THE ELECTROMAGNETIC SPECTRUM

extension

Integrating Technology

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Keyword HF6EMIX

At first glance, radio waves seem completely different from visible light and gamma rays. They are produced and detected in very different ways. A large antenna is needed to detect radio waves, your eye can see visible light, and sophisticated scientific equipment must be used to observe gamma rays. Even though they appear quite different, all the different parts of the *electromagnetic spectrum* are fundamentally the same thing. They are all electromagnetic waves.

The electromagnetic spectrum can be expressed in terms of wavelength, frequency, or energy. The electromagnetic spectrum is illustrated in **Figure 22.** Longer wavelengths, such as radio waves and microwaves, are usually described in terms of frequency. If your favorite FM radio station is 90.5, the frequency is 90.5 MHz (9.05×10^7 Hz). Infrared, visible, and ultraviolet light are usually described in terms of their wavelength. We see the wavelength 670 nm (6.70×10^{-7} m) as red light. The shortest wavelength radiation is generally described in terms of the energy of one photon. For example, the element cesium-137 emits gamma rays with energy of 662 keV (10^{-13} J). (A keV is a *kilo-electron volt,* equal to 1000 eV or 1.60×10^{-16} J.)

Radio waves

Radio waves have the longest wavelengths in the spectrum. The wavelengths range in size from the diameter of a soccer ball to the length of a soccer field and beyond. Because long wavelengths can easily travel around objects, they work well for transmitting information across long distances. In the United States, the FCC regulates the radio spectrum, assigning the bands that certain stations can use for radio and television broadcasting.

Objects that are far away in deep space also emit radio waves. Because these waves can pass through Earth's atmosphere, scientists can use huge antennas on land to collect the waves, which can help the scientists to understand the nature of the universe.

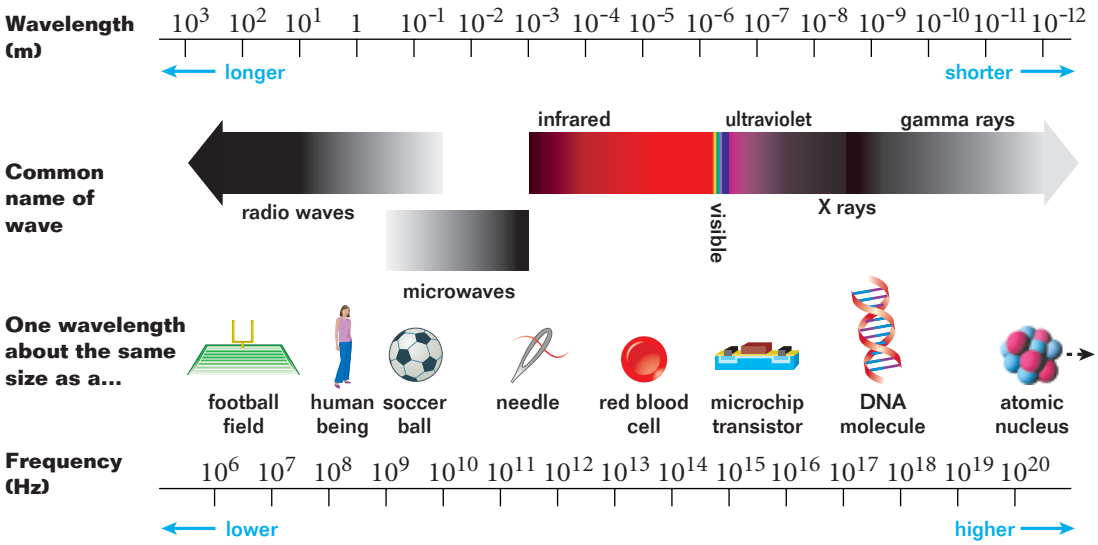

Figure 22

The electromagnetic spectrum ranges from very long radio waves, with wavelengths equal to the height of a tall building, to very short-wavelength gamma rays, with wavelengths as short as the diameter of the nucleus of an atom.