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 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

About the Authors

George L. Crawford, principal of SeismicReady Consulting, provides worldwide consulting services to reduce the impact of geologic hazards through planning, resource development and public education. Mr. Crawford served as the State Earthquake Program Manager for the Washington State Emergency Management Division developing multi-program design and coordination of local, state, national and international seismic and geologic programs in collaboration with the USGS, NOAA, FEMA and state, national, international and private organizations. George served as the Washington State representative to the U.S. National Tsunami Hazard Program, Western States Seismic Policy Council Tsunami Committee Chair, Washington State/ Local Tsunami Workgroup Chair, Cascadia Region Earthquake Workgroup Board of Directors, and the NEMA representative to the ANSS National Steering Committee. George co-developed the All-Hazard Alert Broadcasting (AHAB) Radio that is deployed in U.S. states and internationally, and advises on tsunami community communication issues globally. He has worked extensively with coastal Native American Tribes to link science to Tribal Oral History, and created the "Run to High Ground" video. He has represented the U.S. in international forums, and the Washington State Tsunami Program has become a mitigation model nationally and internationally for at-risk tsunami communities. George supports USAID and UNDP in Indian Ocean tsunami missions, collaborates with NOAA/PMEL to develop the Train-the Trainer Program and Community-based Education Program in Washington State, and assists in the University of Washington Certificate Program in Tsunami Science and Preparedness. In 2008, George was appointed to the National Research Council Committee on Review of the Tsunami Warning and Forecast System and Overview of the Nation's Tsunami Preparedness. During 2009-2010 George, in partnership with the UNESCO/IOC-NOAA International Tsunami Information Center and the NOAA Pacific Marine Environmental Laboratory, developed FEMA certified course AWR-217, Tsunami Awareness. He has written papers on tsunami communication and dissemination, preparedness and mitigation, vertical evacuation guidance (FEMA P646A on vertical evacuation structures), and continues to collaborate in tsunami research.

Barbara Everette Thurman, J.D., safety policy consultant to the Washington State Office of Public Instruction, provides technical assistance and training to Washington school districts, Educational Service Districts, and related state and community agencies and groups. She facilitates the development of supportive learning environments and the reduction and prevention of youth problem behaviors with particular focus on school safety policy guidelines, procedures, and practices of schools and their stakeholders. She conducts regional school safety forums to help identify necessary components of emergency preparedness and response plans, including local hazards, vulnerabilities and resources. Barbara has 26 years of Emergency Management experience at both the state and local level. Barbara earned a Juris Doctor from Seattle University School of Law.

Dr. Laura S.L. Kong, director of International Tsunami Information Center (ITIC), Hawaii, USA, UNESCO/ IOC–NOAA since 2001, oversees efforts to deploy tsunami warning and mitigation systems globally, and works directly with the 46-nation Intergovernmental Co-ordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS) to strengthen international and national tsunami warnings and preparedness. ITIC, hosted by the NOAA National Weather Service, and Chile Navy Hydrographic and Oceanographic Service, provides the Associate Director. The ITIC works closely with the U.S. Pacific and West Coast/Alaska Tsunami Warning Centers, the Japan Meteorological Agency, and other national tsunami warnings centres. The ITIC is the primary provider of information and expertise for technology transfer, training and capacity building in tsunami warning and mitigation for the IOC, which is the acknowledged lead United Nations organization for the global coordination of tsunami warning and mitigation systems. Since the 2004 Indian Ocean tsunami. Dr. Kong has been very active in advising countries around the world on how to build robust and sustainable warning systems. Within the U.S., ITIC works with the U.S. National Tsunami Mitigation Program and its partners, and Dr. Kong serves as the NOAA co-chair to the NTHMP Mitigation and Education Subcommittee. She also serves as the Hawaii State Tsunami Advisor. She is the former chair of the Hawaii State Earthquake Advisory Committee, and a member of the Hawaii State Hazard Mitigation Forum. Previously, she was with the Pacific Tsunami Warning Center, the University of Hawaii's Hawaii Institute of Geophysics, the U.S. Geological Survey's Hawaiian Volcano Observatory, and the University of Tokyo Earthquake Research Institute. She was born and raised in Honolulu, Hawaii, is a graduate of Punahou School, Brown University and received her doctorate in Seismology from the Massachusetts Institute of Technology and Woods Hole Oceanographic Institution in 1990.