

Warm-Up

Radio Waves and Applications

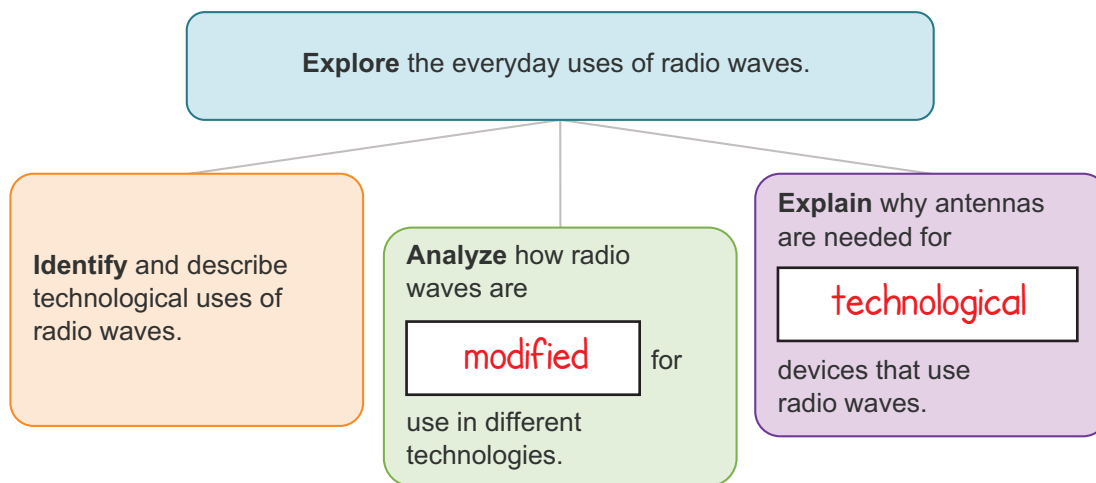


Lesson Question

How are radio waves used in everyday applications?



Lesson Goals



Words to Know

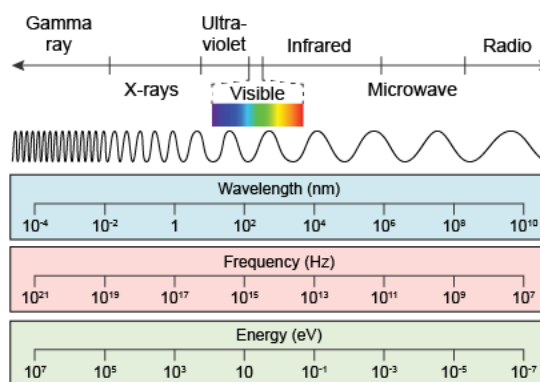
Fill in this table as you work through the lesson. You may also use the glossary to help you.

magnetic resonance imaging	a phenomenon whereby nuclei in a magnetic field absorb and re-emit radiation that is captured and used to create an image
transmitter	a device that modulates, amplifies, and sends out radio waves
antenna	a device that transmits or receives radio waves
receiver	a device that captures, amplifies, and demodulates radio waves
modulation	the process of modifying a property of a wave to transmit information
global positioning system	a system of satellites that provide precise position and velocity data used to pinpoint locations



Electromagnetic Waves

- Electromagnetic waves are composed of **electric** and magnetic fields that radiate out from a source at the speed of light.
- Electromagnetic waves have different **wavelengths**, frequencies, and amount of energy transferred.
 - Wavelength and frequency have an inverse relationship.
 - Frequency and **energy** have a direct relationship.



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Frequency of Radio Waves

- Radio waves have different **frequencies** that can be used in different technologies.

Description	Frequency (Hz)	Technology
Very low frequency (VLF)	$3 \times 10^3 - 3 \times 10^4$	Submarine communication
Low frequency (LF)	$3 \times 10^4 - 3 \times 10^5$	Submarine communication
Medium frequency (MF)	$3 \times 10^5 - 3 \times 10^6$	AM program broadcasting
High frequency (HF)	$3 \times 10^6 - 3 \times 10^7$	CB radios
Very high frequency (VHF)	$3 \times 10^7 - 3 \times 10^8$	TV program broadcasting
Ultrahigh frequency (UHF)	$3 \times 10^8 - 3 \times 10^9$	Space communication

Communication on Earth

Radio waves' long wavelengths make them useful for carrying and transmitting

data for communication purposes.

- Submarines use VLF and LF radio waves.
- CB radios use HF radio waves.
- Cell phones** use UHF radio waves.

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Communication across Space

Scientists on Earth use **radio** waves to communicate with satellites, **spacecraft**, and astronauts in space using UHF radio waves.

Broadcasting

- Radio waves are used to carry and **transmit** data for broadcasting purposes.
 - AM radio stations use MF radio waves.
 - **FM radio** stations use VHF radio waves.
 - Televisions use VHF radio waves.
- Specific frequencies are assigned to television and radio stations to avoid **interference**.

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Medicine

- **Magnetic resonance imaging** (MRI) is a phenomenon whereby **nuclei** in a magnetic field absorb and re-emit radiation that is captured and used to create an **image**.
 - The low **energy** of radio waves does not damage human tissue.

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Navigation

A **global positioning system** (GPS) is a system of **satellites** that provide precise position and velocity data used to pinpoint **locations**.

Research

- Radio telescopes capture radio waves from **space** that are transformed into images of space.
 - Images help determine the composition of **regions** in space.

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Transmission of Information

- Information can be carried by two types of signals.
 - Analog
 - **Digital**
- Signals are added to radio waves, called **carrier** waves, to send information.
 - **Modulation** is the process of modifying a property of a wave to transmit information.

Amplitude Modulation

- Amplitude modulation (AM) is a modulation technique in which the **amplitude** of the carrier wave is modified.
 - AM stations
 - Television stations for **pictures**

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Frequency Modulation

- Frequency modulation (FM) is a modulation technique in which the frequency of the **carrier** wave is modified.
 - FM stations
 - Television stations for **sound**
 - Cell phones

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Pulse Modulation

- Pulse modulation is a modulation technique in which the pulse of the carrier wave is modified to send segments or **pulses**.
 - Remote-control toys

Phase Modulation

- Phase modulation is a modulation technique in which the **phase** of the carrier wave is modified to send information.
 - GPS

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Transmitters and Receivers

- A **transmitter** modulates, **amplifies**, and sends out radio waves.
 - A modulator changes a property of the carrier wave.
 - An amplifier increases the power of the wave.
 - An **antenna** transmits **modulated** carrier waves into the air.

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- A **receiver** captures, amplifies, and **demodulates** radio waves.
 - An antenna captures the modulated radio waves.
 - An amplifier increases the **power** of the captured radio waves.
 - A demodulator extracts the original signal from the carrier wave.

Summary

Radio Waves and Applications



Lesson Question

How are radio waves used in everyday applications?



Answer

(Sample answer) Radio waves are used in everyday applications in the fields of communication, broadcasting, medicine, navigation, and research.

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Review: Key concepts

Radio waves have many applications in communication, broadcasting, medicine, navigation, and research.

Description of Radio Wave	Application
Very low frequency (VLF)	Submarine communication
Low frequency (LF)	Submarine communication
Medium frequency (MF)	AM and television broadcasting
High frequency (HF)	CB radios and MRI
Very high frequency (VHF)	FM and television broadcasting
Ultrahigh frequency (UHF)	Space communication, cell phones , GPS, and radio telescopes

Summary

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Radio waves pass through a **transmitter** that modulates, amplifies, and sends out a radio wave that carries information. A receiver then captures, amplifies, and **demodulates** the wave so it can be seen or heard on an electronic device.

Modulation	Application
Amplitude	AM and television picture broadcasting
Frequency	FM and television sound broadcasting
Pulse	Remote-control toys
Phase	GPS

Use this space to write any questions or thoughts about this lesson.