THE ELECTROMAGNETIC SPECTRUM 06 AUGUST 2013

Lesson Description

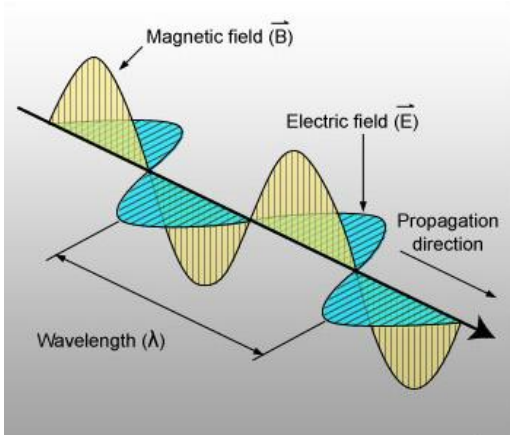
In this lesson, we:

- Describe Electromagnetic Radiation as a vibration of magnetic and electric fields travelling at "c".
- Identify the types and uses of different EM Radiation.
- Link the energy of an EM wave to it's ability to pass through materials

Key Concepts

Electromagnetic Waves are Transverse.

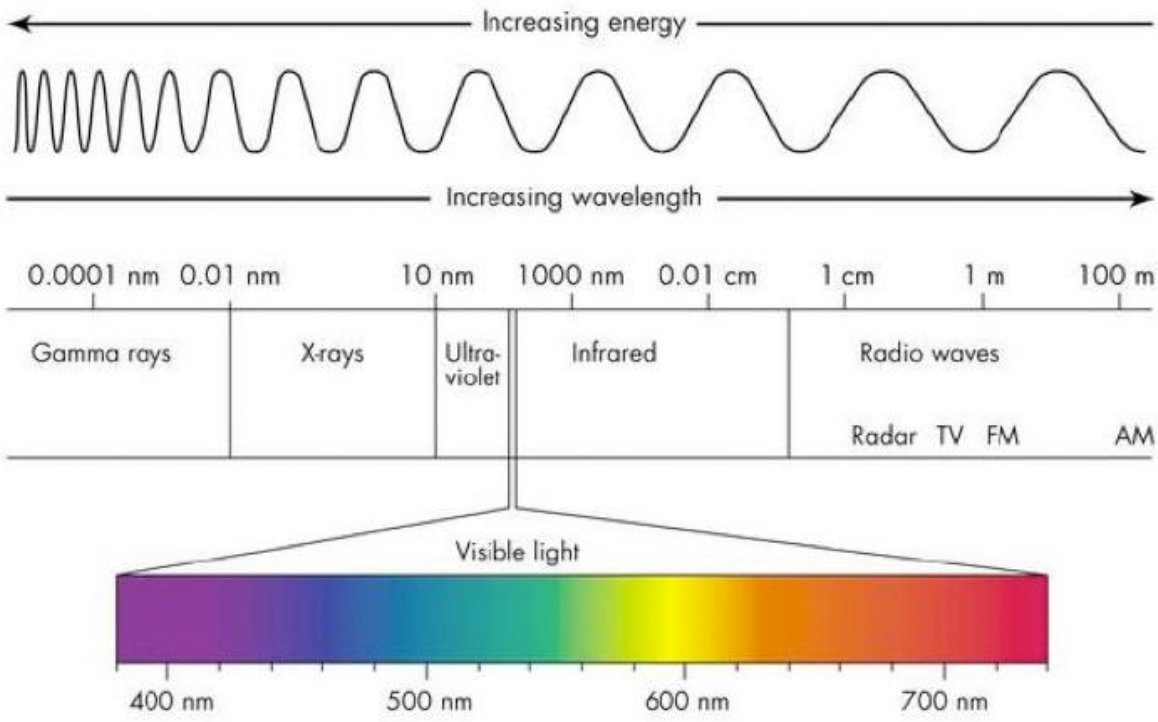
Electromagnetic waves travel at 3×10^8 $m \cdot s^{-1}$ with many of the properties of waves such as.



They are made by causing a disturbance in the mangetic and electric fields at 90° to one another.

Electromagnetic Spectrum

The different wavelengths (and frequencies) of Electromagnetic Radiation are known as the EM Spectrum.

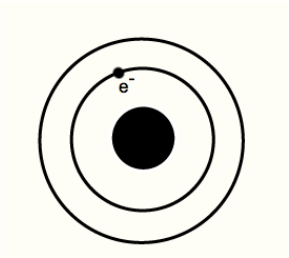


Different EM radiation is found and used in different places:

Type	Wavelength	Uses
Radio	100 - 0.01m	Communication
		Medical Imaging
Microwaves	±1 cm	Radar
		Cooking
Infrared	4000 - 700 nm	Remotes
		Night Vision
Visible Light	400 - 700 nm	Vision
		Photosynthesis
Ultraviolet Light	700 nm - 10 nm	Money Identification
		Flower Patterns
X-Rays	10 nm - 0,01 nm	Medical Images
		Airport and Mine security
Gamma Rays	< 0,01 nm	Sterilisation of Food
		Cancer Treatment

The Energy of EM Radiation

To calculate the energy of these photons of radiation we can use the formula below:

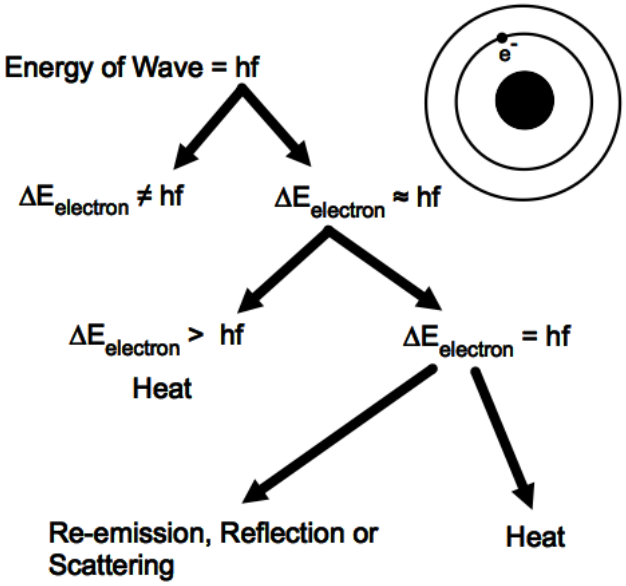


$$E = hf$$

The photons of EM Radiation can explain why they affect matter.

The electrons in the material have energy levels of certain sizes.

When photons energy is close to the energy of the electrons, the photon can be absorbed, raising the energy of the electron.



Sometimes the energy of the photon is FAR greater than the energy holding the electron on the atom. This causes the electron to be ejected.

This is said to be IONISING RADIATION and is very harmful.

Terminology

EM Radiation

Electromagnetic radiation (waves at right angles vibrating on both magnetic and electric fields.)

Radiation

Energy which moves away from a point in all directions.

Wave

A repeating vibration or oscillation of potential energy.

Particle

A small piece of matter.

Photoelectron

An electron ejected from a metal by a photon.

Photon

A particle of EM radiation.

Ionising Radiation

Radiation with enough energy to remove electrons from atoms. Very hamrful eg. UV Rays, Xrays, Gamma Rays.

Demonstration

We continue our demonstration from last week.

Why can some cellphone cameras “see” the LED on a remote (try for yourself!) while the eyes cannot?

This is because the eye can only see wavelengths of 400-700 nm and the remote uses a wavelength of 900 nm.

Questions

Question 1

(DOE Nov 2012 Question 2.8)

Which ONE of the following shows the different types of electromagnetic radiation in order of increasing frequency?

A X-rays; ultraviolet rays; infrared rays; visible light

B Infrared rays; X-rays; visible light; ultraviolet rays

C Infrared rays; visible light; ultraviolet rays; X-rays

D X-rays; ultraviolet rays; visible light; infrared rays

(2)

Question 2

(DOE Mar 2012 Question 2.11)

Overexposure to sunlight causes damage to skin cells.

a.) Which type of radiation in sunlight is said to be primarily responsible for this damage? (1)
b.) Name the property of this radiation responsible for the damage. (1)

Links

- http://www.mindset.co.za/learn/xtra
- http://www.education.gov.za/Examinations/PastExamPapers/tabid/351/Default.aspx
- http://phet.colorado.edu