Lesson Plan: Conditions at Sea
Background

Summary

Forecasting the conditions at sea is an important tool for sailors, fishers, maritime transportation, anyone on the water. In Conditions at Sea, a three-part series, students first learn about the concepts of wave formation and forecasting, conduct an in-class wave-making activity, and access near real-time and real-time data from ocean observing buoys to investigate the relationship between wind and wave height, and predict the actual conditions out at sea using the Beaufort scale.

Subject Area

Physical Science/ Earth science

Grade Level

6-12

Key Concepts

- Ocean wave formation is primarily caused by wind.
- Wave characteristics can be forecasted from wind data.
- Forecasting is an important tool for mariners

Objectives

- Explain the process of wave formation and the forces that cause waves.
- Access and use near real-time data to make predictions on sea conditions.
- Analyze the relationship between the ocean and the atmosphere.

Background Information

Ocean waves are most commonly caused by wind. As wind moves across the water, it "pushes" the ocean water ahead of it. The wind actually transfers some of its energy into the water. The water is able to "gain" energy from the wind because of the

friction between the wind and the water. As wind pushes the water, wrinkles form on the surface. The stronger the wind is, the rougher the water surface. As the surface of the water gets rougher the surface area of the water increases, and thus the more surface area is available for the wind to catch, creating larger and larger waves as the wind travels across the water's surface.

The size of a wave created by wind is determined by three things:

- distance the wind blows over open water, known as the **fetch**
- the length of time the wind blows, the **duration**
- And the speed of the wind, the **wind speed**

The greater any one of these three conditions, the larger the wave. Often, a wave's size and shape can give clues to its origin. A steep, choppy wave out at sea is probably fairly new and formed by a local storm. Slow, steady waves near shore probably come from storms far away.

A wave's characteristics can be described and quantified. A wave's highest point is called its **crest**. The low point between two waves is called a **trough**. The vertical distance between crest and trough is called the **wave height**. The distance between two waves is called the **wavelength** and it is usually measured either from one crest to the next or from one trough to the next. The time it takes for waves to pass is called the **wave period**. It can be measured by counting the seconds it takes for two crests or troughs to pass by a specific point. The number of wave crests passing a specific point each second is the **wave frequency**.

Understanding the wind and wave conditions, or **sea state**, out on the water is an invaluable tool for anyone out on the water, including mariners, fishers, and travelers. In 1805, British Admiral Sir Francis Beaufort (1774-1857) created a wind speed estimation system based on the conditions at sea. Consisting of a 0-12 scale, the **Beaufort Wind Force Scale** ranged from calm to hurricane force winds (which are then measured by the **Saffir-Simpson Scale**; tornadoes are measured by the **Fujita Scale**). Despite many different forms, Sir Beaufort's Scale is still recognized as the standard and is used all over the world for describing wind conditions both at sea and on land.

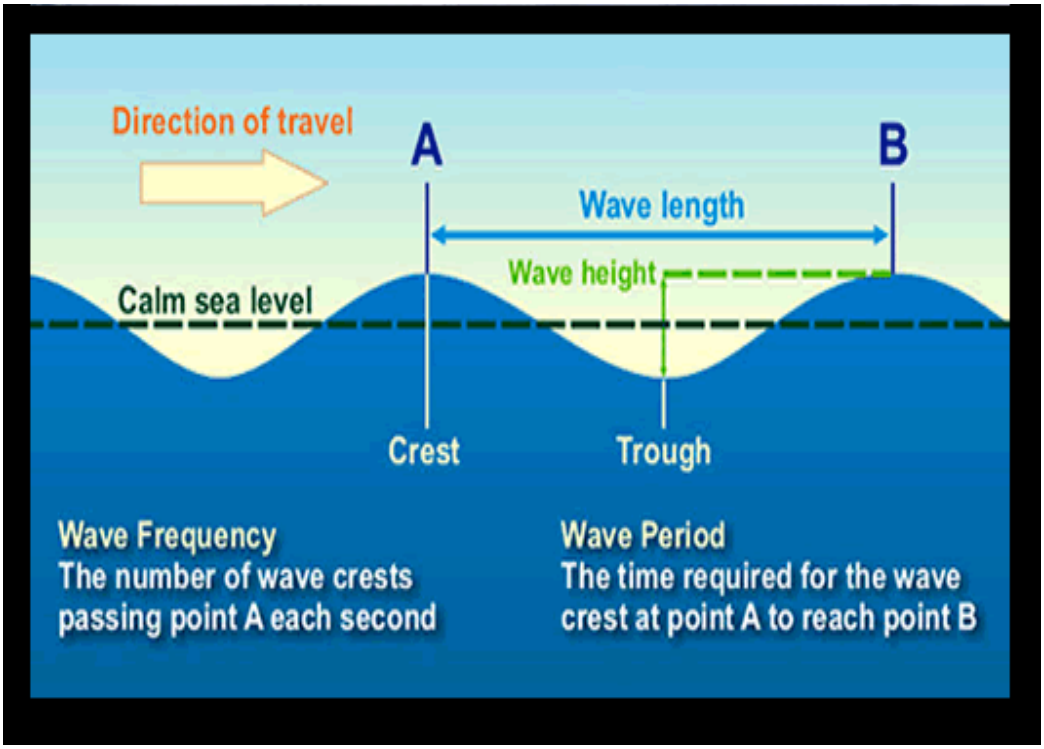

Image from: http://www.windows.ucar.edu/tour/link=/earth/Water/ocean.html

Ocean observing systems maintain buoys along our coasts and offshore to record conditions out on the ocean, and are able to transmit this information, via satellite, in real- time or near real-time. Many of these buoys measure parameters including wind speed, and wave height, which can provide valuable information on sea conditions to anyone who is considering being out on the water.