

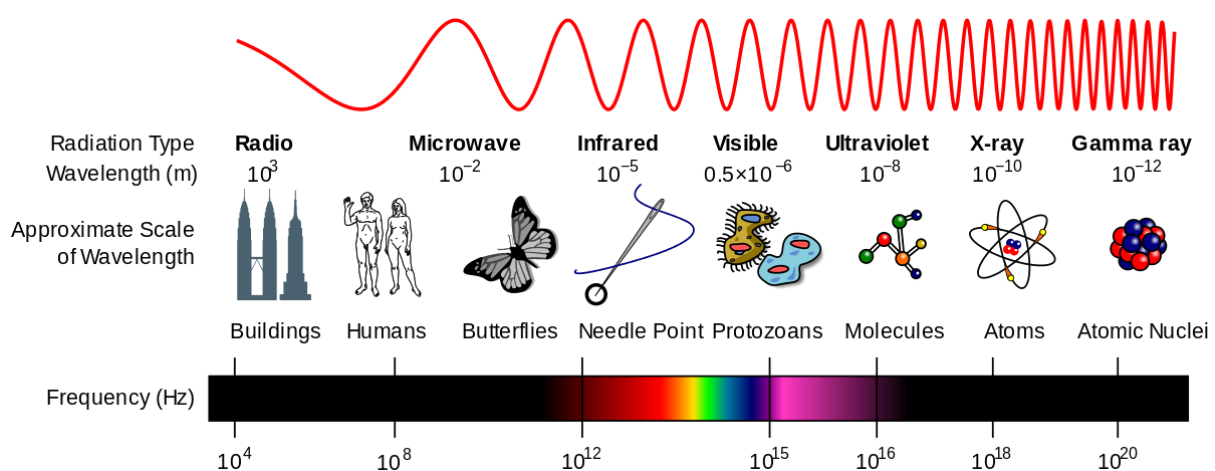
❑ Nature of light:

Light is a form of energy that is transmitted by waves. The energy in light is called radiant energy. Light waves are transverse waves. They can transmit energy in the absence of a medium. They can travel in a vacuum. Light, therefore, can move through the emptiness of outer space, through air, and many other substances. Light waves are only one type of radiant energy. All radiant energy waves are called electromagnetic waves. The electromagnetic waves are produced by the vibrations of electric charges in atoms. The energy in electromagnetic waves is made up of electric and magnetic fields that vibrate at right angles to each other. They travel in a straight line. All electromagnetic waves are arranged in order by their wavelengths and frequencies on a chart called the electromagnetic spectrum. Light that we see is the only part of the electromagnetic spectrum that is visible to human eyes.

Radio waves, microwaves, infrared radiation, visible light, ultraviolet radiation, X-rays, and gamma rays are all forms of electromagnetic radiation. All electromagnetic waves travel at the same speed of 3×10^8 m/s.

❑ Electromagnetic spectrum with their respective wavelength, frequency, and energy are shown in the following chart:

	Types of waves	Wavelength, λ	Frequency, ν (Hz)	Energy (eV)
1.	Radio waves	30 km to 30 cm	10^4 to 10^9	4.1×10^{-11} to 4.1×10^{-6}
2.	Microwaves	30 cm to 1 mm	10^9 to 3×10^{11}	4.1×10^{-6} to 1.24×10^{-3}
3.	Infrared	above 750 nm	below 4×10^{14}	Below 1.66
4.	Visible light	750 nm to 380 nm	4×10^{14} to 7.9×10^{14}	1.66 to 3.27
5.	Ultraviolet	below 380 nm	above 7.9×10^{14}	above 3.27
6.	X-ray	50 nm to 10^{-12} m	6×10^{15} to 3×10^{20}	24.8 to 1.24×10^6
7.	Gamma ray	below 10^{-12} m	above 3×10^{20}	above 1.24×10^6
	Blue	475 nm	6.3×10^{14}	2.61
	Green	520 nm	5.77×10^{14}	2.39
	Yellow	575 nm	5.21×10^{14}	2.15
	Red	630 nm	4.76×10^{14}	1.97



[Ref: https://en.wikiversity.org/wiki/Electromagnetic_radiation]

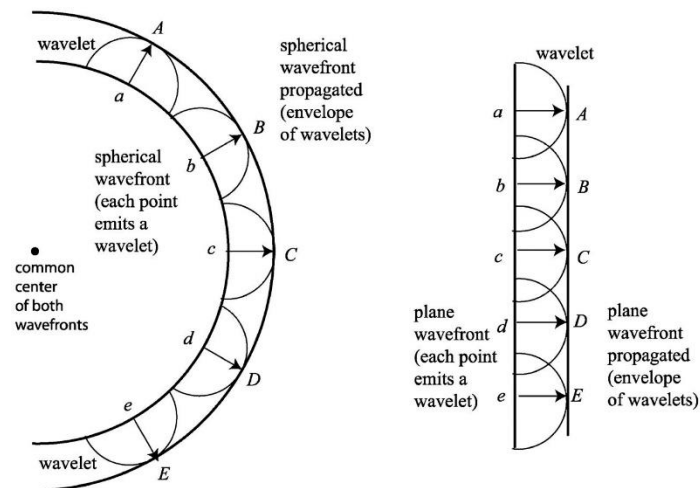
□ Theory of light:

1. Corpuscular theory: In 1672, Sir Isaac Newton proposed this theory. According to this theory “A luminous body emits a stream of particles in all directions. The particles are assumed to be very tiny so that when two light becomes overlap, a collision between them may occur.” This theory can only explain reflection, refraction, and rectilinear propagation of light.

2. Wave theory/ Huygens principle:

In 1679, this theory was proposed by Christian Huygens. According to this theory “Every point on a primary wave front serve as the source of spherical secondary wavelets such that the primary wave front at some latter time is the envelop of these wavelets. Moreover, these wavelets advance in the forward direction with a speed and frequency equal to those of the primary wave at each point in space.”

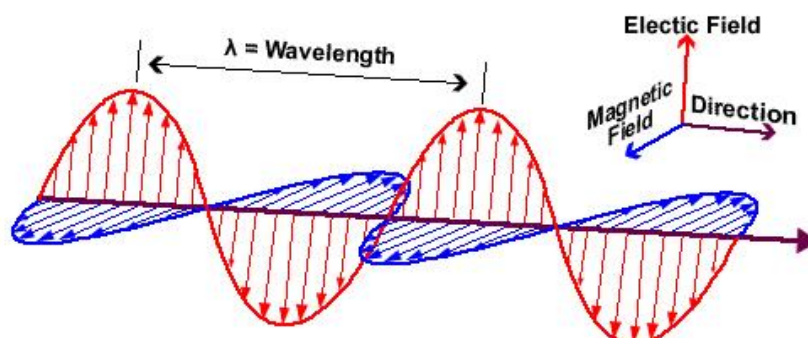
This theory can explain not only diffraction and interference but also reflection, refraction, and rectilinear propagation of light. According to this theory, light is transmitted in the form of wave through a medium. The sunlight is reached in the earth through a medium called **ether**. At present, the presence of ether medium in the free space is proved wrong.



3. Electromagnetic wave theory/ Maxwell theory:

Light waves are electromagnetic waves. Associated with light waves are changing electric and magnetic field which are perpendicular to each other. The changing magnetic field produce a time and space varying electric field and changing electric field produce a time and space varying magnetic field. This result is the propagation of electromagnetic wave in free space.

This theory can explain reflection, refraction, interference, and polarization of light but it is failed to explain photoelectric emission.



4. (Planck's) Quantum theory:

Lights are made up of definite quanta or increment of energy proportional to frequency of the corresponding radiation.

Energy can be gained or lost from a system on its certain amounts. This definite amount of energy is called quantum. The photon is a single quantum of electromagnetic radiation. It can explain photoelectric emission, black body radiation but it is failed to explain interference, polarization, and diffraction of light.

5. New corpuscular theory:

On the basis of quantum theory, Einstein proposed a new form of corpuscular theory in which he asserted that light consists of glob or particles of energy. Each such particles (photon) has an energy proportional to frequency.

$$E = h\nu$$

Conclusion: At one time the corpuscular theory held the ground and at another time the wave theory was accepted. The next important advance in the nature of light was due to the work of Maxwell. Maxwell's electromagnetic theory of light lends support to Huygens wave theory, whereas quantum theory strengthens the particle concept. It is very interesting to note that light is regarded as wave motion at one time and as a particle phenomenon at another time.