



Overview:

In this lesson, the teacher guides students in an investigation of how different waves affect different depths of water in the deep ocean.

Targeted Alaska Grade Level Expectations:

Science

- [3] SA1.2 The student demonstrates an understanding of the processes of science by observing and describing the student's own world to answer simple questions.
- [4] SA1.2 The student demonstrates an understanding of the processes of science by observing, measuring, and collecting data from explorations and using this information to classify, predict, and communicate.

Writing

- [3] 1.1.2 The student writes about a topic by writing a paragraph on a single topic with two or more supporting details.
- [4] 2.1.1 The student writes about a topic by writing a paragraph that maintains a focused idea and includes details that support the main idea.

Objectives:

The student will:

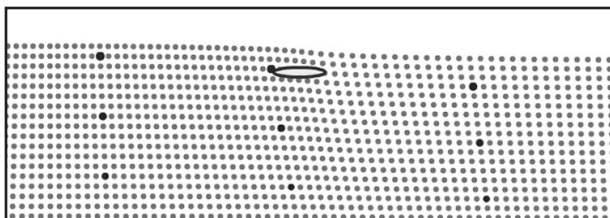
- predict the depth of influence of wave energy;
- observe the depth of influence different waves have; and
- infer the depth of influence of wind waves and tsunamis in the deep ocean.

Materials:

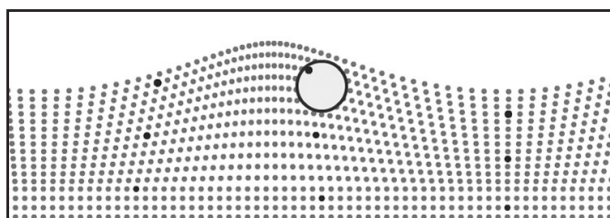
- Clear plastic aquarium
- Water
- Pepper
- Food coloring (assorted colors) or neutrally buoyant glitter
- Couscous, sand or some visible grain that sinks to the bottom of the aquarium
- Fan
- Large rock
- Large pan to catch any splashes from the aquarium
- STUDENT WORKSHEET: "How Deep?"

Whole Picture:

Most ocean waves are generated by wind. Wind waves cause water particles to move in a circular motion. The diameter of each circle decreases with depth. The depth of influence in the deep ocean is $\frac{1}{2}$ of the wavelength. Because of circular motion, wave particles return to the approximate same position, therefore an object on a wave would not move with the wave energy but return to the same general area. In a tsunami wave, the water particles move differently. Their enormous wavelength causes them to act like shallow water waves and the water particles move in an oval shape.



Tsunami Wave



Wind Wave

Wind can create waves of different sizes. The smallest are capillary waves. Increasing winds and storms can produce chops and swells. Tsunami waves are always called by the same name. They may cause runups that are barely noticeable in size compared to those that are enormous and life-threatening. Tsunamis are caused by water displacement associated with earthquakes, landslides, or volcanic activity.

In the Deep Ocean

Type of Wave	Period	Wavelength	Depth of influence	Source
Capillary or ripple	< .1 second	< 2 cm	Very shallow	Light wind, insects
Chop	1-10 seconds	1-10 m	Shallow	Strong wind
Swell	10-30 seconds	Up to hundreds of meters	$\frac{1}{2}$ of the wavelength	Storms
Tsunami	5-60 minutes	20 km to 300+ km	To the bottom	Earthquakes, Landslides, Volcanic eruptions

Activity Preparation:

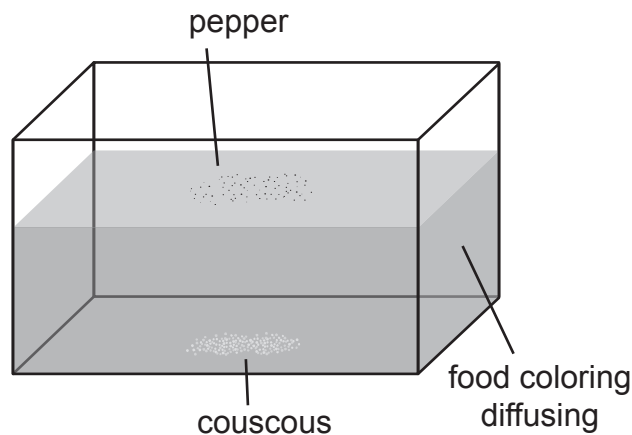
Fill the aquarium 2/3 full of water. Drop about a teaspoon of couscous or other sinking particles.

Teacher Note. For younger students it may be more appropriate to make an overhead transparency of the first page of STUDENT WORKSHEET: "How Deep?" and guide them through the process of recording predictions, observations and writing main ideas.

Activity Procedure:

1. Explain students will see how different forces like wind or landslides make waves move different depths in the deep ocean. They will investigate how a fan will move water at different depths and how a large rock dropped into the aquarium will affect water at different depths.

2. Display the aquarium and explain that two forces will be applied to the water on the aquarium. The fan will model wind and a large rock dropped into the water will model a landslide. Different items in the tank mark different depths. Ask students to look closely to see the couscous on the bottom. Sprinkle some pepper on the top. These items will be observed to see how deep the wave is moving water. Drops of food coloring will help students see if the water in between the pepper and couscous is being moved.



Distribute STUDENT WORKSHEET:
"How Deep?" to older students.

3. Guide students through the investigation by explaining that the first force they will test is blowing on the surface of the water. Ask students to mark predictions of depth on their worksheet. Apply the force then ask students to record observations by checking which depths were affected. Repeat this process for the fan and the rock. Ask students to complete the worksheet by writing the main ideas from this investigation. Also ask them to think how deep wave energy from wind and tsunamis would affect plants and animals at different depths.

Extension Ideas:

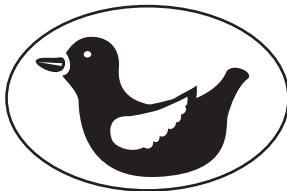
- Investigate the type of animals and plants that live in the sea around your area. Make a bulletin board display.
- Take a fieldtrip to different areas of water and observe the waves. Bring a camera to take pictures. Make a collage of the photographs.

Answers:

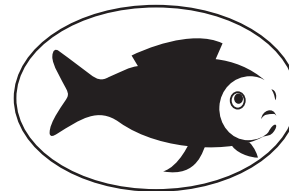
1. *Answers for predictions will vary. Ideally, observations should reflect that the force of blowing air, simulating wind, does not affect the bottom of the water column.*
2. *Answers for predictions will vary. The fan, a stronger force simulating stronger wind, affects depths deeper than just blowing air.*
3. *Answers for predictions will vary. The rock should displace water at all depths, simulating a landslide event.*

4. *Answers will vary.*

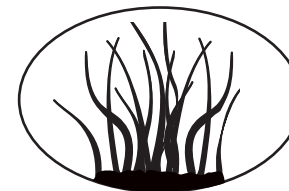
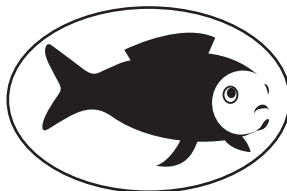
5. *Answer must include:*



Answer might include:



- 6.



Name: _____

How Deep?

Student Worksheet (page 1 of 2)



1. Blowing Air



I predict wave energy will move:

shallow	<input type="checkbox"/>	
middle	<input type="checkbox"/>	
deep	<input type="checkbox"/>	

I observed:

shallow	<input type="checkbox"/>	
middle	<input type="checkbox"/>	
deep	<input type="checkbox"/>	

2. Fan



I predict wave energy will move:

shallow	<input type="checkbox"/>	
middle	<input type="checkbox"/>	
deep	<input type="checkbox"/>	

I observed:

shallow	<input type="checkbox"/>	
middle	<input type="checkbox"/>	
deep	<input type="checkbox"/>	

3. Rock



I predict wave energy will move:

shallow	<input type="checkbox"/>	
middle	<input type="checkbox"/>	
deep	<input type="checkbox"/>	

I observed:

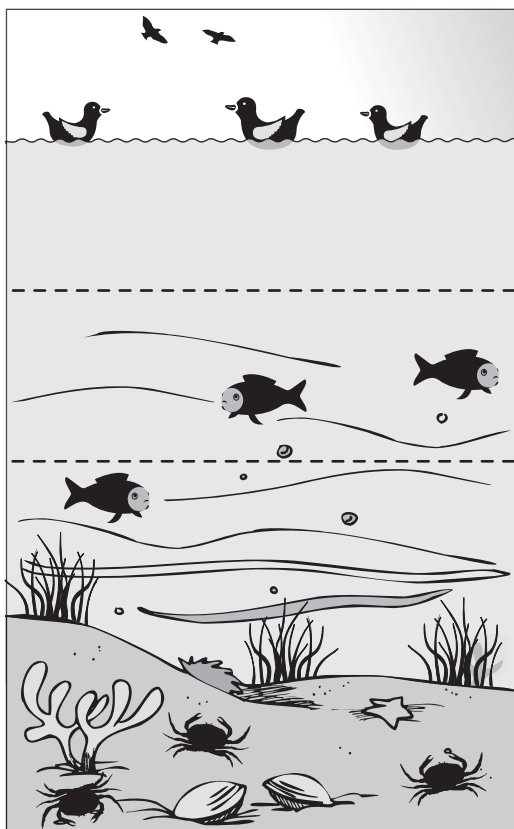
shallow	<input type="checkbox"/>	
middle	<input type="checkbox"/>	
deep	<input type="checkbox"/>	

4. Write a summary of what you learned.

Name: _____

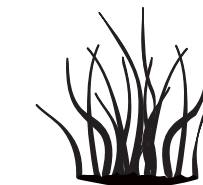
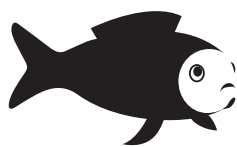
How Deep?

Student Worksheet (page 2 of 2)



Directions: Circle the correct answers.

5. In the deep ocean, these will feel a wave made by the wind  :



6. In the deep ocean, these will feel a tsunami wave.

