



Electromagnetic Waves

section 3 Using Electromagnetic Waves

● Before You Read

When was the last time you listened to the radio or watched TV? How often do you do these things each week?

What You'll Learn

- the different ways of using electromagnetic waves to communicate
- the differences between AM and FM radio signals

● Read to Learn

Telecommunications

You use electromagnetic waves each time you talk on the telephone, listen to the radio, watch TV, or do research on the Internet. Today you can talk to someone far away or send an email almost instantly. Communicating with electromagnetic waves is called telecommunications.

Using Radio Waves

Radio waves are used to send and receive information over long distances. Using radio waves to communicate has several advantages. Radio waves pass through walls and windows easily. They are not harmful to people like X rays and ultraviolet waves are. So, most telecommunication devices like radios, TVs, and telephones use radio waves to send and receive sounds and images.

How does radio transmission work?

Radio and TV stations are given a frequency at which they broadcast radio waves. Carrier waves are the radio waves broadcast by a station at its assigned frequency. To receive the station's signals, you tune your radio or TV to the frequency of the station's carrier waves. The amplitude or frequency of the carrier wave is changed to send information.

Study Coach

Identify the Main Point

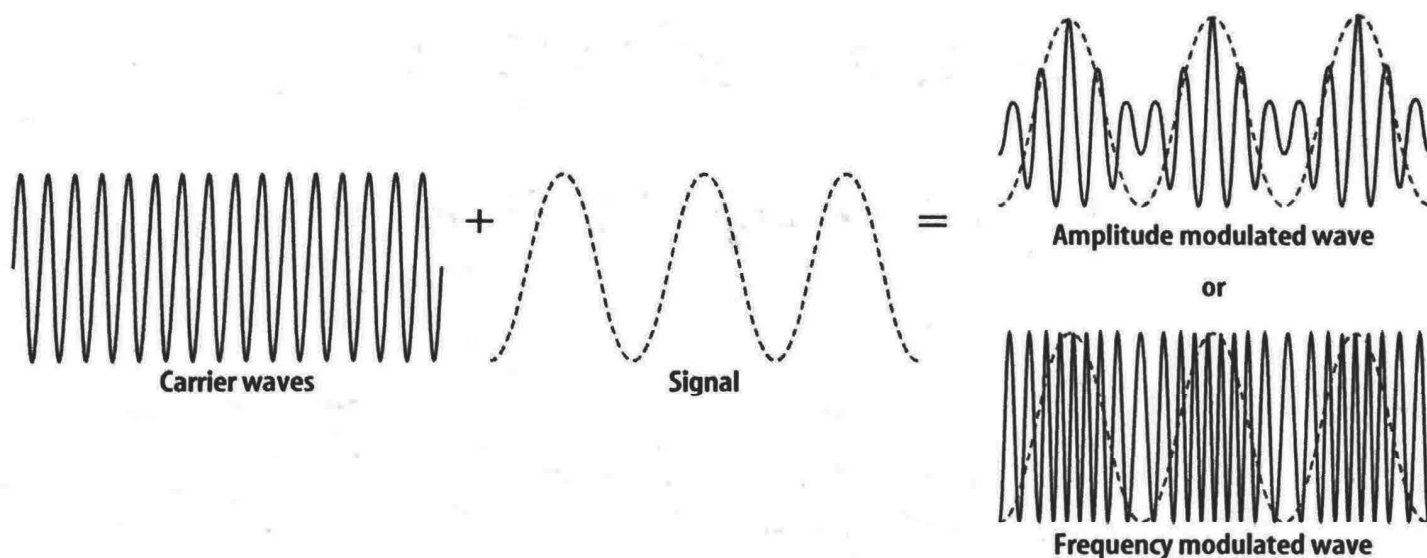
As you read, write down the main point under each heading in the text.

FOLDABLES™

B Organize Information

Make the following Foldable to organize information about using electromagnetic waves.





Picture This

- 1. Explain** Look at the figure above. How does the carrier wave change in an AM wave?

What is amplitude modulation?

The letters *AM* in AM radio stand for amplitude modulation. In amplitude modulation, the amplitude of the carrier wave is changed to send information. The original sound is changed into an electrical signal. The electrical signal is used to vary the amplitude of the carrier wave. You can see an example in the figure above. The frequency of the carrier wave does not change—only the amplitude changes. In the receiver, the varying amplitude of the carrier waves produces an electric signal. The radio's loudspeaker uses the signal to produce the original sound.

What is frequency modulation?

FM stands for frequency modulation. FM radio works much the same way as AM radio. The difference is the frequency of the carrier wave is changed instead of the amplitude. You can see this in the figure at the top of the page. The FM receiver uses the varying frequency of the carrier wave to produce an electric signal. The radio's speaker converts the electric signal into sound waves. ☒

☒ Reading Check

- 2. Describe** What part of the carrier wave is changed in FM transmission?

Telephones

Telephones change a sound wave into an electric signal. The signal travels through a wire to the telephone switching system. The electric signals may be sent through wires or changed to radio or microwave signals and sent through the air. The electric signal may also be changed to a light wave to be sent through fiber-optic cables. At the receiving end, the signal is changed back to sound waves.

How do wireless phones and pagers work?

Many phones do not use wires to send signals. Some use radio waves. Cordless phones change the electrical signal from the microphone of a telephone into a radio signal. The signal is sent to the base station of the telephone. The phone changes the electrical signals into sound waves. If you are receiving a call on a cordless telephone, the base station sends electrical signals to the phone. The phone changes the signals into sound waves. Cellular phones work the same way. But they work over distances of many kilometers. The base station uses a large antenna. The antenna communicates with the cell phone and with other base stations.

Pagers also use base stations. When you dial a pager, the signal is sent to a base station. The base station sends an electromagnetic signal to the pager. The pager receives the signal and beeps or vibrates to indicate that someone has called. You can also send information to a pager if you have a touch-tone phone. The pager receives and displays information such as your phone number.

Communications Satellites

How can radio signals be sent to the other side of the world? Radio signals cannot travel directly through Earth. Instead, radio signals are sent to satellites. The satellites can communicate with other satellites or with ground stations. Some satellites are designed to move at the same speed as Earth, so they are above the same place on Earth at all times. This is called geosynchronous (jee oh SIHN kroh nus) orbit.

The Global Positioning System

The Global Positioning System, or GPS, is a system of ground stations, satellites, and receivers that is used to locate objects on Earth. A GPS receiver measures the time it takes radio waves to travel from several satellites to the receiver. The receiver uses this information to find its latitude, longitude, and elevation. Handheld GPS receivers can give a location within a few hundred meters. Some GPS units are used to measure the movements of Earth's crust. They can measure the movement to within a few centimeters. ✓



Think it Over

3. **Explain** When you are using a wireless phone, you are really using a radio. Explain.



Reading Check

4. **Identify** What is the purpose of the Global Positioning System?
- a. to locate satellites in space
 - b. to locate objects on Earth
 - c. to locate radios on Earth
 - d. to communicate with other parts of Earth

● After You Read

Mini Glossary

carrier waves: the radio waves broadcast by a station at its assigned frequency

Global Positioning System (GPS): a system of ground stations, satellites, and receivers that is used to locate objects on Earth

1. Review the terms and their definitions in the Mini Glossary. Write a sentence explaining how the carrier wave is changed in frequency modulation.

2. In the space provided, give three examples of telecommunication devices that use radio waves. Then, describe how the device uses radio waves.

Example	Use of Radio Waves

3. Which form of telecommunication do you use most often? Explain.



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