Wave Properties

Below is an overview of the activity Wave Properties (National Geographic) to incorporate information learned from Dr. Herrington's presentation and subsequent discussion.

Lesson Overview

Students learn about the varying heights of ocean waves and what causes the variation, how waves are formed, and the parts of waves.

Lesson Rationale

Many students visit the New Jersey shore each summer and thus are familiar with waves for recreation. However, few students understand how waves are formed. Gaining a better understanding of wave formation gives students a broader understanding of a phenomenon many are familiar with and begins to teach students about forces and the movement of matter. In addition, through the thought exercises and online simulation students gain a more thorough understanding of the effects of different components of waves on the overall size of waves and the location of such waves around the Earth.

Key Concept

Students learn the components of a wave, and then discuss the effects of wave height, wavelength, and wave period in determining the overall size of a wave.

Wave Properties (9-12)

Overview:
In this lesson, students will learn the components of a wave, then discuss the effects of wave height, wavelength, and wave period in determining the overall size of a wave. They will use the National Geographic Wave Simulator to experiment with creating different kinds of waves. Discussion will then focus on the effects of geography on wave size as well as additional forces on boats trying to navigate waves.

Connections to the Curriculum:
Geography, math, earth science

Connections to the National Geography Standards:
Standard 7: "The physical processes that shape the patterns of Earth's surface"

Time:
Two to three hours

Materials Required:
- Computer with Internet access
- Wall or blank Xpeditions outline map of the world showing latitude and longitude lines
- Globe (optional)
- Paper and writing utensils

Objectives:
Students will
- identify various bodies of water on the planet, discuss their observations about the amount of water on the planet, and hypothesize about the potential wave size in each location;
- learn the different parts of the wave and identify them;
- look at the effects of wave height, wavelength, and wave period on the overall size of a wave; and
- create various scenarios on the online National Geographic Wave Simulator, and discuss additional forces that might affect the way a boat might react to varying wave sizes.

Suggested Procedure
Opening:
Show the students a wall or outline map of the world, or a globe; then ask them to identify and describe the oceans. For example, have them look up which oceans are the largest, the deepest, and which possess the strongest currents. Then ask the students to hypothesize where on the planet they might find the largest waves.

Some of the largest recorded waves exist in what is often referred to as the Southern Ocean, the stretch of water surrounding Antarctica to the 60: south latitude. In these southern latitudes, the winds and currents wrap around the planet with little land to slow them down. Sailors refer to them as the "Roaring 40s," "Furious 50s," and "Screaming 60s" for the latitudes where these

winds occur. Look at the Drake Channel between the tip of South America and the Antarctic peninsula, where some of the largest waves in the world occur. Why do the students think this phenomenon occurs?

Development:
Draw a wave on the board so all of the students can see it. Identify the crest, trough, wave height, and wavelength of each wave; then explain the concept of wave period—that one cycle is the amount of time for two consecutive crests to pass a given point.

Send the students in pairs to the National Geographic Wave Simulator and ask them to experiment with the various controls. After a few minutes, have them record all of their observations. What did they notice about the position of the boat as the waves rolled past? Explain to them that in the real world, the wind acts as a key force on a boat.

When a boat encounters high waves and strong winds, it is virtually impossible to sail against the wind and over the waves so the boats actually surf down the waves. However, if the wind carries the boat faster than the waves, then the boat risks plowing into the wave ahead of it and pitch-poling (when the stern flips over the bow and the boat cartwheels). To prevent this from happening, sailors have two options: they can take down their sails—a technique called "reefing"—or they can throw out what is called a sea anchor or "drogue." A sea anchor creates drag to slow down the boat, much like a drag racing car uses a parachute off the back to slow down after a race.

Send the students back to the simulator and assign each group a different geographical scenario (i.e. you are sailing through the Drake channel, what would the wave and wind conditions resemble and what should you do to best handle them?). Have them determine which variables they may want to increase/decrease to improve the situation. Students can explore the National Geographic Sailing Simulator to learn more nautical terms and see how boats behave in the wind.

Closing:
Review the parts of the wave and the concepts of wave height, wavelength, and wave period. Ask the students to describe the situations that they created on the simulator. What situation created the most difficult wave conditions? The easiest? Do they feel that the simulator gave them an accurate picture of how the boat would react in the real world? What can they conclude from their study of the different oceans? What factors may also contribute to having larger waves? What other variables might contribute to how a boat might react to a wave?

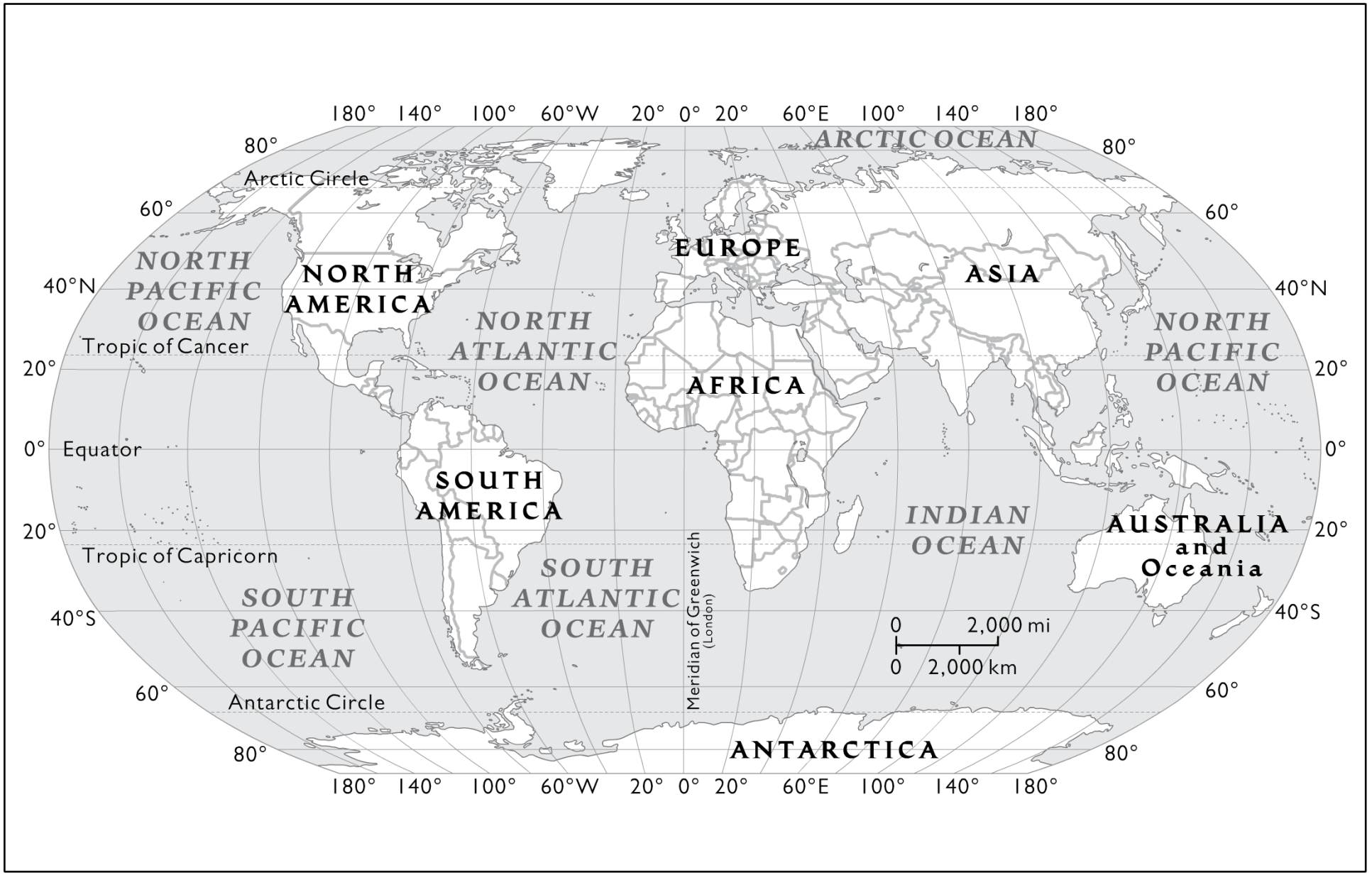
Suggested Student Assessment:
Ask the students to research the Perfect Storm from 1992. What conditions allowed for this storm to have such an enormous effect? Why did the waves become so daunting? Why was it called the Perfect Storm?

Using the simulator, try to re-create the waves from this storm as compared to other ones discovered during the lesson. What did the students observe about these wave sets? Which

element played the greatest role during the storm: wave height, wavelength, wave period, or wind? Why?

Extending the Lesson:
In 2004, the first ever non-stop race around Antarctica is scheduled to occur. To date, several entrants have already registered. The entry fee includes the purchase of a sailboat for the event. In groups, research the conditions that the racers expect to encounter, and then make a list of suggestions for the designer of the boats. What factors should be taken into account? How many sails should be included? What types of safety gear might the competitors want on board? Remember that this is a race, the boat needs to be both fast and strong.

Related Links:
International Sailing Federation
National Geographic: Volvo Ocean Race 2001-2002
National Geographic: Wave Simulator
Sailing Source



THE WORLD