



PLTW Engineering

# 10-12/AM/FM Radio Waves

April 28, 2020



10-12/DE

Lesson: **4/28/2020**

**Students will be able to explain how radio stations code sound information into radio waves.**



## Stages of a radio broadcast

If you have ever listened to a baseball, football, or basketball game on the radio, as well music, the broadcast you hear breaks down into 4 stages.

First, a microphone converts sound waves into electrical signals.

Second, the electrical signal from the microphone changes, or modulates, a radio wave called a carrier radio wave, so that it will contain the sound information.



## Stages of a radio broadcast

Now the signal is ready to be transmitted through the tower. Radio towers can vary in height - but they make up some of the tallest structures in the United States.

Third, a receiving antenna on a radio tuned to the proper frequency picks up the carrier wave, which then travels to the receiver or radio. Finally, the receiver detects the modulation in the carrier wave and converts it back into electrical signals. The electrical signals are sent to a loudspeaker, which changes them once again into sound waves.



## How is a radio wave emitted?

The signal is an electric current, and every electric current is actually electrons moving in a wire. Wire is made of metal, usually copper.

All of the atoms that make up the wire have something in common -- each has one or two electrons in its outer-most shell.

These electrons do not have a strong bond with the rest of the atom. In fact, it takes just a slight amount of energy to push the electron away from its atom.



## How is a radio wave emitted?

But, if you have enough energy, the outer electrons from all of the atoms will move at once. They will each travel from one atom to the next atom, and so on and so on.

Just as the electrons move in the wire, they move in the transmitter's antenna. And just as an electromagnetic field is created around the wire, a field is created around the antenna.



## How is a radio wave emitted?

The electromagnetic field travels from the antenna in all directions and at the speed of light. It travels until it hits your radio's antenna as well as hundreds of other receiving antennas.

And what happens at the receiving antenna? Just as a current in a wire produces an electromagnetic field, an electromagnetic field produces current in a wire (or antenna). This current is then amplified and processed by the radio.



## AM vs FM broadcasts

Amplitude modulation, or AM stations code information in the carrier wave by changing, or modulating, the amplitude, the height of the carrier wave's peaks and valleys.

The speed at which the amplitude changes determines the pitch of the sound, and the amount that it changes determines its loudness.

Generally, AM carrier waves have much longer wavelengths than FM carrier waves, and as a result, they can bend around obstacles like mountains and buildings better than FM waves and can travel greater distances before the signal fades.





## AM vs FM broadcasts

Frequency modulation, or FM, stations alter the frequency of the carrier signal.

In this case, the speed at which the frequency changes determines the pitch, and the amount that it changes determines the loudness.

FM waves are much more clear, because there is little chance the frequency of the wave will be accidentally be modulated.



## Activity and questions

Listen to a radio and see if you can tell the difference between AM waves and FM waves in terms of static.

Why do FM radio stations usually have less static than AM stations?

Try to find a radio that has a digital tuner. Now try to find a radio that has an analog tuner.

Which tuner is better and picking up AM stations? Why?



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## Helpful Links

[Youtube video explaining AM and FM radio](#)

[How the Ionosphere effects the strength of radio signals](#)