EARTH SCIENCE ACTIVITY #1
Tsunami in a Bottle

Grades 3 and Up

This activity is one of several in a basic curriculum designed to increase student knowledge about earthquake science and preparedness. The activities can be done at any time in the weeks leading up to the ShakeOut drill. Each activity can be used in classrooms, museums, and other educational settings. They are not sequence-bound, but when used together they provide an overview of earthquake information for children and students of various ages. All activities can be found at www.shakeout.org/schools/resources/.

Please review the content background (page 3) to gain a full understanding of the material conducted in this activity.

OBJECTIVE:

For students to learn that tsunamis can be caused by earthquakes and to understand the effects of tsunamis on the shoreline

MATERIALS/RESOURCES NEEDED:

- 2-liter plastic soda bottles
- Small gravel (fish tank gravel)
- Water source
- Empty water bottle (16 oz)
- Overhead projector
- Transparency of Tsunami Facts
- "What Do I See?" handout

PRIOR KNOWLEDGE:

In order to conduct this activity, students need to know how fault slippage can generate earthquakes.

ACTIVITY:

Set-Up (Time varies)

Collect as many 2-liter soda bottles as possible or ask students to bring in bottles for this activity (3 students can share one bottle). Obtain an empty water bottle (about 16 oz). Remove labels from all bottles. Purchase or gather enough small gravel to fit through the mouth of the soda bottles. Students will fill up their soda bottles with gravel to create at least a 2 inch layer on the bottom of the bottle. Secure a water source, such as a water fountain, sink, or a water container, for students to collect water. Make copies of the "What Do I See?" handout for each student.

Procedure (45 minutes)

The italicized phrases are spoken suggestions for the instructor and those in parenthesis are possible answers students might provide.

1. Begin a discussion about tsunamis by asking students the following:

a. *Do earthquakes occur under the ocean?* (Yes)
b. *Why? Are there faults in the ocean?* (Yes)
c. *Does anyone know what earthquakes in the ocean can cause*? (Some may guess tsunamis)

2. Show students the Tsunami Facts transparency and select students to read a segment.
3. Students will start the activity.
   Today, we will create a tsunami in a bottle.
   a. *Please form groups of three* (based on the number of soda bottles available).
   b. Distribute the soda bottles to students.
      Here is a soda bottle which will contain our tsunami.
   c. Students fill their soda bottles with gravel.
      One at a time, please come up and I will help you fill your soda bottles with gravel. Please hold your bottles upright.
      Fill up their bottles until there is about a two inch layer of gravel on the bottom.
   d. After collecting pebbles, direct students to pour water into their bottles.
      One at a time, use the empty water bottle. Fill it halfway up (8 oz) to the top at the available water source. Carefully pour this water into your soda bottles to avoid spills.
   e. When you are finished, please return to your desk and wait for everyone else to finish. I will give you more instructions then.
   f. With their bottles standing upright, say "With its cap on, *carefully lie down your bottle on its side. This will create a "hill" as the pebbles slide to the side*.
   g. Students create a tsunami.
      Place one hand underneath the mouth of the closed bottle. Now pretend your hand is one side of an ocean fault. If you are going to recreate an earthquake, what should your hand do? (Move, move up) *TSUNAMI!*
4. All the students should create a tsunami by sharing the bottle.
   What do you see as you lift the bottle? (The water moves in the bottle)
   What do you think the water and the pebbles represent? (ocean and land)
   The wave you have created is like a tsunami as it moves up the gravel which represents a coastline.
5. Discuss how tsunamis are created.
   When there is an earthquake in the ocean, the water shifts by the movement of the faults. This causes the tsunamis you see in your bottles.
6. Distribute the 'What Do I See?' handouts.
   I want you to draw what you see in the bottle from different angles. Also, draw what you would see if you were sitting at the coastline when the tsunami occurs.
7. To emphasize the danger of tsunamis to people discuss the following topics:
   a. *Where can tsunamis occur?* (Anywhere near a shoreline)
   b. *Can they be dangerous?* (Yes) *Why?* (Loss of property and life)
   c. *If you are at the beach and you feel an earthquake, what should you do*? (Move to higher ground immediately.)

CONTENT BACKGROUND:

Underwater Earthquakes
Sometimes an earthquake can occur along the ocean floor, resulting 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, or seismic sea wave. A series of these waves may travel at speeds up to 800 km/hr (~500 mi/hr) in the deep ocean, where they are too small to be seen. However, 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 many lives can be lost.

It is difficult to recognize the geological events and structures that surround us on dry land. It is even more difficult to think about those events and structures when they occur underwater, where we cannot see them. Yet, water covers about 70 percent of our planet, and the same tectonic forces are at work on the floors of the oceans as on the continents.

Although the same processes are at work, we need a new vocabulary to understand them. Mountain ranges in the ocean are called *mid-ocean ridges*; plains are called *abyssal plains*. Submarine slides occur as well, but we call them *turbidity currents*.

Warning Systems
The National Oceanic and Atmospheric Administration (NOAA) is responsible for providing tsunami warnings in the United States.

According to the NOAA,

> *Since 1946, the tsunami warning system has provided warnings of potential tsunami danger in the pacific basin by monitoring earthquake activity and the passage of tsunami waves at tide gauges. However, neither seismometers nor coastal tide gauges provide data that allow accurate prediction of the impact of a tsunami at a particular coastal location. Monitoring earthquakes gives a good estimate of the potential for tsunami generation, based on earthquake size and location, but gives no direct information about the tsunami itself. Tide gauges in harbors provide direct measurements of the tsunami, but the tsunami is significantly altered by local bathymetry and harbor shapes, which severely limits their use in forecasting tsunami impact at other locations. Partly because of these data limitations, 15 of 20 tsunami warnings issued since 1946 were considered false alarms because the tsunami that arrived was too weak to cause damage.*

What to do Before and During a Tsunami
The following are guidelines from the Federal Emergency Management Agency on what you should do if a tsunami is likely in your area:

- If an earthquake occurs and you are in a coastal area, turn on your radio to learn whether there is a tsunami warning.
- Move inland to higher ground immediately and stay there.
- Stay away from the beach. Never go down to the beach to watch a tsunami come in. If you can see the wave, you are too close to escape it.
- *CAUTION* – If there is noticeable recession in water away from the shoreline, this is nature's tsunami warning and it should be heeded. You should move away immediately.

Information retrieved from:
National Oceanic and Atmospheric Administration. *The Tsunami story*.
http://www.fema.gov/hazard/tsunami/ts_before.shtm
Federal Emergency Management Agency. (2009). *What to do before and during a tsunami.*
http://www.tsunami.noaa.gov/tsunami_story.html

Tsunami Facts

Tsunami

- Japanese word
- pronounced: soo - nah – me
- means “wave in the harbor”
- misnamed as “tidal waves”

Caused by:

- earthquake
- other movements on the ocean floor

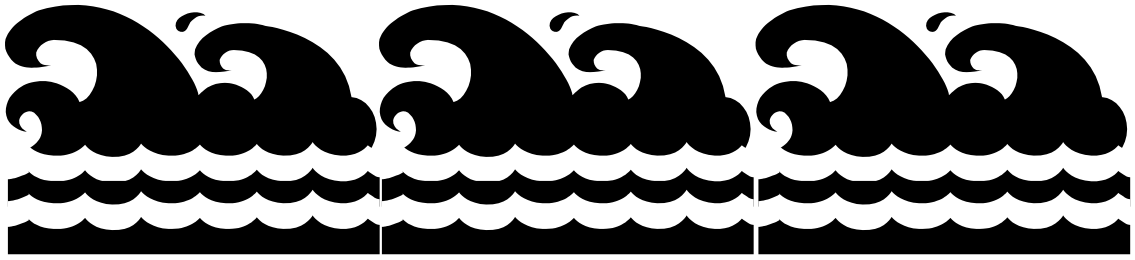
Travel at speeds up to 600 miles per hour

Tsunami traveling in deep water and open ocean cause no damage and are hardly noticeable.

Tsunami traveling in shallow water can batter coastlines with waves as high as 100 feet, causing considerable damage.

Tsunami Warning Centers

Post warnings when earthquake of tsunami potential occurs.



Tsunami! – What do I see?

Name_____

Side

Top

Front

What would I see if I were on the coastline?