

The Electromagnetic Spectrum

For hundreds of years, scientists believed that light energy was made up of tiny particles which they called “corpuscles.” In the 1600s, researchers observed that light energy also had many characteristics of waves. Modern scientists know that all energy is both particles, which they now call *photons*, and waves.

Photons travel in *electromagnetic waves*. These waves travel at different *frequencies*, but all travel at the speed of light. The *electromagnetic spectrum* is the range of wave frequencies from low frequencies (below visible light) to high frequencies (above visible light). (See figure below.)

The *radio wave* category includes radio and television waves. These low-frequency waves bounce off many materials.

Microwaves pass through some materials but are absorbed by others. In a microwave oven, the energy passes through the glass and is absorbed by the moisture in the food. The food cooks, but the glass container is not affected.

Like other wavelengths, *infrared* or heat waves are more readily absorbed by some materials than by others. Dark materials absorb infrared waves while light materials reflect them. The Sun emits infrared waves, heating the Earth and making plant and animal life possible.

Visible light waves are the very smallest part of the spectrum and are the only frequencies visible to the human eye. Colors are different within this category, ranging from the red wavelengths, which are just above the invisible infrared, to violet. Most of the Sun’s energy is emitted as visible light.

The Sun also emits many *ultraviolet* waves. High-frequency ultraviolet wavelengths from the Sun cause sunburn.

X rays can penetrate muscle and tissue but are blocked by bone, making medical and dental x-ray photographs possible.

Gamma-ray waves, the highest frequency waves, are more powerful than x rays and are used to kill cancerous cells.

The atmosphere protects Earth from dangerous ultraviolet, x-ray, and gamma-ray radiation.

