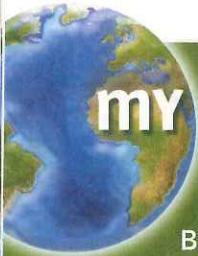


Properties of Waves



- 🔑 What Are the Amplitude, Wavelength, Frequency, and Speed of a Wave?
- 🔑 How Are Frequency, Wavelength, and Speed Related?



my planet DiARY

The Sound of Romance

Bzzzzzzzz! Bzzzzzzzz! What's that noise?

It's the sound of a mosquito buzzing in your ear. This distinct buzzing sound comes from sound waves formed as a mosquito beats its wings. Researchers recently discovered that the buzzing sound of female mosquitoes attracts male mosquitoes. When a male mosquito meets a female, he quickly adjusts his own buzz to match the frequency of the sound waves created by the female.

Researchers think that this matched buzzing frequency aids in mosquito mating.

DISCOVERY

Communicate Discuss this question with a partner. Write your answer below.

What are two other animals you know of that make buzzing sounds?



Do the Inquiry Warm-Up
What Do Waves Look Like?

Vocabulary

• amplitude • wavelength • frequency • hertz


Skills

 Reading: Identify the Main Idea

 Inquiry: Calculate

What Are the Amplitude, Wavelength, Frequency, and Speed of a Wave?

Waves may vary greatly. For example, waves can be long or short. They can carry a little energy or a lot of energy. They can be transverse or longitudinal. However, all waves have common properties—amplitude, wavelength, frequency, and speed.

 **Amplitude** describes how far the medium in a wave moves. **Wavelength** describes a wave's length, and **frequency** describes how often it occurs. **Speed** describes how quickly a wave moves.

Amplitude The height of a wave's crest depends on its amplitude. **Amplitude** is the maximum distance the medium vibrates from the rest position. For a water wave, this distance is how far the water particles move above or below the surface level of calm water. High waves have more energy than low waves. The more energy a wave has, the greater its amplitude.

A transverse wave is shown in **Figure 1**. Its amplitude is the maximum distance the medium moves up or down from its rest position. The amplitude of a longitudinal wave is a measure of how compressed or rarefied the medium becomes. When the compressions are dense, it means the wave's amplitude is large.

FIGURE 1

Amplitude

The amplitude of a transverse wave is the maximum distance the medium vibrates from the rest position.

 **Label the parts of the wave. Then answer the question.**

Measure What is the amplitude of the wave in centimeters?

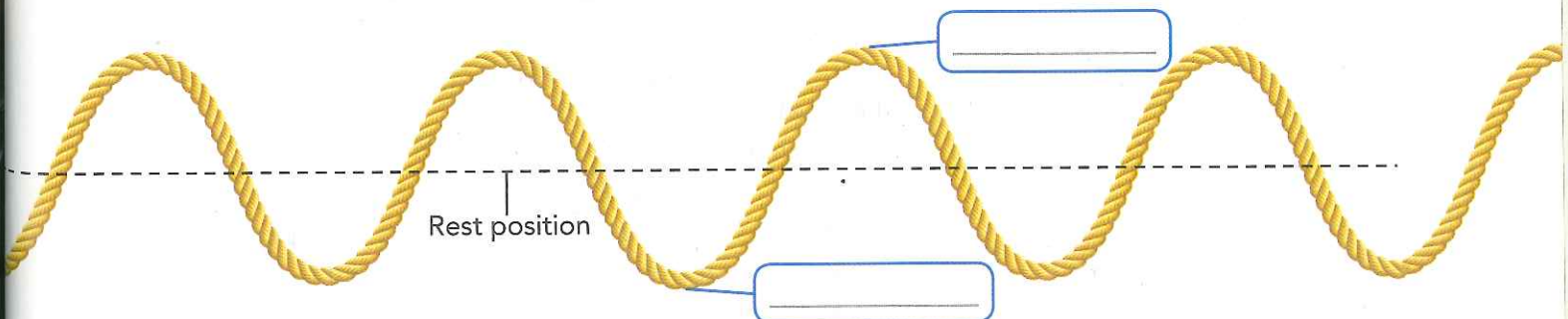



FIGURE 2

Properties of Waves


All waves have amplitude, wavelength, frequency, and speed.

 Read the text on these pages before filling in the boxes and answering these questions.

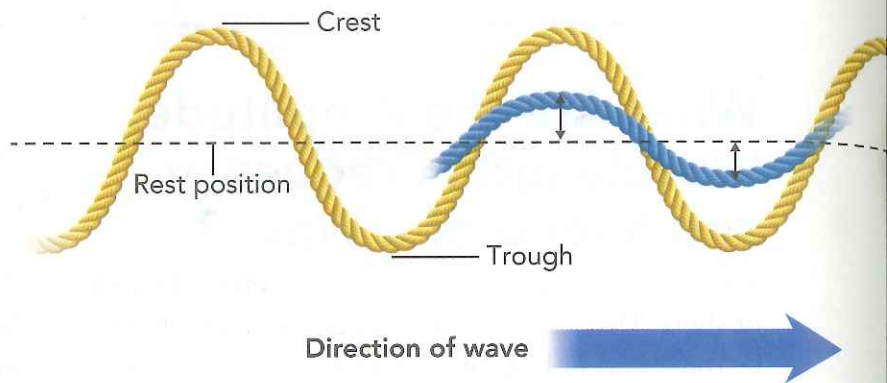
1. **Name** Which transverse wave has the shortest wavelength?

2. **Apply Concepts** If a transverse wave travels 10 meters in 5 seconds, what is its speed?

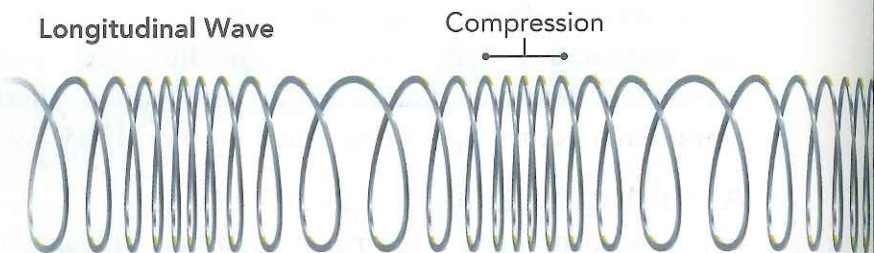
3. **Draw Conclusions** How does a shorter wavelength affect the frequency of a wave?

 **Identify the Main Idea** Read the text. Underline the main idea in each of the three sections.

Transverse Wave



Longitudinal Wave



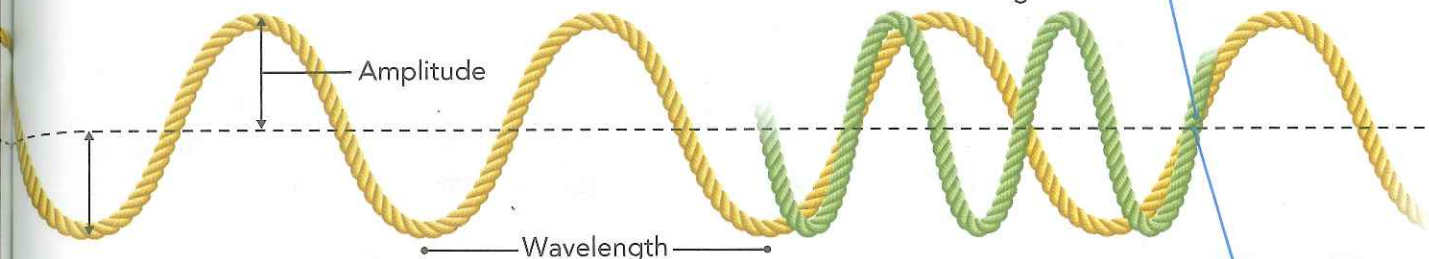
Wavelength A wave travels a certain distance before it starts to repeat. The distance between two corresponding parts of a wave is its **wavelength**. You can find the wavelength of a transverse wave by measuring the distance from crest to crest as shown in **Figure 2**. For a longitudinal wave, the wavelength is the distance between compressions.

Frequency The **frequency** of a wave is the number of waves that pass a given point in a certain amount of time. For example, if you make waves on a rope so that one wave passes by a point every second, the frequency is 1 wave per second. Move your hand up and down more quickly and you increase the frequency.

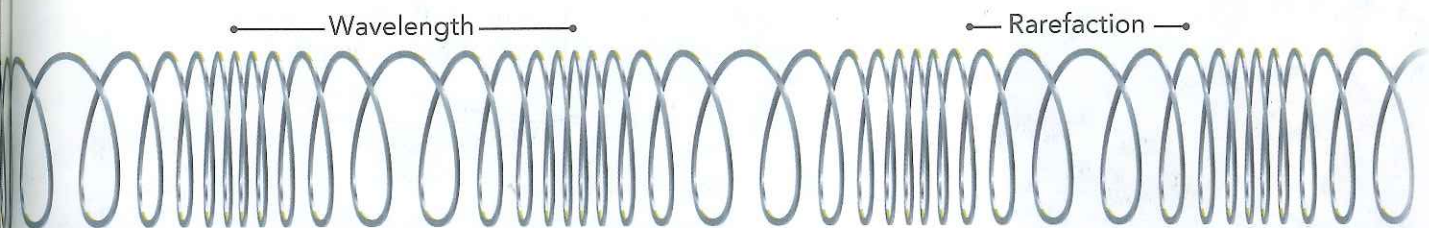
Frequency is measured in units called **hertz** (Hz), and is defined as the number of waves per second. A wave that occurs every second has a frequency of 1 wave per second (1/s) or 1 Hz. If two waves pass every second the frequency is 2 waves per second (2/s) or 2 Hz.

Which wave has the greater amplitude—yellow or blue?

One yellow wave passes this point each second, so the frequency is _____.



Two green waves pass this point each second, so the frequency is _____.



Speed Different waves travel at different speeds. Think about watching a distant thunderstorm on a hot summer day. The thunder occurs the instant the lightning flashes, but the light and sound reach you seconds apart. This happens because light waves travel much faster than sound waves. In fact, light waves travel about a million times faster than sound waves!

The speed of a wave is how far the wave travels in a given amount of time. You can determine a wave's speed by dividing the distance it travels by the time it takes to travel that distance. Sound, for example, travels about 990 meters in 3 seconds in air when the temperature is 0°C. Therefore, its speed is 330 m/s in these conditions. As long as the temperature of the medium (air) doesn't change, the speed of sound will stay the same.




Do the Quick Lab Properties of Waves.

Assess Your Understanding
 got it?

- I get it! Now I know that for any wave,
 - amplitude describes _____
 - _____
 - wavelength describes _____
 - frequency describes _____
 - _____
 - and speed describes _____
 - _____
- I need extra help with _____
- _____
- _____

How Are Frequency, Wavelength, and Speed Related?

You just learned that you can calculate the speed of a wave by dividing the distance it travels by the time it takes to travel that distance. But you can also calculate the speed of a wave if you know its wavelength and frequency.  **The speed, wavelength, and frequency of a wave are related by a mathematical formula.**

$$\text{Speed} = \text{Wavelength} \times \text{Frequency}$$

If you know two quantities in the formula, you can calculate the third quantity. For example, if you know a wave's speed and wavelength, you can calculate its frequency. If you know the speed and frequency, you can calculate the wavelength.

$$\text{Frequency} = \frac{\text{Speed}}{\text{Wavelength}}$$

$$\text{Wavelength} = \frac{\text{Speed}}{\text{Frequency}}$$

The speed of a wave remains constant if the medium, temperature, and pressure do not change. For example, all sound waves travel at the same speed in air at a given temperature and pressure. Even if a sound wave's frequency changes, its speed stays the same. So, if the frequency of a sound wave increases, its wavelength must decrease to maintain a constant speed.



do the math!

The table shows measurements of some properties of a sound wave in water and in air.

1 Calculate Using what you know about the relationship between wavelength, frequency, and speed, fill in the table.

2 CHALLENGE What can this table tell you about the speed of a wave?

Medium	Wavelength	Frequency	Speed
Water	<input type="text"/>	200 Hz	1500 m/s
Water	3.75 m	400 Hz	<input type="text"/>
Air (20°C)	10 m	<input type="text"/>	343 m/s
Air (20°C)	<input type="text"/>	17.15 Hz	343 m/s
