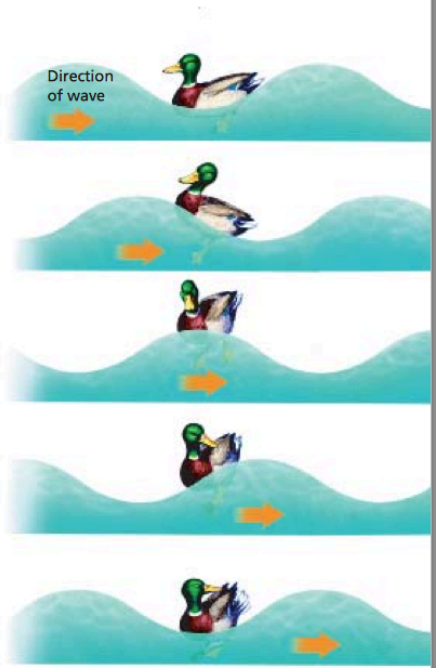
What are waves?

Far out to sea, the wind disturbs the calm surface of the water. A ripple forms. As the wind continues to blow, the ripple grows into a powerful wave that can travel a great distance. Near the beach, surfers wait eagerly. They quickly paddle into deeper water to catch the monstrous wave. Surfers enjoy the power of nature as they ride the wave to the shore.

What are waves? How can they travel so far? Why are some waves more powerful than others? In this section, you will explore how waves begin and how they move.

Waves and Energy



Waves crashing on a beach show the tremendous energy waves can carry. A wave is disturbance that transfers energy from place to place. In science, energy is defined as the ability to do work. To understand waves, think of a boat out on the ocean. If a wave disturbs the surface of the water, it will cause anything floating on the water to be disturbed, too. The energy carried by a wave can lift even a large ship as it passes.

The disturbance caused by a wave is temporary. After the wave has passed, the water is calm again.

What Carries Waves? Many waves require something to travel through. Water waves travel along the surface of the water, and sound waves travel through air. You can even make a wave travel along a rope. The material through which a wave travels is called a medium. Gases (such as air), liquids (such as water), and solids (such as ropes) all act as mediums. Waves that require a medium through which to travel are called mechanical waves.

Although waves travel through a medium, they do not carry the medium itself with them. Look at the duck in picture. When a waves moves under the duck, the duck moves up and down. It does not move along the surface of the water. After the waves passes, the water and the duck return to where they started.

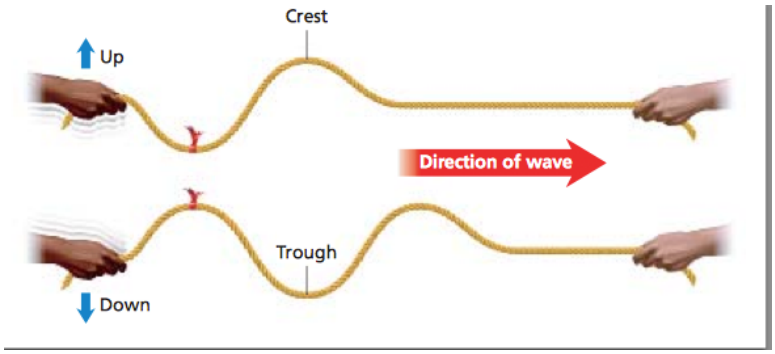
Breaking waves at a beach behave a little differently. When waves hit a beach, the water does move along with the wave. This happens because the ocean floor near the beach slopes upward. As the water at the bottom of the wave hits the slope, it moves up toward the top of the wave. The top of the wave gets bigger and continues to move forward. Eventually it topples over, turning white and frothy.

Not all waves require a medium to carry them along. Light from the sun, for example, can travel through empty space. Light is an example of an electromagnetic wave.

What Causes Waves? You can create waves by dipping your finger in water. Waves are created when a source of energy cause a medium to vibrate. A vibration is a repeated back and forth or up and down motion. This motion is the wave.

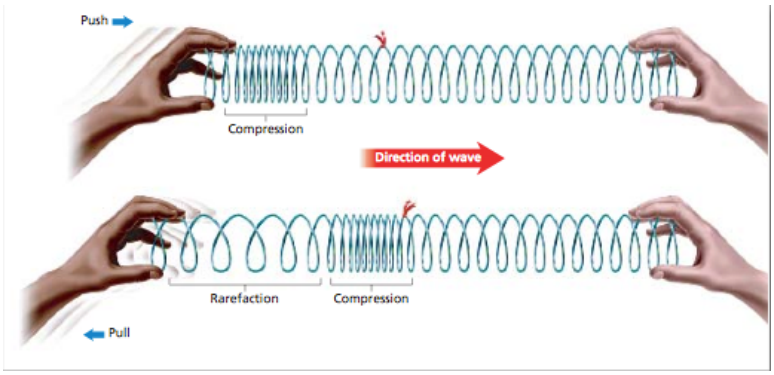
Types of Waves
Different types of waves travel through mediums in different ways. Waves are classified according to how they move. The three types of waves are transverse waves, longitudinal waves and surface waves.

Transverse Waves:
When you make a wave on a rope, the wave moves from one end of the rope to the other. The rope itself, however, moves up and down or from side to side. Waves that move the medium at right angles to the direction in which the waves are traveling are called transverse waves. Transverse mean "across." As a transverse wave moves in one direction, the particles of the medium move across the direction of the wave. The image on the right shows that some parts of the rope are very high while some are very low. The highest part of the wave are called crests, and the lowest parts are called troughs.



Longitudinal Waves. Figure 3 shows a different kind of wave. If you stretch out a spring toy and push and pull one end, you can produce a longitudinal wave. Longitudinal waves move the particles of the medium parallel to the direction in which the waves are travel. The coils in the spring move back and forth parallel to the wave motion.

Notice in pictrue that in some parts of the spring the coils are close together. In other parts, the coils are more spread out. The parts where the coils are close together are called compression. The parts where the coils are spread out, or rarefied, are called rarefactions.



As compressions and rarefactions travel along the spring toy, each coil moves slightly forward and then back. The energy travels from one end of the spring to the other, creating a wave. After the wave passes, each part of the spring returns to the position where it started.

Combinations of waves. Surface waves are combinations of transverse and longitudinal waves. These waves occur at the surface between two mediums, such as water and air. When a wave passes through water, the water (and anything on it) moves up and down, like a transverse wave on a rope. The water also moves back and forth slightly in the direction that the wave is traveling, like the coils of the spring. But unlike the coils of a spring, water does not compress. The up and down and back and forth movements combine to make each particle of water move in a circle. Figure 4 shows the circular motion of surface waves.