Introduction

What happens when a rock is dropped into a calm lake? A circular pattern will form on the surface. This pattern is made up of **waves**. You know that a rock has **kinetic energy**. When the rock hits the water, some energy is transferred to the water. The wave moves the energy away from the rock. Although the water moves up and down, it does not move away from the rock. Only the energy moves outward in the form of a wave. There are many kinds of waves. Waves can be produced by different kinds of energy. Some of the properties of waves will be discussed in this unit.

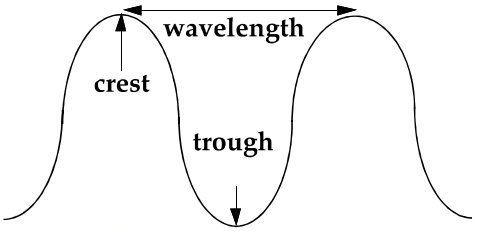
Features of Waves

Waves are caused by energy. Waves carry energy from one place to another. You can see waves that travel across the surface of water. Some waves also move through gases, solids, and vacuums. Sound and light are types of waves. Sound can travel through gases, liquids, and solids. Light, however, can travel through gases, liquids, solids, and vacuums.

It is easy to show what one type of wave looks like. Tie a rope to the leg of a chair. Snap the rope up and down. Watch what happens. A wave will pass through the rope. Did the rope move from one place to another? No, only the energy moved. All waves carry energy. Waves have other similarities. Waves can change direction. They also can have an effect on each other.

Basic Properties of Waves

There are four basic properties of waves—wavelength, speed, frequency, and amplitude—that will be described. Imagine the beach and the waves in the ocean. The waves have high points and low points. The high point of a wave is called a **crest**. The distance between the crest of one wave and the next is called a **wavelength**.

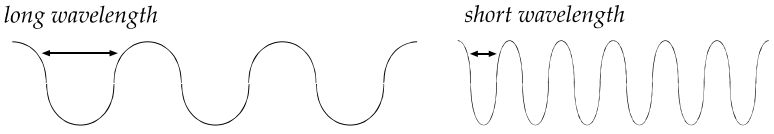


Parts of a Wave

Remember that the waves on the ocean have both high and low points. The low points are called **troughs**. Half the distance between the crest and trough of a wave is the wave's **amplitude**. Amplitude can vary. Imagine listening to the radio. You are hearing sound waves. If you want the waves to be stronger, you turn up the volume. This does not change their speed, frequency, or wavelength. It increases the amplitude of the wave and the amount of energy of the wave.

Remember that waves move. **Speed** tells how fast a point on a wave moves. For example, watch one crest of a wave. The number of meters that it moves in one second can be measured. All waves have speed.

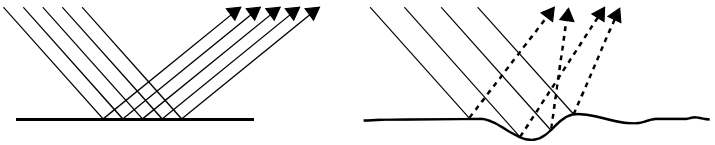
Because the waves have speed and wavelength, only a certain number can pass a point in a certain time. **Frequency** is the measure of the number of crests that pass a point in one second. The unit of measure for frequency is called **hertz** *(Hz)*. Frequency and wave length are related in an inverse way. A wave with a great wavelength has a low frequency. A wave with a small wavelength has a high frequency.



low frequency **high frequency**

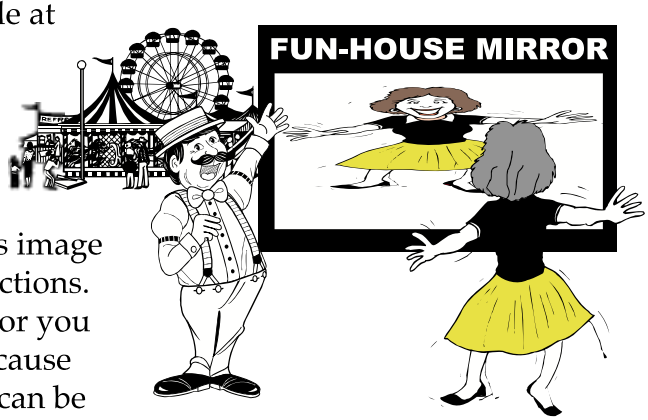
Wave Motion

Waves move energy. Waves can move in different directions. The waves at the beach usually move in a straight line. If the speed of part of a wave changes, the direction of the wave will also change. This is known as **refraction**. Think about the waves at the beach. They move in a straight line until they hit shallow water. Shallow water will slow down the bottom of the wave. The direction of the wave will change. It will crash on itself. The speed of other waves depends on what the wave passes through. Gases, liquids, and solids all affect the speed of a wave.

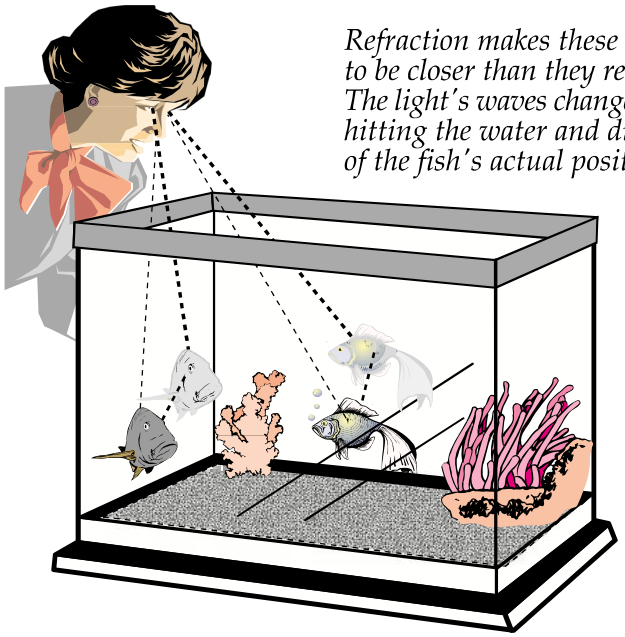


Waves are reflected at the same angle they are received, unless they are reflected off a rough surface.

Sometimes a wave will hit a barrier or a wall. A barrier can absorb or take up some of the energy of the wave. The rest of the energy is bounced away. This is called **reflection**. Picture an ocean wave hitting a seawall. The seawall is a barrier. The wave is reflected back into the ocean. Of course, you are more familiar with your own reflection. The image that you see is light that has bounced off the mirror. If you look in a fun-house mirror, however, the image may be very different because of the way waves are reflected. The angle at which light strikes the reflecting surface is the angle at which it will leave. When you look at a mirror that is curved, different parts of your body's image get reflected in different directions. You may look short, or thin, or you may look unrecognizable because light behaves like a wave. It can be reflected and refracted.



Anyone who wears glasses relies on the wavelike behavior of light. The light that enters the lens of the glasses is bent and makes the image clearer for the eyes. The material (glass or plastic) and how thick it is determines how the light will bend. All types of waves are affected by refraction and reflection. Different kinds of matter affect waves in different ways.



Refraction makes these two fish appear to be closer than they really are located. The light's waves change direction upon hitting the water and distort the image of the fish's actual position.

Waves and Matter

We have discussed waves as a way for energy to move, but waves can describe other things. For instance, consider the electron. Remember that the electron is always moving and always has energy. The electron is sometimes described as a particle, a very small piece of matter. Sometimes, though, the electron acts more like a wave. It behaves as if it has a frequency and a wavelength. Because this small piece of matter sometimes acts like a wave, understanding waves is very important to physicists. Physicists have learned that sometimes matter acts like particles, sometimes acts like waves, and sometimes behaves differently from either.

Waves are reflected at the same angle they are received. Rough surfaces cause diffusion of waves and images, resulting in weaker reflections.

Summary

Waves are caused by energy. Waves move energy from one place to another. All waves have wavelength, speed, frequency, and amplitude. Waves are affected by refraction and reflection. Different waves can move through different forms of matter and/or vacuum. Sound and light are types of waves. Matter can act as a wave, a particle, or something different.