The Electromagnetic Spectrum

RESOURCE CENTER
CLASSZONE.COM
Learn more about the electromagnetic spectrum.

The range of all EM frequencies is known as the **electromagnetic spectrum** (SPEHK-truhm), or EM spectrum. The spectrum can be represented by a diagram like the one below. On the left are the waves with the longest wavelengths and the lowest frequencies and energies. Toward the right, the wavelengths become shorter, and the frequencies and energies become higher. The diagram also shows different parts of the spectrum: radio waves, microwaves, infrared light, visible light, ultraviolet light, x-rays, and gamma rays.

The EM spectrum is a smooth, gradual progression from the lowest frequencies to the highest. Divisions between the different parts of the spectrum are useful, but not exact. As you can see from the diagram below, some of the sections overlap.

Measuring EM Waves

Because all EM waves move at the same speed in a vacuum, the frequency of an EM wave can be determined from its wavelength. EM wavelengths run from about 30 kilometers for the lowest-frequency radio waves to trillionths of a centimeter for gamma rays. EM waves travel so quickly that even those with the largest wavelengths have very high frequencies. For example, a low-energy radio wave with a wavelength of 30 kilometers has a frequency of 10,000 cycles per second.

EM wave frequency is measured in hertz (Hz). One hertz equals one cycle per second. The frequency of the 30-kilometer radio wave mentioned above would be 10,000 Hz. Gamma ray frequencies reach trillions of trillions of hertz.

SUPPORTING MAIN IDEAS
Write details that support the main idea that EM waves form a spectrum based on frequency.

CHECK YOUR READING
Why is wavelength all you need to know to calculate EM wave frequency in a vacuum?

The Electromagnetic Spectrum

Frequency in Hertz (1 hertz = 1 wavelength/second)

10^{5} 10^{6} 10^{7} 10^{8} 10^{9} 10^{10} 10^{11} 10^{12} 10^{13} 10^{14} 10^{15} 10^{16} 10^{17} 10^{18} 10^{19} 10^{20} 10^{21} 10^{22} 10^{23} 10^{24}

Radio Waves | Microwaves | Infrared Light | Visible Light | Ultraviolet Light | X-Rays | Gamma Rays

This woman is speaking on the radio. **Radio waves** are used for radio and television broadcasts. They are also used for cordless phones, garage door openers, alarm systems, and baby monitors.

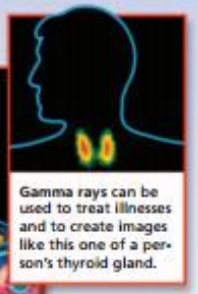
Not all astronomy involves visible light. Telescopes like the one above pick up **microwaves** from space. Microwaves are also used for radar, cell phones, ovens, and satellite communications.

The amount of **infrared light** an object gives off depends on its temperature. Above, different colors indicate different amounts of infrared light.

Visible light is the part of the EM spectrum that can be seen with the human eye. This bird's colors come from different wavelengths.

The researcher in this photograph is using **ultraviolet light** in the process of DNA analysis. A chemical in the samples gives off visible pink light when ultraviolet rays are present.

X-rays are useful for showing hard tissues inside the body, such as bones. To make images like the one above, x-ray images have to be displayed using visible light.



Gamma rays can be used to treat illnesses and to create images like this one of a person's thyroid gland.