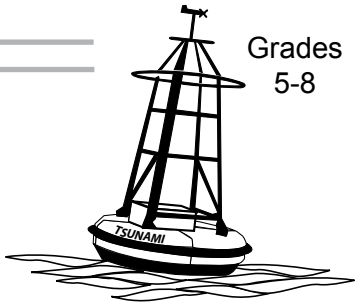
Making Waves

Grades 5-8



Overview:

Students investigate location, magnitude, duration, and area of different forces as they create waves.

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] SB4.1 The student demonstrates an understanding of motions, forces, their characteristics, relationships, and effects by investigating that the greater the force acting on an object, the greater the change in motion will be (L).

[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).

[6-7] SG2.1 The student demonstrates an understanding of the bases of the advancement of scientific knowledge by recognizing differences in results of repeated experiments.

[8] SG2.1 The student demonstrates an understanding of the bases of the advancement of scientific knowledge by describing how repeating experiments improves the likelihood of accurate results.

Objectives:

The student will:

- hypothesize the depth of the water column affected by wave motion caused by different sources;
- describe location, magnitude, duration and area of a source as factors in wave generation;
- explain results in repeated experiments;
- describe how the likelihood of accurate results improves with repeat experiments; and
- relate findings to earthquakes and tsunamis

Materials:

- Large, waterproof box (the type for storage under a bed) (1 per group)
- Pitcher (1 per group)
- Corks or small balloons (five or six per group)
- Heavy-duty thread
- Permanent marker
- File folders of various widths
- 1½'' wide masking tape
- Ruler
- Fan
- 2x4 piece of wood – long enough to fit across the shorter width of the bottom of the box
- 2 pounds of aquarium gravel
- Bowl
- Large slotted spoon
- STUDENT WORKSHEET: "Making Waves"

Science Basics:

A force is a push or a pull. The energy that causes ocean waves comes from a disturbing force. In oceanography, the disturbing force is called a "source." The different combinations of location, magnitude (the strength), duration (the time it lasts), and the area of a source create different types of waves. Sources include wind, gravitational pull, changes in atmospheric pressure, earthquakes, volcanic eruptions and landslides. The period of a wave refers to the time it takes for one wavelength (one crest + one trough) to pass a given point.

In the Deep Ocean

Type of Wave	Period	Wavelength	Depth of influence	Source
Capillary or ripple	< .1 second	< 2 centimeters	Very shallow	Light wind, insects
Chop	1-10 seconds	1-10 meters	Shallow	Strong wind
Swell	10-30 seconds	Up to hundreds of meters		Storms
Tsunami	5-60 minutes	20 kilometers to 300+ kilometers	To the bottom	Earthquakes, Landslides, Volcanic eruptions
Tide	12-24 hours	½ Earth	To the bottom	Gravitational pull of the sun and moon

Consider the potential location, magnitude, duration, and area of the above sources. A light force on the surface, like the light wind, creates capillary waves, which only create motion on the surface of the ocean. In contrast, a strong force emanating from the bottom of the ocean creates tsunami waves that affect the entire depth of the ocean.

The following activity is designed to help students investigate different forces and how they affect wave generation in a water tank. The force that should be the most consistent from trial to trial is the force applied by the fan. The other forces that students apply to their tank will depend upon the strength and duration with which they are applied. The various sizes of folders should help reveal area as a factor of a generating source.

Activity Preparation:

Set up a model tank using the information on the STUDENT WORKSHEET.

Activity Procedure:

1. Explain that the activity in this lesson will require students to investigate how a force affects different depths of water. A force can be described as a push or a pull.
2. Distribute STUDENT WORKSHEET: "Making Waves." Review the background information and the process for conducting this investigation. Display the model tank that students may refer to as they prepare.
3. Divide students up into groups of three or four and begin the activity.
4. At the end of the activity, debrief the investigation by allowing students to share their analysis, conclusions and responses to "Further Questions."

5. Ask members of different groups to share their results. How did the folders of different areas affect the corks? If the folders were applied with the same magnitude over the same duration, the smaller folders wouldn't affect the corks as strongly as a larger folder.

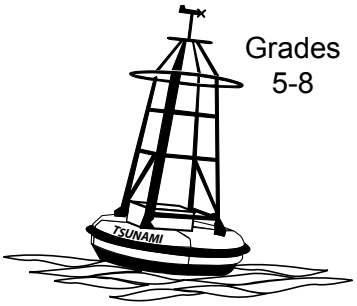
Answers:

Hypotheses: *Answers will vary*
Data: *Answers will vary, but should mostly reflect that blowing air on the surface only influences shallow depths. A fan should also affect the surface but at depths deeper than blowing air. The hammer, folder and gravel are most likely to impact the lower corks and possibly not reach the surface.*
Analysis of Data: *Answers will vary, but should include an explanation for results that were different.*
Conclusion: *Answers will vary, but should mostly reflect that blowing air on the surface only influences shallow depths. A fan should also affect the surface but at depths deeper than blowing air. The hammer, folder and gravel are most likely to impact the lower corks and possibly not reach the surface.*

Further Questions:
1. Answers should reflect that repeating an experiment improves the likelihood of accurate results because it decreases the risk of other factors affecting the results.
2. volcanic eruptions, earthquakes, landslides
3. Answers should reflect that not all earthquakes generate tsunamis because the location, magnitude, duration, and area of the source may not be strong enough to create a tsunami. (NOTE: Another factor is the type of fault movement in an earthquake. Vertical fault movements are more likely to produce tsunamis than horizontal fault movements. This will be investigated in a separate lesson.)

Name:_____

Grades 5-8



Student Worksheet

Making Waves (page 1 of 6)

Testable Question:

How do location, magnitude, duration, and area of a source impact the depth of the water column when it is affected by wave generation?

Background Info:

A force is a push or a pull. The energy that causes ocean waves comes from a disturbing force. In oceanography, the disturbing force is called a "source." The different combinations of location, magnitude (the strength), duration (the time it lasts), and the area of a source create different types of waves. Sources include wind, gravitational pull, changes in atmospheric pressure, earthquakes, volcanic eruptions and landslides. The period of a wave refers to the time it takes for one wavelength (one crest + one trough) to pass a given point.

In the Deep Ocean

Type of Wave	Period	Wavelength	Depth of influence	Source
Capillary or ripple	< .1 second	< 2 centimeters	Very shallow	Light wind, insects
Chop	1-10 seconds	1-10 meters	Shallow	Strong wind
Swell	10-30 seconds	Up to hundreds of meters		Storms
Tsunami	5-60 minutes	20 kilometers to 300+ kilometers	To the bottom	Earthquakes, Landslides, Volcanic eruptions
Tide	12-24 hours	½ Earth	To the bottom	Gravitational pull of the sun and moon

Consider the potential location, magnitude, duration, and area of the above sources. A light force on the surface, like the light wind, creates capillary waves, which only create motion on the surface of the ocean. In contrast, a strong force emanating from the bottom of the ocean creates tsunami waves that affect the entire depth of the ocean.

The activity below involves investigating how different forces impact different depths of water.

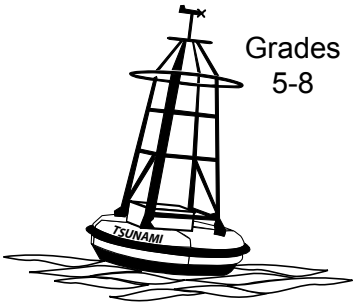
Experiment:

Materials:

- Large, waterproof box
- Pitcher
- Corks or small balloons (five or six)
- Heavy-duty thread
- Permanent marker
- File folder or part of a file folder

Name:_____

Grades 5-8



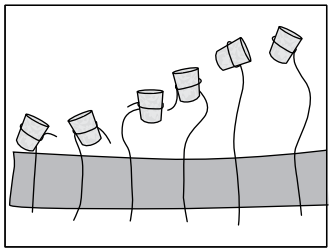
Student Worksheet

Making Waves (page 2 of 6)

Materials (continued):

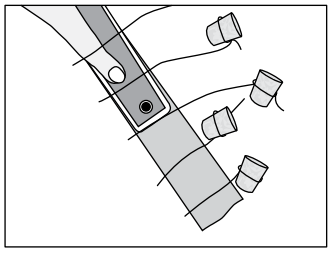
- 1 1/2'' wide masking tape
- Ruler
- Fan
- 2x4 piece of wood
- 2 pounds of aquarium gravel
- Bowl
- Large slotted spoon

Procedure:

1. 

   Tie thread to each piece of cork and attach to a strip of tape across the shorter width of the water box. Make the lengths vary so that the corks and their threads vary in height from the bottom of the water level to the surface of the water.

2. Use a permanent marker to number the corks. Number the corks in order with #1 being the shortest and #5 being the longest.

3. 

   Make sure the bottom of the box is dry. Carefully place the piece of tape with the threads and corks on it toward one end along the shorter width of the box. Use a ruler to securely press down the tape.

4. Cut a piece of thread that is long enough to go along the inside crease of the folder and hang outside the box. With the thread looped inside the folder, tape the opposite edge of the folder to the bottom of the box so that the creased side lifts up when the thread is pulled. The folder should be situated on the side of the box across from the line of corks. Place just enough gravel to hold the folder down on the bottom of the box.

5. Fill the box with water.

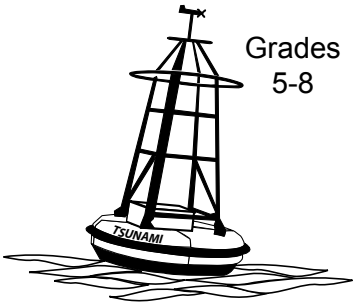
6. For this activity, there are five disturbing forces to use on the tank of water. For each force, target the force on the side opposite the corks. Do three trials for each force. After each trial, make sure the water settles down before the next trial. One person should perform the force as the others observe.

Name:_____

Grades 5-8

Student Worksheet

Making Waves (page 3 of 6)



Hammer	**Blow Air**
Strike the hammer on the wall of the box opposite from the corks.	One person in the group blows his or her own air on the surface of the water opposite from the corks.
Fan	**Gravel**
With caution, use the fan to blow on the surface of the water opposite the corks.	Dump 2 lbs. of gravel on the side of the tank opposite the corks. After each trial, use the slotted spoon to scoop out the gravel into the bowl.

Folder
Lift the thread so that the folder comes up from the bottom. After each trial, move the gravel back on the folder.

Hypotheses:

Use the background information to form hypotheses. Predict which corks the forces will affect. Complete the following sentences:

1. If the force of the hammer is applied, the following corks will be affected:

   _____

2. If the force of the fan is applied, the following corks will be affected:

   _____

3. If the force of breath is applied, the following corks will be affected:

   _____

4. If the force of the gravel is applied, the following corks will be affected:

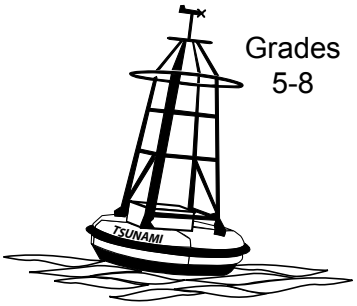
   _____

5. If the force of the folder is applied, the following corks will be affected:

   _____

Name:_____

Grades 5-8



Student Worksheet

Making Waves (page 4 of 6)

Data:

Record the force and mark an 'X' for each impacted cork for each trial.

		Disturbing Force														
Trials →		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Corks	#1															
	#2															
	#3															
	#4															
	#5															

Analysis of Data:

Circle the response to each question.

1. When the force of the hammer was applied, were the results from all three trials the same or different?
   SAME DIFFERENT

   If there was a difference, please explain. Was the location or the magnitude of the disturbing force a factor? How?

2. When the force of the fan was applied, were the results from all three trials the same or different?
   SAME DIFFERENT

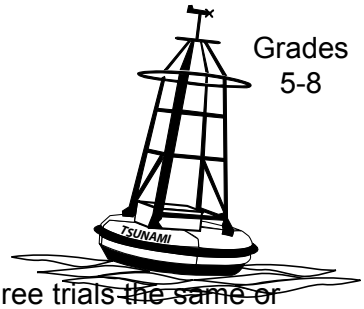
   If there was a difference, please explain. Was the location or the magnitude of the disturbing force a factor? How?

3. When the force of breath was applied, were the results from all three trials the same or different?
   SAME DIFFERENT

   If there was a difference, please explain. Was the location or the magnitude of the disturbing force a factor? How?

Name:_____

Grades 5-8



Student Worksheet

Making Waves (page 5 of 6)

4. When the force of the gravel was applied, were the results from all three trials the same or different?
   SAME DIFFERENT

   If there was a difference, please explain. Was the location or the magnitude of the disturbing force a factor? How?

5. When the force of the folder was applied, were the results from all three trials the same or different?
   SAME DIFFERENT

   If there was a difference, please explain. Was the location or the magnitude of the disturbing force a factor? How?

6. Which force was most likely to have consistent results?
   hammer fan breath gravel folder

Conclusion:

1. How do the hypotheses compare to the actual results?

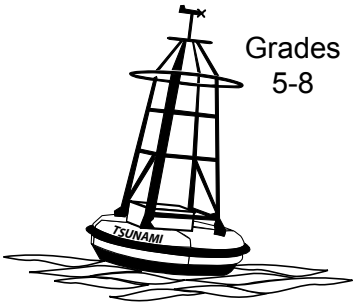
2. Place an "X" to mark the corks disturbed by each force based on each hypothesis and on actual data. At the bottom of each column, write "C" if the hypothesis was confirmed or "D" if it was disproved.

Hammer	#1	#2	#3	#4	#5
Hypothesis					
Actual					
Confirmed/ disproved					

Fan	#1	#2	#3	#4	#5
Hypothesis					
Actual					
Confirmed/ disproved					

Name:_____

Grades 5-8



Student Worksheet

Making Waves (page 6 of 6)

Blow Air	#1	#2	#3	#4	#5
Hypothesis					
Actual					
Confirmed/ disproved					

Folder	#1	#2	#3	#4	#5
Hypothesis					
Actual					
Confirmed/ disproved					

Gravel	#1	#2	#3	#4	#5
Hypothesis					
Actual					
Confirmed/ disproved					

Further Questions:

1. Why does repeating the experiments more than once improve the likelihood of accurate results?

_____

_____

_____

2. Identify three causes of tsunamis.

_____

_____

_____

3. Why don't all earthquakes generate tsunamis?

_____

_____

_____