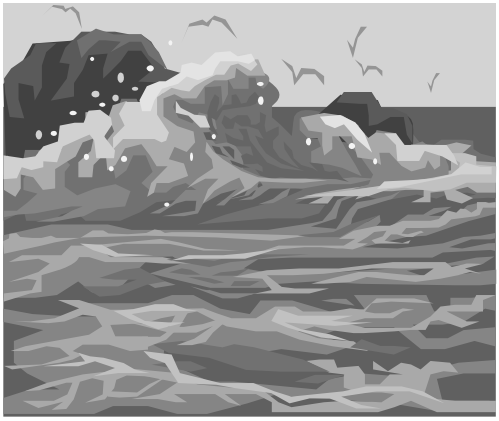
Wind and Waves



Topics
Waves, Wind

Grades
3-5

Site
Indoor

Duration
30 minutes

Materials
See page 2

Vocabulary
adaptations, rocky shore, waves, wind

Next Generation Science Standards

Practices

Constructing explanations and designing solutions

Core Ideas

PS4.A Wave properties

Crosscutting Concepts

Cause and effect

Performance Expectations

See page 4

Focus Question

What causes ocean waves?

Overview

What creates ocean waves? Through exploration, students learn that moving air, or wind, often causes waves. Students use their breath, straws and battery-powered fans to experiment with wind strength and create waves in a model ocean. They then predict and test the effect of waves on a rocky shore habitat and animals.

Objectives

Students will be able to:

- Describe how wind causes ocean waves.
- Explain the effects of waves on a rocky shore habitat and its inhabitants.

Background

Most ocean waves are primarily generated by wind moving across the surface of the water. Wind-generated waves represent mechanical energy that has been transferred from the energy in air motion, or wind, to water. The size of a wind-generated wave is determined by three main factors: the length of time the wind is in contact with the water's surface, the velocity of the wind and the distance over which the wind has been in contact with the water. Wave energy varies seasonally. Stronger winds in the winter produce winter waves which release more energy onto the coastline while summer winds produce gentler waves that release less energy.

Waves are a limiting factor in the complex communities of shorelines, such as the rocky shore. Waves hit the shore with a powerful force, releasing their energy onto the land. They crash against the shore, smashing and tearing seaweeds and other organisms away. Waves also throw water higher on the shore than tides alone could, which extends the upper boundary of the intertidal zone. (The intertidal zone stretches from the highest wave-splashed rocks down to levels uncovered during extreme low tides.)

VOCABULARY

Adaptations: physical structures and behaviors that help an organism survive in its habitat

Rocky Shore: coastline that includes the high and low tide line consisting primarily of rocks

Waves: mechanical energy traveling through water

Wind: air in natural motion, often travelling horizontally at any speed

ELL TIPS

Building on prior knowledge is important support for English Language Learners encountering new concepts.

Prior to the activity, read non-fiction books, show videos or visit the shore to place the activity in the context of shorelines and their characteristics.

Animals living at the rocky shore have many adaptations to help them survive in their habitat and withstand the force of waves. Some animals like barnacles and mussels, anchor themselves to the substrate using glue-like chemicals. Other species, like abalone and sea urchins, have mucus-covered body parts that can stick to rocks temporarily, giving them limited movement. A rounded or flat shape makes it easier for waves to flow over the animal so that the animals experience less force when the wave hits them.

Materials

For each group:

- Water
- Dishpan
- Soda straws
- Paper
- Battery-operated fan
- Wave maker (half of a plastic plate or other 4-inch by 6-inch piece of wood or plastic)
- Assorted sizes of rocks (some large enough to extend above the water in the dishpan)
- Clay
- Gravel (optional)

For the class:

- Images or video of waves crashing on a rocky shore

For each student:

- Notebooks
- Pencils

Teacher Preparation

1. Gather supplies from the materials list.
2. You may choose to set up the dish pans of water in advance.

Procedure

1. **INTRODUCE THE FOCUS QUESTION TO THE CLASS.**
   Share the question: *What causes ocean waves?* You may write it up on the whiteboard or have students add it to their science notebook. Give students time to write their initial thoughts down or discuss with a partner. Depending on their prior knowledge, you may need to spend some time exploring the concepts of waves and wind first.

2. **REVIEW STUDENTS' PRIOR KNOWLEDGE ABOUT THE CONCEPT OF WIND.**
   Read a story about wind as a class. Have students share with a partner an experience they have had with the wind. You may open a window or take students outside. Ask them if they can feel any wind.

3. **STUDENTS EXPLORE THE IDEA OF DIFFERENT KINDS OF WINDS.**
   Have students create wind by blowing air onto the palm of their hand. Can they feel the wind they created? Challenge them to create a breeze or gentle wind. Now have them make a hurricane or strong wind. Give students straws to use to create wind. *Blow air through a straw onto the palm of your hand. Does the wind feel similar or different than when you used only your mouth? Experiment with making gentle, medium and strong winds with your straw.* Discuss how wind is actually energy in the form of moving air.

4. **Student groups create wind on the water in the dishpan.**
   Divide students into small groups. Pass out a dishpan full of water to each group. Challenge them to create wind using the straw. You may guide their exploration with instructions like: *Keeping the end of the straw above the surface of the water, blow through the straw. What happens when the wind hits the surface of the water? Experiment with different strengths and directions of wind. Try changing the angle of the straw or the distance of the straw end from the water's surface. What happens when you blow for different lengths of time?* Have them record their observations in a science notebook.

5. **Use different methods to create wind on the water.**
   Encourage students to use alternate methods to create wind. Pass out paper and battery-operated fans. Students can fold the paper to make a fan. *What happens when you use a paper fan on the water? What happens with the battery-operated fan? Are there other ways you could create wind on the water?* Have students record their observations.

6. **Discuss how wind creates waves with a partner.**
   Have students explain their observations to a partner. *What do they think might happen when wind blows across a lake or the ocean? (waves created) How does wind strength affect wave size? How does wind direction affect waves? How does the length of time wind blows affect waves?* They should be able to explain their thinking using evidence from their explorations. Be sure students understand that waves are created when energy from moving air (wind) is transferred to the water. Thus a wave is mechanical energy traveling through the water. (Note: it is the energy that moves with the speed of the wave, not the water. The water may move too but at a much slower speed and generally in a circular or back-and-forth motion.)

7. **Students experiment with size and frequency of waves.**
   Pass out the "wave makers" (plastic plates cut in half or small blocks of wood or plastic). Have students use a "wave maker" to create waves of a consistent height and frequency. Ask them to describe what happens as a wave travels through water. *Does the wave energy get stronger or weaker as it travels? Does the height change? Does the time between waves change? What other patterns do you notice?* (Note: wind speed, wind duration and distance over which the wind blows all affect wave size.)

8. **Students observe the impact of waves on a model rocky shore.**
   Refer back to the picture or video of waves hitting a rocky shore. Ask students how they think waves affect a shoreline. *What do you think happens if the waves are small? If the waves are large? Where does the energy in the waves go?* Have them experiment by placing an assortment of large and small rocks into one end of the dishpan. You may want to give them gravel as well to help hold the rocks in place. Have students use their wave makers to create waves. *What happens? When waves hit the rocks in the pan, do any of the rocks move? Which rocks move? Which stay in one place? Does the size or frequency of the waves make a difference? How might waves affect a rocky shore differently than a sandy shore?*

TEACHER TIP

If it is difficult for students to observe the water movement, try placing little pieces of Styrofoam or packing peanuts in the water.

The mission of the Monterey Bay Aquarium is to inspire conservation of the oceans.

9. **STUDENTS EXPERIMENT WITH EFFECTS OF WAVES ON ROCKY SHORE ANIMALS.**
Pass out clay. Have students create an animal (e.g., sea cucumber, anemone, hermit crab and so on) and place it on the shoreline. This may be a good time to discuss if the animal lives in the water, on the rocks, behind the rocks or somewhere in between. Ask students to think about effects of waves on rocky shore animals. *What happens when small waves hit the shore? What happens if the waves get larger? What adaptations could you add to your animals to help them survive when waves come?*

10. **DISCUSS WIND AND WAVES AS NATURAL AND IMPORTANT EARTH PROCESSES.**
Review how most waves are created. (wind energy) Lead a discussion with questions like; *How does strength and direction of wind affect waves? What effects do waves have on a rocky shore? What body parts might animals have to deal with waves?*

11. **RETURN TO THE FOCUS QUESTION.**
Now that students have experimented creating wind and waves, have them revisit the question: *What causes ocean waves?* Students may think on their own or discuss with a partner. Then in their science notebook, you may have them draw a line of learning and under it add to their original thoughts about the question.

Extensions

- Make a wind meter with a piece of old audiocassette tape or Mylar ribbon tied to the end of a pencil. What happens to the tape on a calm day? A windy day? How can you tell the direction of the wind with your wind meter?
- Add different-sized grains of sand to the dishpan and experiment to see the effects of waves on a sandy shore.

Resources

Website

Monterey Bay Aquarium www.montereybayaquarium.org
Find information about animals and habitats in the exhibits.

Books

Gilberto and the Wind. Ets, Marie Hall. Usborne Publishing, 1978.
Where Does the Wind Blow? Rink, Cindy. Dawn Publications, 2002.
Where Does the Wind Go? Vaughan, Marcia. Mondo Publishing, 1996.
Where the Waves Break: Life at the Edge of the Sea. Malnig, Anita. Carolrhoda Books, 1985.

Standards

Next Generation Science Standards www.nextgenscience.org

Performance Expectation

Relates to PS4-1: Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move

CONSERVATION TIPS

Talk to students about how wind carries many items to the ocean. Plastic bags are a common sight on our shores. Unfortunately, animals can become entangled or accidentally eat plastic. Help keep our neighborhoods and shorelines clean.