KEY CONCEPT

13.3 Waves move through oceans.

BEFORE, you learned

- Currents are masses of moving water
- Surface currents are driven mainly by winds
- Deep currents are driven mainly by differences in density

NOW, you will learn

- How waves form
- How waves move energy through water
- How wave action changes near the shore
- How waves can cause currents near the shore

VOCABULARY

longshore current p. 444
rip current p. 444

EXPLORE Waves

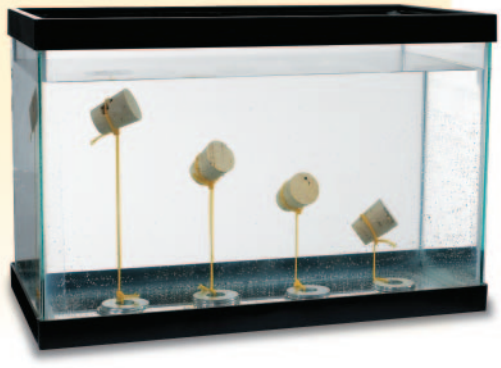
How does wave motion change with depth?

PROCEDURE

1. Fill an aquarium or another clear rectangular container about three-fourths full of water.
2. Tie several metal washers to each of four corks to make them float at different heights, as shown in the photograph.
3. Using your hand or a piece of cardboard, make steady waves in the water. Experiment with a variety of waves—some small and some large. Observe the cork movements.

MATERIALS

- aquarium or clear container
- corks
- string
- metal washers
- water



WHAT DO YOU THINK?

How does the movement of the corks change with depth?

OUTLINE

Remember to start an outline for this section.

I. Main idea
  A. Supporting idea
    1. Detail
    2. Detail
  B. Supporting idea

Waves form in the open ocean.

If you have ever blown across the surface of hot chocolate, you may have noticed ripples. Each of these ripples is a small wave. A wave is an up-and-down motion along the surface of a body of water. The vast ocean surface is covered with waves of various sizes, which are usually caused by winds. Moving air drags across the water's surface and passes energy to the water, causing waves. Other disturbances—such as earthquakes, landslides, and underwater volcanic eruptions—can also cause waves.

CHECK YOUR READING What can cause waves to form in the ocean?

Wave Action at the Water's Surface

READING TiP

As you read about wave action at the water's surface, look at the illustrations on page 443.

A wave in the ocean has the same basic shape as many other waves.

- The **crest** is the high point of the wave.
- The **trough** (trawf) is the low point of the wave.
- **Wave height** is the vertical distance between the top of the crest and the bottom of the trough.
- **Wavelength** is the distance between one wave crest and the next.

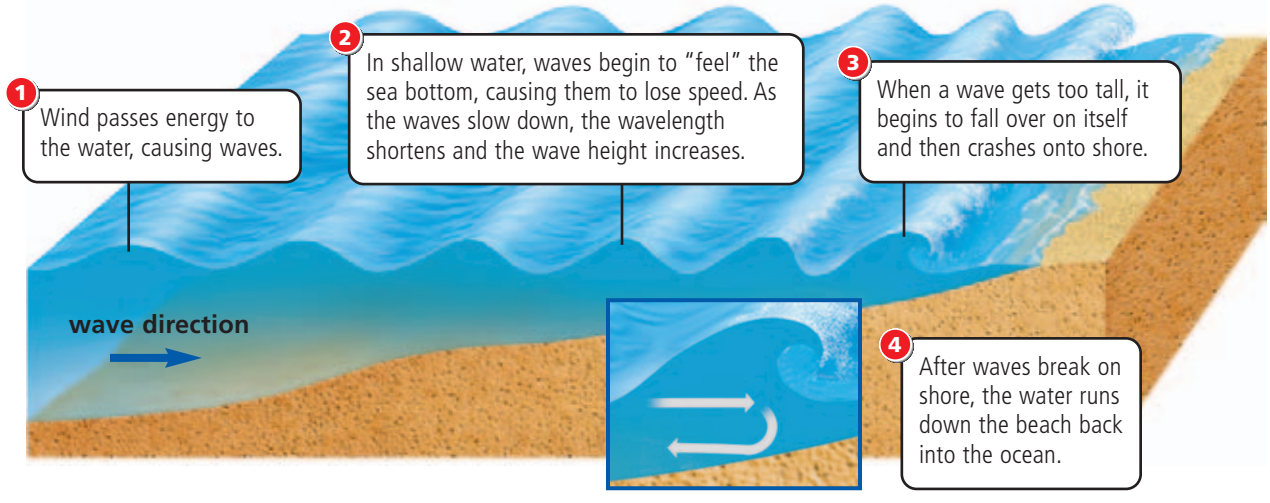
RESOURCE CENTER
CLASSZONE.COM
Explore ocean waves.

You have read that currents move water from one place to another. In contrast, waves do not transport water. Waves move energy. They move through water, but the water stays more or less in the same place. Follow the drawings on page 443 to see how water particles move in a circle as a wave passes through. If waves do not transport water, how do surfers zip toward shore on waves? Surfers are powered by the energy traveling in the waves. Waves transport energy, not water.

Most waves affect only the water near the surface of the ocean. Water particles farther down move in smaller circles than particles near the surface. Below a certain depth, the waves no longer affect the water.

Wave Action near Shore

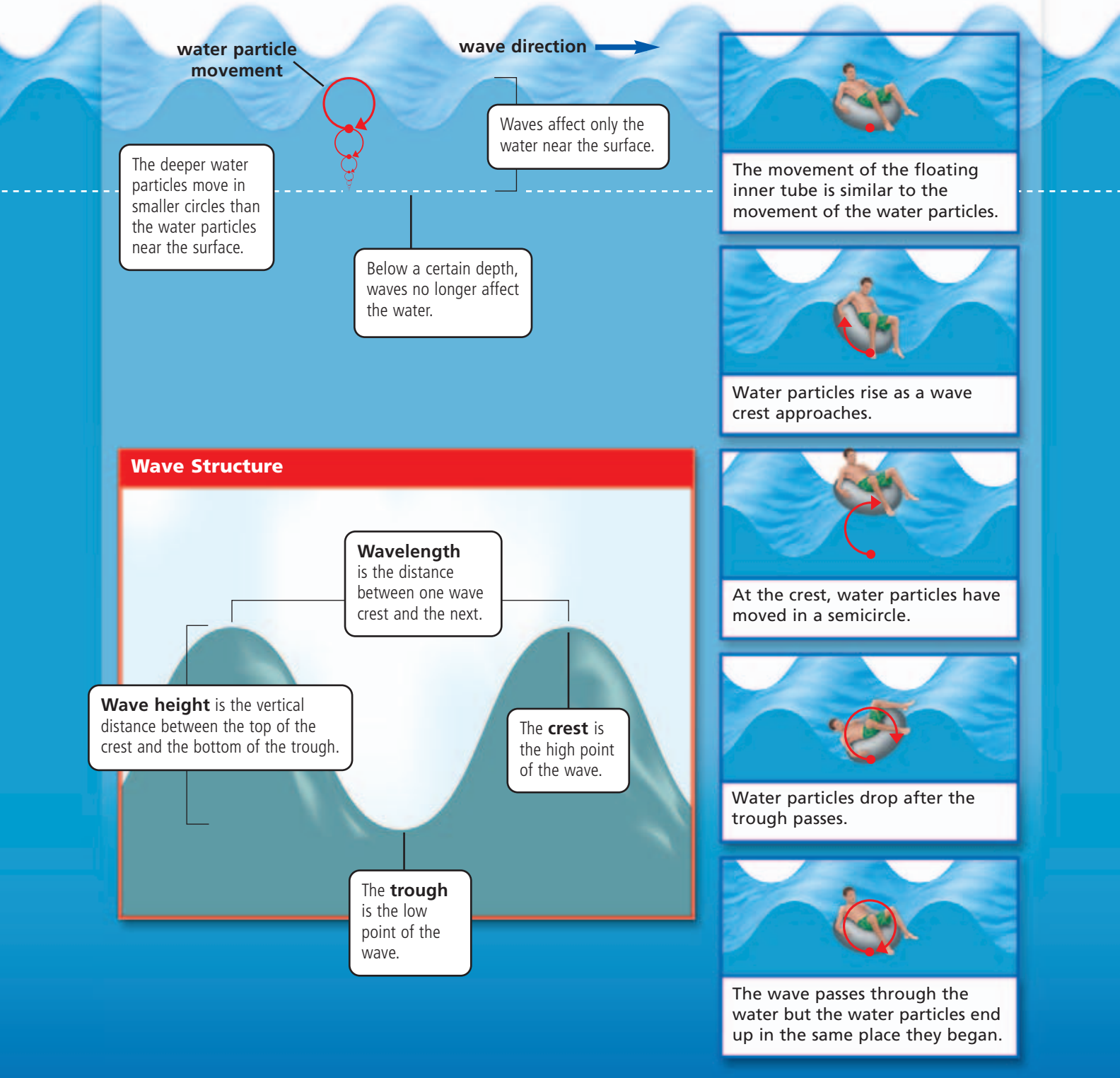
Waves may pass through the ocean for hundreds or thousands of kilometers before moving into shallow water. Then the waves lose speed and eventually topple over, losing their energy as they break on shore.



When waves break on a beach, the water runs back down the sand into the ocean. If the shore is steeply sloped toward the water, the water may rush back to sea forcefully. An undertow is the pull of the water as it runs back to sea. Undertows may be dangerous. Some are strong enough to knock a person off his or her feet and into the waves.

Ocean Waves

Waves transport energy, not water. As a wave crest passes, the water particles move in circular paths.



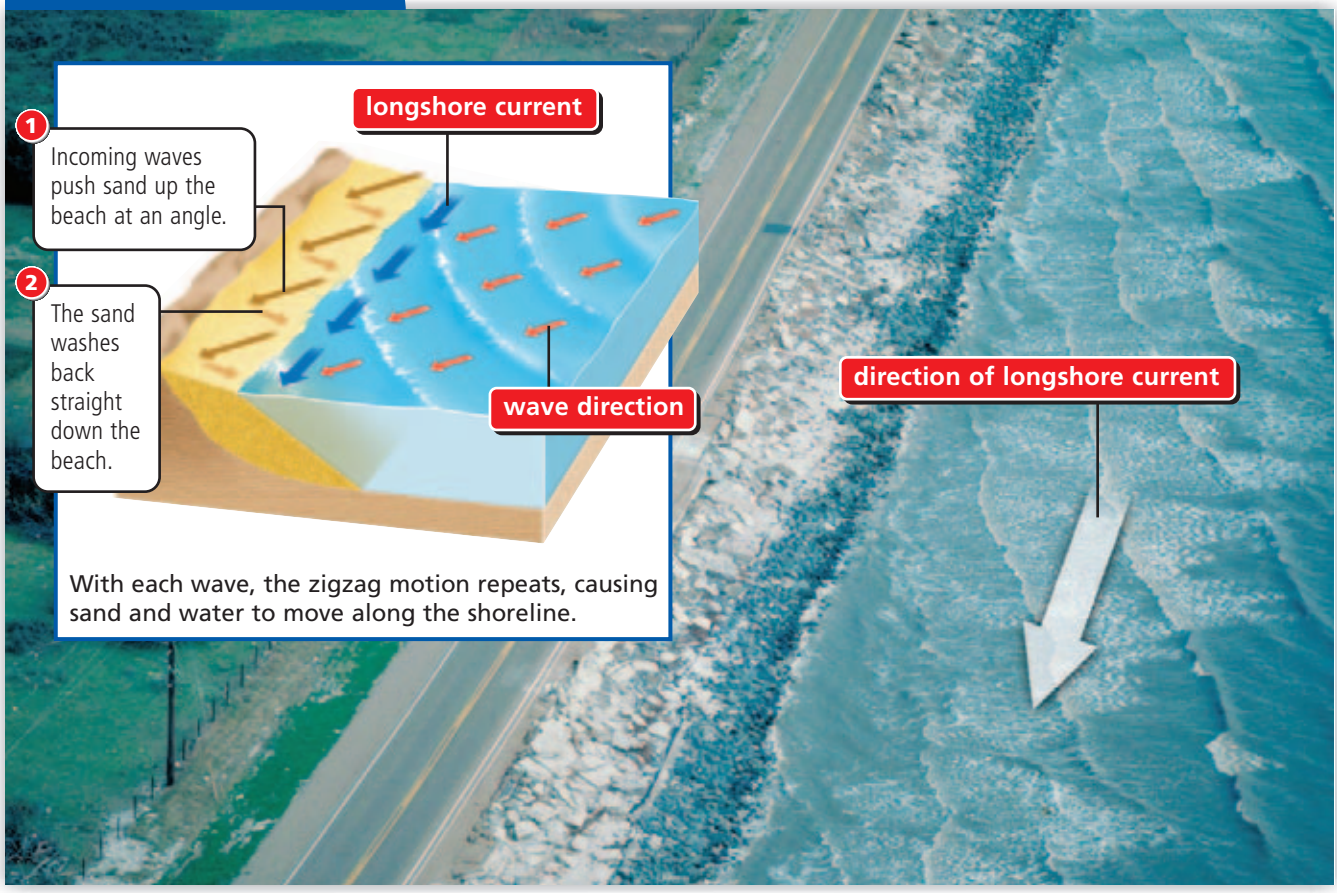
Wave Structure

READING VISUALS What happens to water particles as a wave passes through?

Waves cause currents near shore.

Sometimes swimmers notice that without trying, they have drifted far down a beach. Their drifting is due to a **longshore current,** which moves water parallel to the shore. Longshore currents occur in places where waves meet the land at an angle rather than head-on. Since waves rarely meet the land exactly head-on, or perpendicular to the shore, there is a longshore current along almost every shore. The waves hit the shore at an angle and then wash back straight down the beach into the ocean. This zigzag motion moves sand along the beach, piling it up at one end.

Longshore Current



The movement of waves and longshore currents can build up sandbars in the waters near a shore. Sandbars are long ridges or piles of sand that can form parallel to the coastline. As waves wash over the sandbars and onto shore, water may collect behind the sandbars. Eventually, the pooled water will break through. **Rip currents** are narrow streams of water that break through sandbars and drain rapidly back to sea. Rip currents occur when high winds or waves cause a larger-than-usual amount of water to wash back from the shore.

CHECK YOUR READING What role does a sandbar play in the formation of a rip current?

Rip Current

Signs such as this one on a beach in Hawaii warn swimmers of dangerous currents.

1. High winds or waves cause a larger-than-usual amount of water to collect behind a sandbar.

2. The water breaks through the sandbar and washes rapidly out to sea in a rip current.

3. Swimmers can escape a rip current by swimming parallel to shore, out of the narrow current.

Like undertows, rip currents can be dangerous for swimmers. In the United States, around 100 people drown in rip currents each year. Most rescues made by lifeguards on U.S. beaches involve swimmers caught in rip currents.

Rip currents are too strong to swim against, but as you can see in the diagram, they are narrow. Swimming parallel to the shore is the best way to escape a rip current. Of course, it is better to avoid rip currents altogether! Many beaches offer daily rip-current forecasts based on information about wind and wave conditions.

13.3 Review

KEY CONCEPTS

1. How does moving air form waves in water?
2. Describe the movement of a water particle as a wave passes through.
3. What happens to waves near shore?
4. Name and describe two kinds of currents that wave action can cause near shore.

CRITICAL THINKING

5. **Compare and Contrast** Describe the similarities and differences between surface currents and waves.
6. **Apply** Imagine you find a piece of wood on the beach. The next day, the wood is 100 meters farther north. How might it have moved? Your answer should refer to currents.

CHALLENGE

7. **Infer** Some coastlines are more steeply sloped than others. How might wave action on a steeply sloped coastline differ from that on a gently sloped coastline?