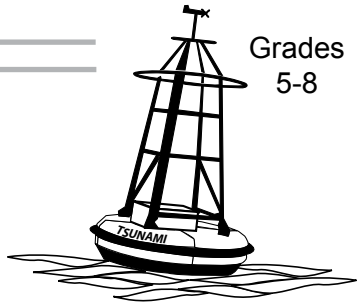
Salty Sea

Grades 5-8



Overview:

Tsunami waves and regular ocean waves differ in many ways. One of those ways is how far on shore they travel or how much land they inundate. Scientists have many ways of determining how large an area a tsunami wave has inundated. In this lesson, students learn the differences between regular ocean waves and tsunami waves, and perform a hands-on experiment to determine tsunami inundation.

Targeted Alaska Grade Level Expectations:

Science

[5-8] 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.

[5] SA1.2 The student demonstrates an understanding of the processes of science by using quantitative and qualitative observations to create inferences and predictions.

[6] SA1.2 The student demonstrates an understanding of the processes of science by collaborating to design and conduct simple repeatable investigations.

[7-8] SA1.2 The student demonstrates an understanding of the processes of science by collaborating to design and conduct simple repeatable investigations in order to record, analyze (i.e., range, mean, median, mode), interpret data, and present findings.

[7] SA3.1 The student demonstrates an understanding that interactions with the environment provide an opportunity for understanding scientific concepts by designing and conducting a simple investigation about the local environment.

[6] SD2.1 The student demonstrates an understanding of the forces that shape Earth by describing the formation and composition (i.e., sand, silt, clay, organics) of soils.

[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, floods, landslides, avalanches).

[5-8] SG2.1 The student demonstrates an understanding of the bases of the advancement of scientific knowledge by recognizing differences in results of repeated experiments.

Objectives:

The student will:

- use scientific method to test soil salinity;
- graph tsunami inundation;
- use a control in an experiment; and
- discuss tsunami inundation evidence.

Materials:

- Straw (1 per student)
- Scissors, to share
- Rulers, to share
- Black permanent marker, to share
- Red permanent marker, to share
- Small nail, to fit inside straw ~ 2 inches (1 per student)
- Tape

- 4 wide-mouth quart canning jars
- 2 cups of soil (potting or other)
- 1 ½ cups of table salt
- ¼ and 1 cup measuring cups
- Water
- Paper towels
- STUDENT WORKSHEET 1: “Inundation Graph”
- STUDENT WORKSHEET 2: “Salty Sea”

Science Basics:

Tsunami inundation is the area from the shoreline to the limit of the distance the tsunami travels on-shore. Inundation varies from run-up. Tsunami run-up is the elevation above sea level of a tsunami wave at its maximum inundation. The inundation by a tsunami wave is affected by the bathymetry of the ocean floor as well as the elevation and topography of the shoreline.

Tsunami inundation is usually determined by a combination of eyewitness accounts and measurements. Measurements are taken of erosion depth, and tsunami sand deposit thickness and salinity to determine the extent of inundation. Sand grain size, distribution, composition, and chemistry indicate a great deal about the path of a tsunami and tsunami inundation extent.

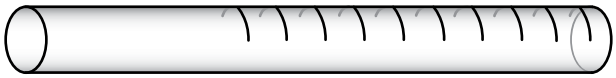
Activity Preparation:

1. Place ¼ cup of soil in each of 4 canning jars.
2. Label each jar (use a piece of tape if necessary) as follows: 0 – control; 1 – 5 meters, 2 – 10 meters, 3 – 15 meters.
3. Place ¾ cup of salt in Jar #1. Mix thoroughly.
4. Place ½ cup of salt in Jar #2. Mix thoroughly.
5. Pour 2 cups of water into each canning jar. Mix thoroughly. (NOTE: Soil samples may need to be stirred occasionally throughout the lesson to prevent stratification.)

Activity Procedure:

1. Ask students how they can tell a wave is a tsunami wave. How does a tsunami wave differ from a wind-generated ocean wave? Students should point out that a tsunami wave is sometimes higher than an ocean wave, has a longer wavelength than an ocean wave, and inundates a larger area of the shore.
2. If needed, explain that inundation is the inflow of water or tide onto the shore. Tsunami waves differ from typical ocean waves because their inundation area is far greater.
3. Distribute the STUDENT WORKSHEET 1: “Inundation Graph.” Instruct students to complete the worksheet individually or in small groups.
4. Discuss how scientists are able to determine the area of inundation after a tsunami has occurred. (eg. eye-witness accounts, damage to property and environment, salinity testing)
5. Explain that one way scientists determine how large an area a tsunami has inundated is to test the salinity of the soil. Scientists collect soil samples at various locations and elevations and examine the soil for indications of tsunami inundation. Because seawater itself contains salt, soil that has been saturated with seawater will contain more salt than regular soil. Soil that contains a large quantity of salt indicates possible tsunami inundation.

6. Ask students how much salt is in seawater. Provide ten minutes for students to use books, the Internet, or other reference sources to answer the question.
7. Distribute STUDENT WORKSHEET 2: “Salty Sea.” Ask students to complete the hypothesis section of the worksheet.
8. Explain that Jar 0 serves as an experimental control. Explain that an experiment is designed to test a variable. In this experiment, the variable is the salinity of the soil. To verify that the salinity is the only difference between the two samples, a control is created. The control should be exactly the same as the samples to be tested, except that the variable to be tested is absent. In this way, alternative explanations for a result can be eliminated.
9. Explain that soil was mixed with water to allow the salt in the soil to dissolve into the water. Students will measure the relative salt content of the soil by measuring with a hydrometer. Hydrometers are used to determine the relative density of liquids. Discuss how a hydrometer, which measures density, will help to determine salinity. (Salt increases the density of water.)
10. Assist students in making hydrometers. Distribute one straw to each student. Instruct students to measure their straw and cut it in half. The second half can be retained or thrown away. Instruct students to draw a scale on their straw, starting at 2 inches and making a mark with a black permanent marker every ¼ inch.



11. Instruct students to place the nail inside their straw so that it is on the unmarked side and tape the end.

12. Demonstrate how to calibrate the hydrometer by placing the straw in the control jar (Jar 0) and marking the top of the water in red permanent marker. Next, demonstrate how to take a measurement by removing the straw and drying it with a paper towel. Place it in another jar and note the water level against the straw. Explain that the salinity can be listed in relation to the control. For example, if the water level is 1 notch below the red line, the reading is -1; if the water level is 2 notches above the red line, the reading is 2.
13. Divide the class into small groups and lead the groups through the remainder of the worksheet. Each group will need to take turns calibrating and measuring. Students can work on STUDENT WORKSHEET 1: “Inundation Graph” before and after they have completed the data section of STUDENT WORKSHEET 2: “Salty Sea.”
14. Compare conclusions and discuss why results may vary.

Critical Thinking:

The 3-minute Rule: Ask the following question and wait three minutes before providing an answer. This allows students to think through their replies and provides an opportunity for several students to answer and expand upon the question. Studies show that teachers often answer their own questions within five seconds when students do not respond immediately.

What is the purpose of determining tsunami inundation?

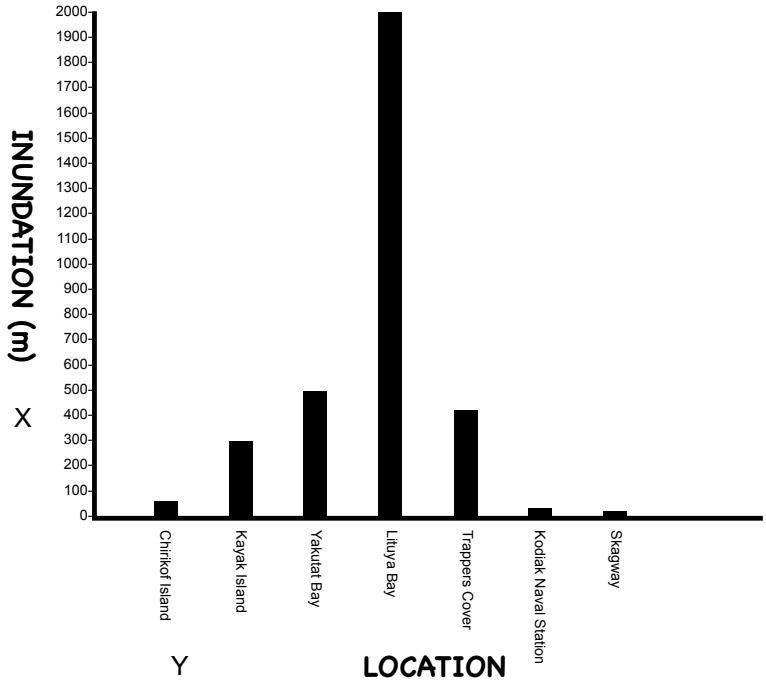
If necessary, explain that knowing what areas have been inundated by tsunamis in the past helps scientists and state and borough officials to prepare for the possibility of a damaging tsunami in the future. Knowing what areas a tsunami has inundated in the past can help officials to know which homes to evacuate, should the need arise.

Extension Idea:

Study the effects of water salinity on the growth of plants by planting two of the same type of plant and caring for them equally. Make sure the plants are labeled. Water one with plain water and the other with a water/salt mixture. The salt solution should remain the same proportion of salt and water throughout the experiment. Keep a growth chart and compare.

Answers:

STUDENT WORKSHEET 1: "Inundation Graph"



STUDENT WORKSHEET 2: "Salty Sea"

Hypothesis: Answers will vary.
Data: Answers will vary.
Analysis of Data: Answers will vary.
Conclusion: Answers will vary.
Further Questions: 1. D. all of the above
2. A. Jar 0

Name:_____

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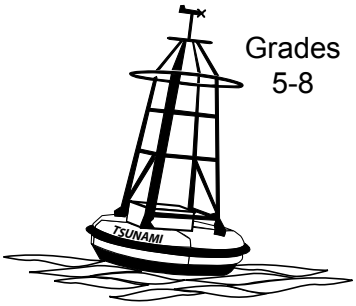

Student Worksheet 1

"Inundation Graph"

Directions: Graph the following tsunami inundations on the bar graph below. Be sure to label each tsunami by its location.

Tsunami Location	**Date**	**Inundation (m) rounded to the nearest 1**
Chirikof Island, AK	1880	55 meters
Kayak Island, AK	1899	300 meters
Yakutat Bay, AK	1899	500 meters
Lituya Bay, AK	1936	2000 meters
Trappers Cover, Vsevidof Island, AK	1957	402 meters
Kodiak Naval Station, AK	1964	15 meters
Skagway, AK	1964	9 meters

Name:_____

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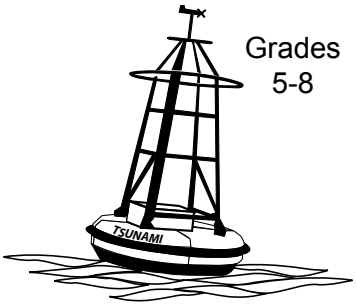


Student Worksheet 2
"Salty Sea" (page 1 of 2)

The following is a hypothetical situation:

Background Information:

Eyewitness accounts of the Salty Sea Tsunami indicated that the ocean inundated to 15 meters. However, homes were only damaged up to 10 meters, suggesting to scientists that the eyewitnesses were mistaken.

Hypothesis:

Use the background information on this worksheet to fill in the blank below.

The Salty Sea Tsunami inundated the shore to _____ meters.

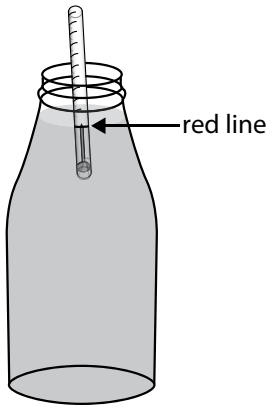
Experiment:

Materials

- Straw (1 per student)
- Scissors, to share
- Rulers, to share
- Black permanent marker, to share
- Red permanent marker, to share
- Small nail, to fit inside straw ~ 2 inches (1 per student)
- Tape
- 4 wide-mouth quart canning jars
- 2 cups of soil (potting or other)
- 1 ½ cups of table salt
- ¼ and 1 cup measuring cups
- Water
- Paper towels

Procedure

1. Jar 0 represents the control. In this experiment, the control is the sample that was not inundated with ocean water. Place the hydrometer in the jar for Jar 0. Place a line with a red marker on the hydrometer to show the water level for Jar 0.
2. Using the hydrometer, measure each soil sample and record results in the Data chart. Remember to read the meter as a positive or negative number based on its location in relation to the red line.



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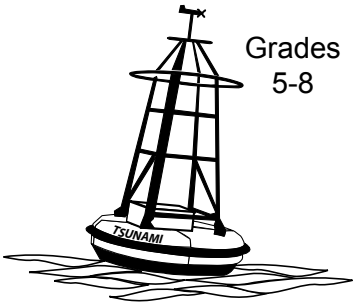

Student Worksheet 2
"Salty Sea" (page 2 of 2)

Data:

Jar #	Distance from Shore	Hydrometer Reading
1	5 meters	
2	10 meters	
3	15 meters	

Analysis of Data:

1. Which sample has the same salinity as the control? _____

2. What is the distance from the shore for that sample? _____ meters

Conclusion:

1. How far did the ocean inundate during the Salty Sea Tsunami? _____ meters

2. Was your hypothesis proved or disproved? _____

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

_____

_____

Further Questions:

1. One way scientists determine ocean inundation is:

   A. observing damage to the landscape and property
   B. eyewitness accounts
   C. testing salinity
   D. all of the above

2. In this experiment, the control was:

   A. Jar 0
   B. Jar 1
   C. Jar 2
   D. Jar 3