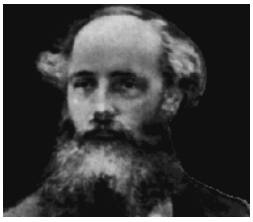
Lunar CRater Observation and Sensing Satellite

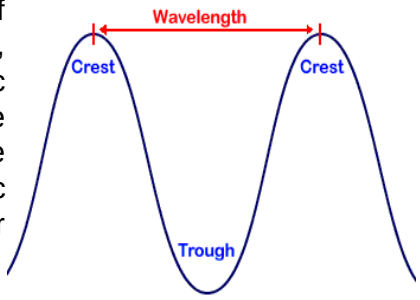
The Electromagnetic Spectrum



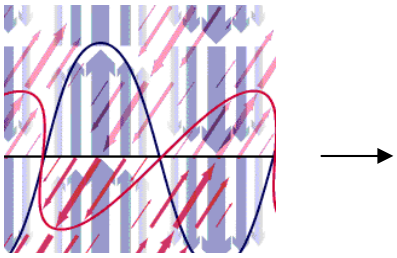
James Clerk Maxwell

The visual light that you see with your eyes is just one form of electromagnetic radiation. In the 19th century, physicist James Clerk Maxwell dedicated himself to understanding the nature of light. He unified the rules governing electricity and magnetism in his work "Treatise on Electricity and Magnetism" published in 1873. Maxwell determined that visible light was just one member of a family of electromagnetic (EM) waves[1] we call the electromagnetic spectrum.

The electromagnetic spectrum[2] is divided into ranges of wavelength; Gamma Rays, X-Rays, Ultraviolet, Visible light, Infrared, and Radio Waves. The other forms of electromagnetic radiation differ from visible light only in their wavelengths. The wavelength of electromagnetic waves is defined as the distance between one wave crest to the next. The magnetic and electric fields of an electromagnetic wave are perpendicular to each other and to the direction of the wave's motion.

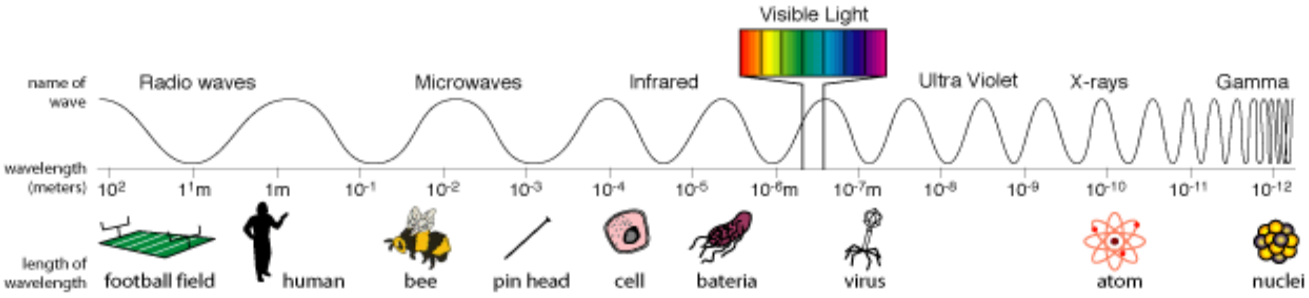


Measuring the Wavelength of EM Radiation
Courtesy NASA/JPL Caltech



The Magnetic and Electric Fields of an Electromagnetic Wave
Courtesy NASA/JPL Caltech

Very long radio waves are on the order of the size of football fields while very short gamma rays are the size of the nucleus of an atom. Each group of electromagnetic waves can also be described by their energy. Long-wavelength waves like radio waves carry less energy per second (or have less energy in a given volume of space) than short-wavelength waves like X-rays.



The Wavelengths of EM Radiation
Courtesy NASA/JPL Caltech

Lunar CRater Observation and Sensing Satellite

The Electromagnetic Spectrum (continued)

Objects in space, such as planets, stars, and galaxies emit radiation at many different wavelengths, and astronomical instruments are designed to detect this light in specific regions of the spectrum[3]. Transmitters on spacecraft, which communicate with Earth, use microwaves in the radio region of the spectrum whose wavelengths are on the order of 1 to 10 centimeters, or from about the size of a bee to that of a bird. Microwaves are good for transmitting information because they can penetrate Earth's atmosphere and clouds.

In 1888, German physicist Heinrich Hertz made the discovery of radio waves, confirming James Clerk Maxwell's ideas about EM radiation.

In 2009, Goldstone Apple Valley Radio Telescope (GAVRT) students all over the world will operate a state-of-the-art radio telescope located at Goldstone, CA to track the LCROSS spacecraft. They will be the first students in the history of space exploration to monitor a NASA spacecraft on its way to the Moon.

We experience the longest infrared waves as warmth or heat, while ultraviolet rays from the Sun cause sunburns. High energy X-rays are used to picture our bones for medical analysis and to study black holes in space. Gamma rays are emitted from some of the most energetic processes in the universe.

Although visible light like all other regions of the EM spectrum can be broken down into its component wavelengths to give scientists information about what emitted the light, the visible region of the spectrum contains only a fraction of the information scientists might learn from studying light emitted in many regions of the spectrum. The light that we see with our eyes is only a part of the story of EM radiation.

1: Electromagnetic (EM) waves - one of the waves that are propagated by simultaneous periodic variations of electric and magnetic field intensity and that include radio waves, infrared, visible light, ultraviolet, X rays, and gamma rays. 2: Electromagnetic spectrum - the entire range of wavelengths or frequencies of electromagnetic radiation extending from gamma rays to the longest radio waves and including visible light. 3: Spectrum - a plot of the intensity of light at different frequencies.