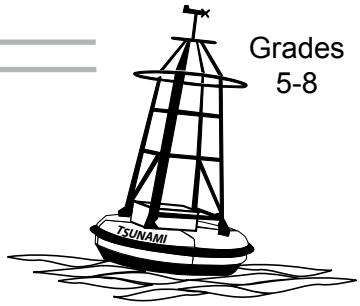
1964 Tsunamis

Grades 5-8



Overview:

During this lesson students model a tsunami wave, then watch and perform an activity related to *Ocean Fury*, a documentary film about the tsunami event that occurred in Alaska in 1964.

Targeted Alaska Grade Level Expectations:

Science

[5] SE3.1 The student demonstrates an understanding of how scientific discoveries and technological innovations affect our lives and society by: describing the various effects of an innovation (e.g. snow machines, airplanes, immunizations) on the safety, health, and environment of the local community.

[6] SD2.3 The student demonstrates an understanding of the forces that shape Earth by describing how the surface can change rapidly as a result of geological activities (i.e., earthquakes, tsunamis, volcanoes, landslides, avalanches). [Note: Earthquakes and tsunamis are discussed here, volcanoes, landslides, and avalanches are investigated in Units 2 and 3.]

[6-8] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.

Objectives:

The student will:

- predict what will happen on the surface of a model ocean when the elevation of a section of the model's sea floor suddenly rises;
- observe, sketch and describe the waves created by an increase in the elevation of a section of the model sea floor;
- analyze observations from multiple trials and then generalize the results;
- communicate conclusions in writing and as a class;
- explain how a sudden rise in elevation of a section of the ocean floor can cause a tsunami; and
- describe the potential effects of a tsunami warning system on the safety of a community.

Materials:

- 2-liter bottles (1 per group of 4 students)
- Water
- Blue food coloring
- Two books (per group of 4 students)
- Measuring cup
- *Ocean Fury: Tsunamis in Alaska* DVD
- DVD player
- Television
- STUDENT WORKSHEET: "Ocean-in-a-Bottle"

Science Basics:

The second largest earthquake ever recorded struck Alaska in 1964, the epicenter of which was in northern Prince William Sound. Intense shaking during the earthquake triggered many submarine and surface landslides along the Alaska shoreline. The earthquake caused a tectonic uplift of the sea floor, which generated open-ocean tsunamis that traveled as far as Oregon and California. These

tsunamis devastated many Alaska communities. The death toll from the earthquake and tsunamis totaled 122, and more than $100 million in damage was reported. Entire communities were relocated as a result.

Tsunamis are generated by a sudden displacement of water, usually caused by one of the following: violent earthquakes that change the elevation of the sea floor; landslides above or below the water line (often generated by earthquakes); eruption of submarine volcanoes; or meteor impacts. Alaska is a very seismically active state. Along the state's southern coastline, the Pacific Plate is being forced under the North American Plate. This plate subduction causes earthquakes that can induce landslides or cause the elevation of the sea floor in this area to shift, placing the Pacific coast of Alaska at high risk of tsunamis.

Activity Preparation:

Create an ocean-in-a-bottle by removing the label from a clear plastic two-liter bottle then filling it with about 2 cups of water. Put a few drops of blue food coloring in the water. Screw the lid tightly onto the bottle and shake. Turn the bottle on its side. Lay a book on each side of the bottle to hold it in place. The water in the bottle represents the ocean. The bottom of the bottle represents the sea floor.

Activity Procedure:

1. Ask students what they know about underwater earthquakes or landslides. Record their answers on the board. Visit the following website: https://earthquake.alaska.edu/tsunami-animation-page and show students the Alaska Earthquake Center animation of tsunami waves inundating a coastal town.
2. After students have viewed the animation, ask them to answer four questions on a piece of paper:
   - Why did this happen?
   - What forces are at work?
   - Is it common?
   - Where does it happen most?
3. Ask students to set their answers aside, but keep them in mind as they complete today's activity. Explain that students will create an ocean-in-a-bottle and then perform an investigation to determine what will happen when there is a sudden change in the elevation of the sea floor in their model. Show students the ocean-in-a bottle. Explain that the water in the bottle represents the ocean and the side of the bottle that is resting on the table represents the sea floor.
4. Ask students what will happen to the water on the surface of the ocean model if someone presses upward on the "sea floor" (creating a dent in the bottle). Record their answers on the board.
5. Place students in groups of 4 and distribute a worksheet to each student. Ask students to read the background information and write a hypothesis.
6. Distribute a two-liter bottle to each group and ask them to follow the directions on their worksheet to test their hypothesis. Emphasize that students must observe closely to recognize changes on this small scale "ocean."
7. After students have completed their investigation, discuss the resulting data and conclusions.
8. Explain that earthquakes, landslides and underwater volcanic eruptions can cause areas of the sea floor to change shape very suddenly. An ocean wave created when a section of the sea floor suddenly changes shape is called a tsunami. In 1964, a large earthquake caused several devastating tsunamis to strike Alaska's coastal areas. Explain that students will watch a movie about the 1964 tsunami event.
9. Play the *Ocean Fury* DVD for students.

Critical Thinking:

Think-Pair-Share-Method: Ask students to discuss the following question in their lab groups for three minutes. Choose a member from each group to share their answers with the class. How is Alaska better prepared to deal with a tsunami today than it was in 1964?

10. After students have watched the DVD, ask the Critical Thinking Question featured above.

Extension Ideas:

- Ask students to press different spots on the bottles to see how this affects wave generation.
- Use Google Earth to measure distances waves traveled in some of the movie examples.

Answers:

***Hypothesis*:** *Answers will vary*

***Data*:**

Control Bottle: *Drawing should show a stationary waterline. Water/ocean and bottle/sea floor may be labeled.*

Trial #1-3: *Answers will vary but should show waves moving from the lid-end to the bottom-end of the bottle. Parts (e.g. sea floor and ocean) should be labeled and arrows used to indicate the direction of motion.*

Analysis of Data:

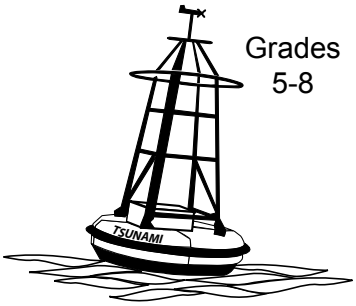
1. *Yes, but answers may vary from student to student.*
2. *Answers may vary, but all three trials should have produced waves on the surface of the water.*
3. *Answers may vary, but the water in the control bottle should have been still, while the water in the trial bottles moved in small waves.*

Conclusion:

1. *Answers will vary, but should indicate that waves formed on the surface of the water when the elevation of a section of the model's sea floor suddenly rose. The waves started in the area of the rise and traveled away from the rise.*
2. *Answers will vary, but should indicate that waves would form on the surface of the water and travel away from the area of rise.*
3. *Answers will vary, but should relate the outcome of the investigation to the conclusion.*

Name:_____

Grades 5-8



Student Worksheet

Ocean-in-a-Bottle (page 1 of 3)

Testable Question:

What will happen to the ocean's surface when the elevation of the sea floor suddenly rises?

Background Info:

Earthquakes, landslides and underwater volcanic eruptions can cause areas of the sea floor to change shape very suddenly. The activity below involves building an ocean-in-a-bottle, then using this model to discover how a sudden rise in elevation of the sea floor impacts the surface of the ocean.

Hypothesis:

Use the background information on this worksheet to make a hypothesis. What will happen on the surface of the model ocean when the elevation of a section of the model's sea floor suddenly rises? Complete the following sentence:

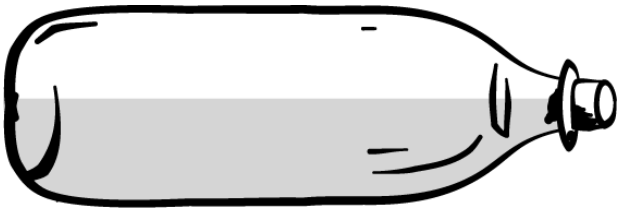
If a section of the sea floor in my model suddenly rises, then _____

_____

Investigation:

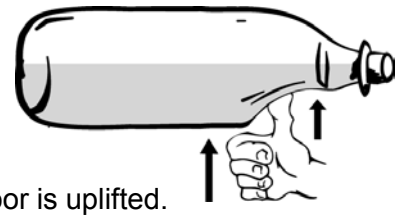
Materials:

- Empty 2-liter bottle
- Water (dyed blue)
- Two books
- Measuring cup



Procedure:

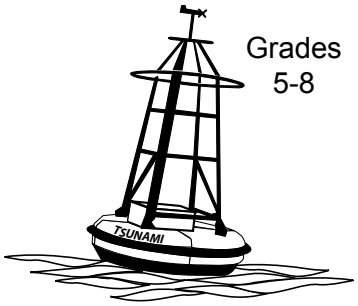
1. Measure 2 cups of blue water and pour it into the bottle, then screw the lid on tightly.
2. Tip the bottle onto its side and lay it on the edge of the table, with the lid-end of the bottle sticking out over the edge of the table.
3. Place a book on each side of the bottle to hold it in place. Wait for the water in the bottle to stop moving.
4. When the water in the bottle has stopped moving, turn to the Data: Control Bottle section of this packet and record the model sea surface by drawing a side-view of the water in the model. Label the drawing, showing what part represents the ocean and what part represents the sea floor.
5. Carefully rest one hand on top of the bottle to hold it in place without disturbing the water. With the thumb of your other hand, press firmly and quickly on the bottom side of the lid-end of the bottle, creating a dent in the bottle (a rise in the model sea floor). Keep the thumb in place for 10 seconds.



6. Carefully observe the surface of the water in the bottle while the sea floor is uplifted. Note any movement of the water and record any observations in the Data: Trial #1 section of this packet. Be sure to include the rise in the model sea floor, and any waves created on the surface of the water. Use arrows to indicate direction of motion. Label the drawing.
7. Repeat steps 5 & 6, three times, allowing different group members to use the bottle. Record observations for all three trials, then work with the group to answer the remaining questions in this packet.

Name:_____

Grades 5-8

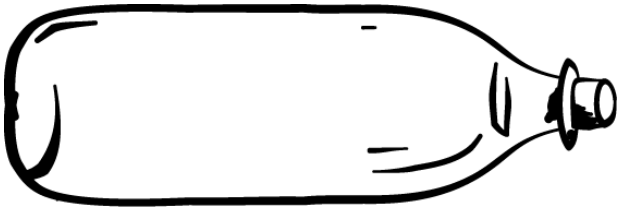


Student Worksheet

Ocean-in-a-Bottle (page 2 of 3)

Data:

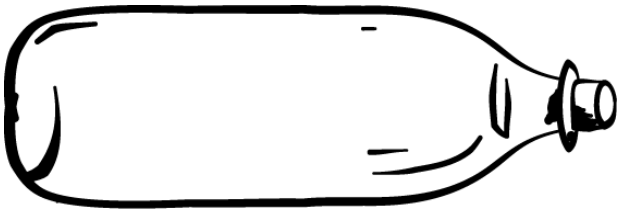
Control Bottle:



Description: _____

_____

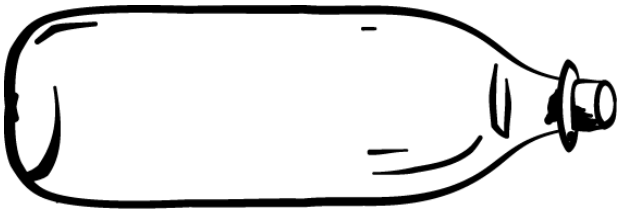
Trial #1:



Description: _____

_____

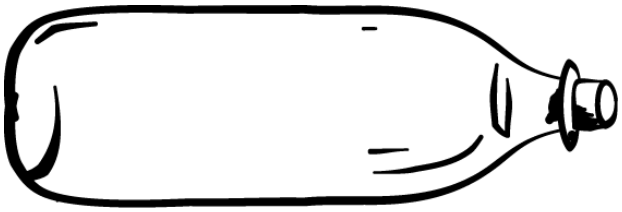
Trial #2:



Description: _____

_____

Trial #3:

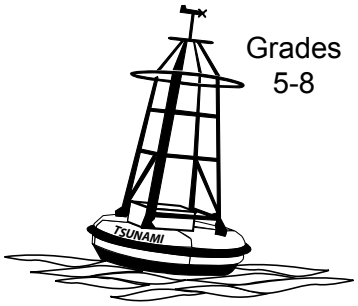


Description: _____

_____

Name:_____

Grades 5-8



Student Worksheet

Ocean-in-a-Bottle (page 3 of 3)

Analysis of Data:

1. Look at the collected observation data. Were any waves visible when a sudden rise was created in the model sea floor?

   _____

2. What data did the three trials have in common?

   _____

   _____

   _____

3. How did the observational data recorded for the control bottle differ from the three trials?

   _____

   _____

   _____

Conclusion:

1. In general, what happened on the surface of the model ocean when the elevation of a section of the model's sea floor suddenly rose?

   _____

   _____

   _____

2. What would you expect to happen on the surface of the ocean if a section of the sea floor suddenly rose in elevation?

   _____

   _____

   _____

3. Explain what evidence supports your conclusion. Use complete sentences.

   _____

   _____

   _____