

LESSON 3 Waves

Lesson at a Glance

Using a PowerPoint presentation, the teacher introduces basic information about waves and how they can be described. Students then create a wave box and make observations and inferences about how and why the shape of waves change with shifts in wind. Students can use these observations to make connections to the type of data that buoys collect.

Lesson Duration

Two 45-minute periods

Essential Question(s)

What are the characteristics of a wave and how are waves formed?

How are an observation and an inference different?

Key Concepts

- Waves can be described according to their height and length.
- Most ocean waves are formed by winds blowing across the surface of the ocean.
- The size of the wave depends on wind speed, wind duration, and fetch (the distance over which wind acts on the water's surface to generate waves).
- An observation is the act of examining something carefully using one or more of your five senses. An inference is a conclusion that can be drawn based on facts, premises and/or observations.

Related HCPSIII Benchmark(s):

Science SC.4.1.2
Differentiate between an observation and an inference.

Language Arts LA 4.1.1
Use new grade-appropriate vocabulary, including homophones and homographs, learned through reading and word study, including root words, affixes, and word origins.

Instructional Objectives

- I can explain the characteristics of a wave.
- I can describe how wind and other elements influence the formation and shape of waves.
- I can make detailed observations of water and wind using a model, and draw correct inferences about how wind affects water.



Assessment Tools

Benchmark Rubric:

Topic		Scientific Knowledge	
Benchmark SC.4.1.2		Differentiate between an observation and an inference	
Rubric			
Advanced	Proficient	Partially Proficient	Novice
Explain the difference between an observation and an inference and give examples	Differentiate between an observation and an inference	Provide examples of observations and inferences	Define an observation and an inference

Topic		Vocabulary and Concept Development	
Benchmark LA.4.1.1		Use new grade-appropriate vocabulary, including homophones and homographs, learned through reading and word study, including root words, affixes, and word origins	
Rubric			
Advanced	Proficient	Partially Proficient	Novice
Use new grade-appropriate vocabulary, including homophones and homographs, with fluency, accuracy, and precision	Use new grade-appropriate vocabulary, including homophones and homographs, with no significant errors	Use new grade-appropriate vocabulary, including homophones and homographs, with difficulty and a few significant and/or many minor errors	Use new grade-appropriate vocabulary, including homophones and homographs, with great difficulty and many significant errors or rarely use new vocabulary

Assessment/Evidence Pieces

Lesson
<ul style="list-style-type: none"> • <i>Wind and Waves</i> student worksheet • <i>Check for understanding discussion</i>

Materials Needed

Teacher	Class	Group	Student
<ul style="list-style-type: none"> • Computer • Method to project PowerPoint • Butcher or bulletin board paper • Markers 	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • Large, shallow, rectangular pans (aluminum or plastic) • Small fan (optional) • Water 	<ul style="list-style-type: none"> • Student Worksheet- <i>Wind and Waves</i>

Instructional Resources

PowerPoint Presentation: *What is a Wave?*

Student Reading: *Observations and Inferences*

Student Worksheet: *Wind and Waves*

Student Worksheet: *Weather and Wave Notes (Optional)*

Supplemental Resource: *Weather and Wave Patterns Interactive Game*



Student Vocabulary Words

crest: the top of the wave.

fetch: the distance over which wind acts on the water's surface to generate waves.

inference: arriving at a conclusion based on facts, premises and/or observations.

observation: the act of recognizing and noting or recording a fact or occurrence.

trough: the bottom of the wave.

wave: a transfer of energy, progressively from point to point in a medium (in this case water) with speed determined by the properties of the medium.

wind duration: how long in time the wind blows at a certain speed over a certain distance.

wave height: the distance from trough to crest.

wave length: the distance between consecutive wave crest to wave crest.

Lesson Plans

Lesson Preparation

- Review the Science Background provided in the Unit Overview.
- Review and make copies of the Student Worksheets *Wind and Waves*, *Weather and Wave Notes (optional)* and Student Reading *Observations and Inferences*, one per student.
- Obtain large, shallow, rectangular pans for each group, as well as a supply of water to fill pans halfway.
- Attach 15-20 feet of butcher or fadeless paper to a wall.
- Preview the interactive piece *Weather and Wave Patterns* to be completed at the end of Step III.

I. Waves

- Ask students why they think that in Hawai'i there is a surf report when most other states don't. Accept a variety of answers. Inform students that surf reports in Hawai'i are used not only to tell where the best places to surf that day are, but to keep surfers and other users of the beaches from going into water wherever and whenever the waves are not safe. Let students know that today you are going to show them the parts of a wave and how they form so that they can see why the surf reports may tell people to beware and stay out of the water.
- Use the PowerPoint presentation, **What is a Wave?** to introduce the idea of describing waves using the new vocabulary words for this lesson. Prior to starting the PowerPoint, take a moment to write the new vocabulary terms on the board for students. Go through them verbally so that students know how they are pronounced. Ask students to watch for these new terms in the PowerPoint to learn their meaning. The notes in the PowerPoint slides should help guide the discussion. (NOTE: Some of the vocabulary words won't be covered until the video in the next step.)
Suggestion: Having students take notes on the presentation and video(s) will help them to write up their background in the next section. There are many ways to take notes, and a sample note taking page is included as only one suggestion.
 - Students can fill in the column on the left with the facts and information from the presentation/videos.
 - Then, students can go back over the information written and summarize it in their own words and/or draw a quick picture about the information in the right hand column.
- To reinforce this concept of wavelength, line up a group of students who are similar in height side by side, and ask them to stretch out their arms a bit and hold hands. Explain that the students now act as a set of waves by tracing from their hands to their heads. The heights can be measured from the tops of their heads, to their hands (from crest to trough). Explain that wavelength is measured from crest to crest (head to head) or trough to trough (hand to hand). Ask the students to look at the distances between

different students' heads or hands. Then ask students to move closer and hold elbows. Trace this new "wave" in a different color. Ask students to discuss what now has happened to the wavelength.

Note: Adapted from National Geographic Expeditions Introduction to Waves

<http://www.nationalgeographic.com/xpeditions/lessons/07/gk2/wavesintro.html>

- D. Show the video from NOAA learning demo website: <http://www.learningdemo.com/noaa/lesson09.html> Have students pay special attention to the different wave sizes and shapes in the video. Remind students to watch for the new vocabulary in the video. (NOTE: Hit pause on the video when the announcer introduces Tsunamis. The rest of the video can be seen during the next lesson, which addresses Hurricanes and Tsunamis.)
- E. Once the PowerPoint presentation and the video are complete, take a moment to review the vocabulary terms written on the board (or create a word wall) with the students. (Optional: another good reference is the ocean world website below: <http://oceanworld.tamu.edu/students/waves/waves3.htm>.)

II. Wave Observations

Safety Note:

During the lesson, students may spill water onto the floors. This may cause slippery conditions. ALL students should be using covered shoes to do this lab activity.

Remind students to walk carefully (NO running and/or horseplay) and to follow all classroom safety rules. Students should also tell the teacher when they see water on the ground so that the teacher can clean it up.

- A. Tell students to recall what they saw in the video about the wave sizes.
- B. Hand out the **Wind and Waves** worksheet. Have students summarize things they learned from the presentation, video(s), and previous lessons.
- C. Conduct a brief discussion and have students generate questions from observing the waves in the video. Ask each group to write a question about what they would like to know about the effect of wind speed and wind duration on the size of the waves. An example could be, *Does wind speed and wind duration affect wave size?* Explain that the students will now be guided to create a hypothesis about wave size and wind. Review that a hypothesis is "an idea that can be tested by an experiment or observation" (ScienceSaurus, 2005). Tell students that hypotheses can be stated in different formats, but for purposes of this lesson we will use an *If – Then* statement.

IF (State Conditions)	THEN (Hypothesis)
Example 1: If the duration of the wind blowing in a particular direction is long and the fetch is far	then the wavelengths that are created from the wind will be long



Example 2:

If the duration of the wind blowing in a particular direction is short and the fetch is also short

then the wavelengths created from the wind will be short

- D. Check with the students to determine that their hypothesis is testable. If necessary, discuss what the term “testable” means. As an example, explain to students that only one thing can be tested each time. If we test more than one thing (e.g. strength and duration of wind) we will not be able to tell which one is causing the change. (e.g. wavelength)
- E. Distribute the Student Worksheet, **Observations and Inferences**, to each student and go over together as a class.
- F. Divide students into groups of four. Give each group a pan (large, shallow, rectangular pan), water, and a small fan (optional) to each group.
- 1) Give each student goggles to use through the duration of the lab. Instruct students on the proper way to wear safety goggles.

Safety Note:

Goggles should be worn over the eyes at all times and should not be removed until the end of the lab when the teacher instructs them to.

- G. Tell students that the purpose of this activity is to look at the effects of wind speed, wind duration, and fetch on waves. Please define fetch for students by reviewing the vocabulary word. **Fetch** is the distance over which wind acts on the water’s surface to generate waves. Have students conduct the activity according to the directions provided on the worksheet.
- H. Ask students to record their observations and data on the wind and waves student worksheet.
- Adding a colored bead or other small object that floats may help students observe the wave heights.
 - Safety: please remind students that any materials in a science activity should only be used for what the teacher instructs. Students must follow directions at all times.
 - Have students record their measurements on their worksheets as one type of data and their observations as another type. Ask students to record their observation on the Wind and Waves student worksheet.
- I. Make inferences based on observations and write a possible conclusion to their question.

III. Check for Understanding

- A. Ask a group of students to share their answers to the activity questions. Check whether the other groups agree or disagree with the answer. Students should come away from the activity understanding that the size of the wave depends on wind speed, wind duration, and fetch (the distance over which wind acts on the water’s surface to generate waves).
- B. In order to reinforce student learning have the class work in pairs on the computer using the *Weather and Wave Patterns Interactive Game*.

Extension Activity

A wave simulator is available online at the following website.

<http://www.nationalgeographic.com/volvoceanrace/interactives/waves/index.html>

LESSON 3 Student Worksheet (optional)

Weather and Waves Notes

Information	Summary and Drawing

LESSON 3 Observations and Inferences

Meteorologists use observations and inferences as they gather weather data to create weather and surf predictions. It is important to know the difference between an observation and an inference. An **observation** is something that you notice by paying attention to your surroundings. An example of an observation could be as simple as a change in the way the wind is blowing, or how the ocean smells, or even the color of the ocean. An inference takes an observation one step further by offering an explanation for the observation or drawing a conclusion. Some inferences turn out to be correct, while others are incorrect. It is also possible to have more than one **inference** per observation.

Here are a few examples to distinguish the difference between these two terms:

Example 1:

An **observation** is seeing a woman walking down the street with a briefcase at 9 a.m.

An **inference** would be to say that the woman is walking to work.

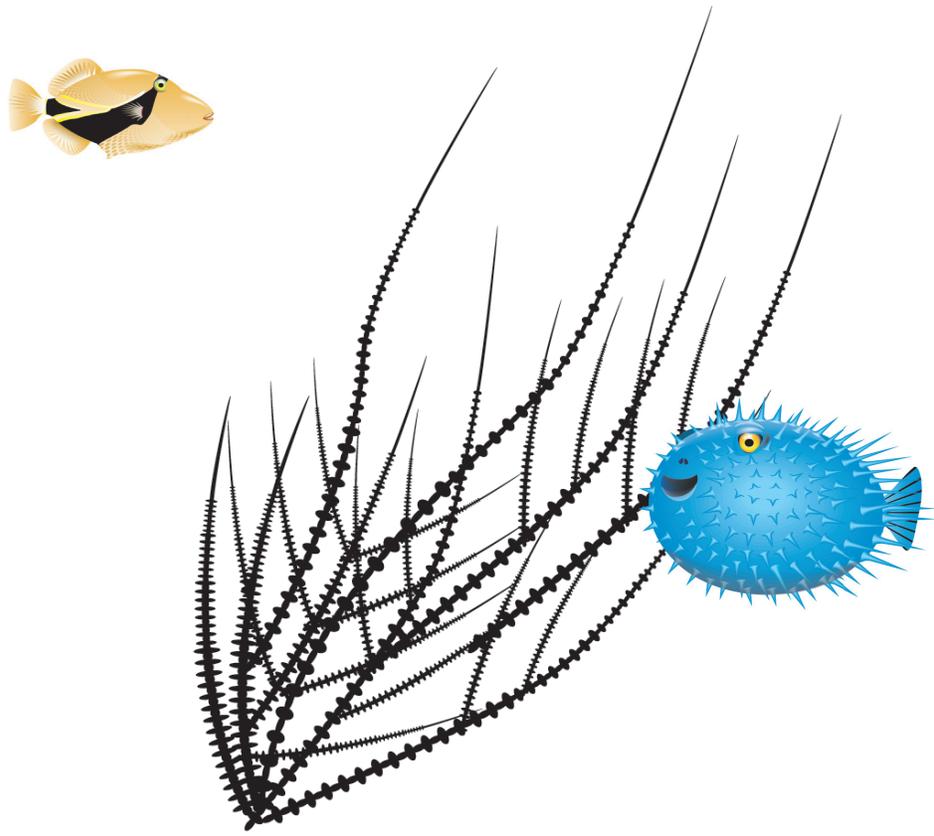
Example 2:

An **observation** is seeing three small waves break and, ten minutes later, four very large waves break.

An **inference** would be to say that the wave size is increasing.

Another **inference** would be to say that the waves are inconsistent in size.

Another **inference** would be to say that the waves are coming in as sets of sizeable waves every 20 minutes.



LESSON 3 Student Worksheet

Wind and Waves

NAME: _____

DATE: _____

What do you know up to this point about---wind and waves?

(You may use your notes from the video(s)/PowerPoint presentation.)

Directions

Answer the following questions using a shallow pan, water, and your own breath or small fan (optional). For each question: a.) Write a hypothesis. b.) Do the procedure (try the same thing 3 times). c.) Write your observations.

1. Observation: How does the water appear when there is no wind?
2. Speed: What happens if one person blows gently on the water for five seconds? What happens when someone blows hard on the water for five seconds? Take data and write your observations.

Hypothesis:

Observations: Blowing gently for 5 seconds
1.
2.
3.
Observations: Blowing hard for 5 second
1.
2.
3.

3. Duration: What happens if one person blows gently on the water for ten seconds?

Hypothesis:

Observations: Blowing gently for 10 seconds

1.

2.

3.

4. Fetch: How does the water appear with one person blowing directly on it? How does the water appear with one person blowing across the entire surface?

Hypothesis:

Observations: Blowing directly on the water

1.

2.

3.

Observations: Blowing across the surface of the water

1.

2.

3.



5. Inference: How did each of the following affect waves? Use data as examples in your explanations.
- Wind speed
 - Wind duration
 - Ocean surface area
6. How do the observations you just made about how waves are created, wave height and wave length relate to the data collected by buoys in lesson 2?

