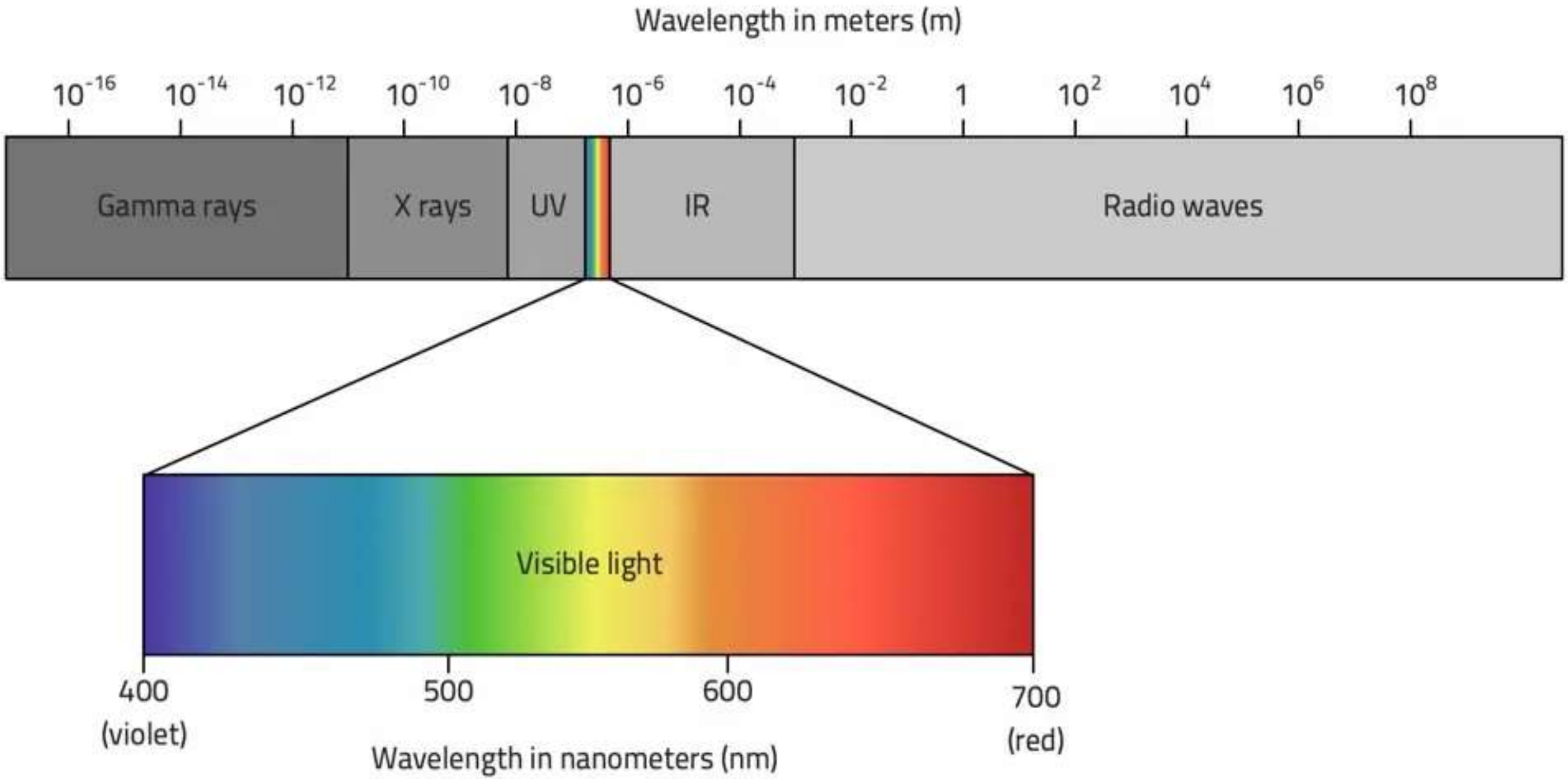
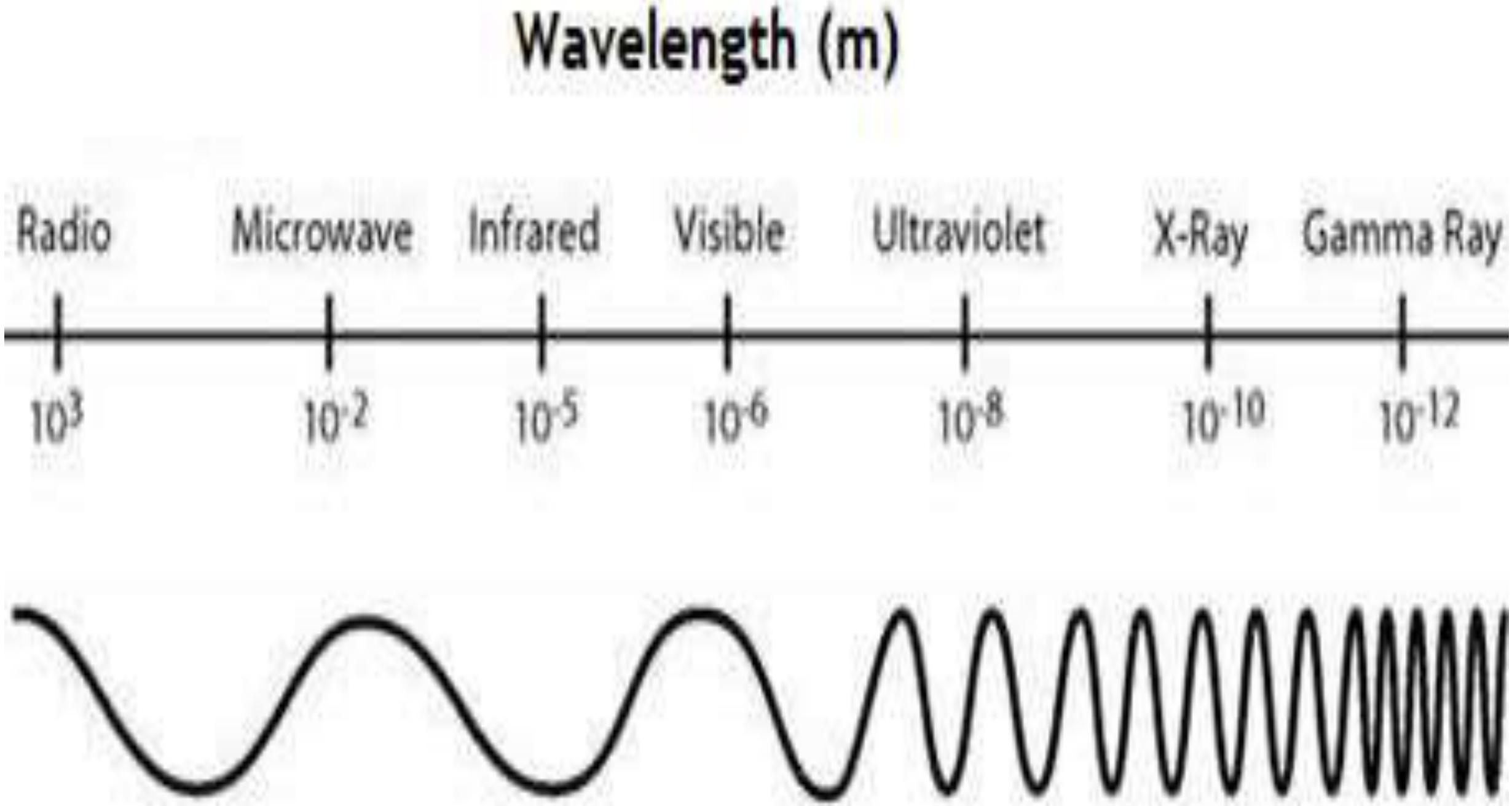
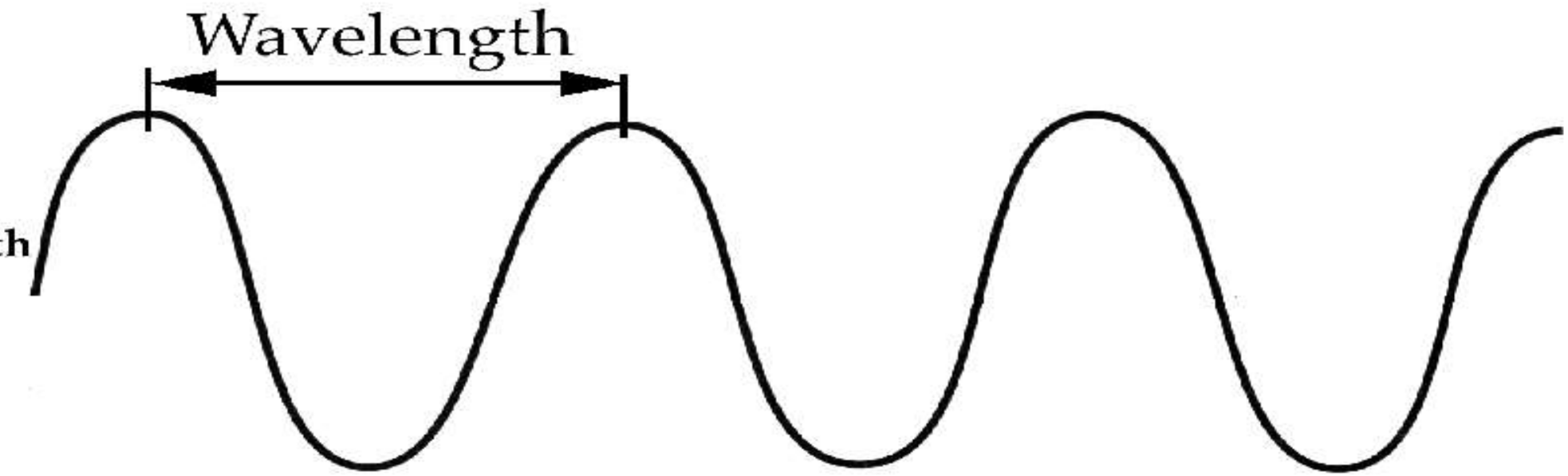
Electromagnetic Magnetic Spectrum and Beers-Lamberts Law

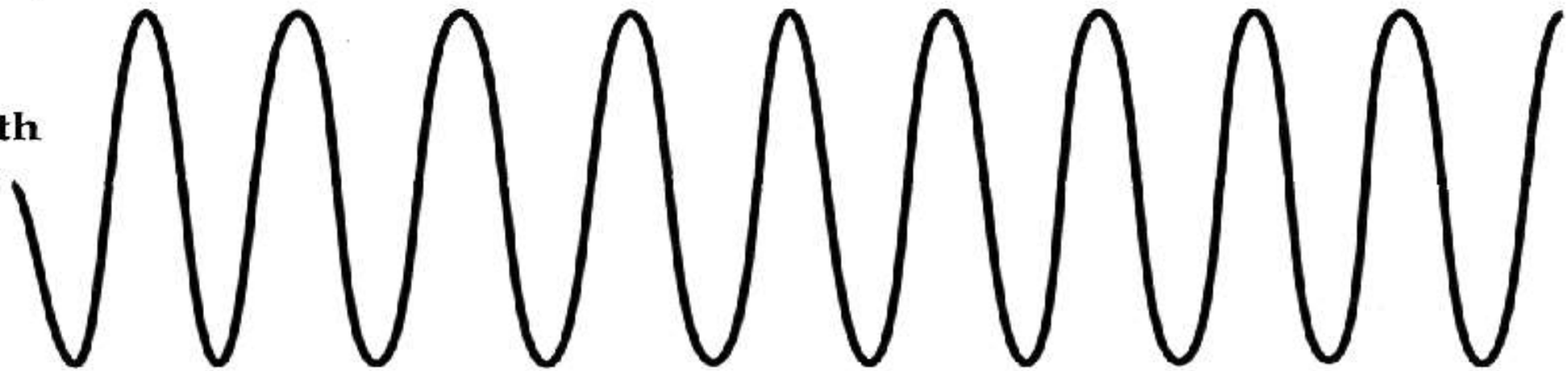

Wavelength in meters (m)
10^{-16}
10^{-14}
10^{-12}
10^{-10}
10^{-8}
10^{-6}
10^{-4}
10^{-2}
1
10^{2}
10^{4}
10^{6}
10^{8}
Gamma rays
X rays
UV
IR
Radio waves
Visible light
400
(violet)
500
600
700
(red)
Wavelength in nanometers (nm)


Wavelength (m)
Radio
Microwave
Infrared
Visible
Ultraviolet
X-Ray
Gamma Ray
10^3
10^-2
10^-5
10^-6
10^-8
10^-10
10^-12

WAVES

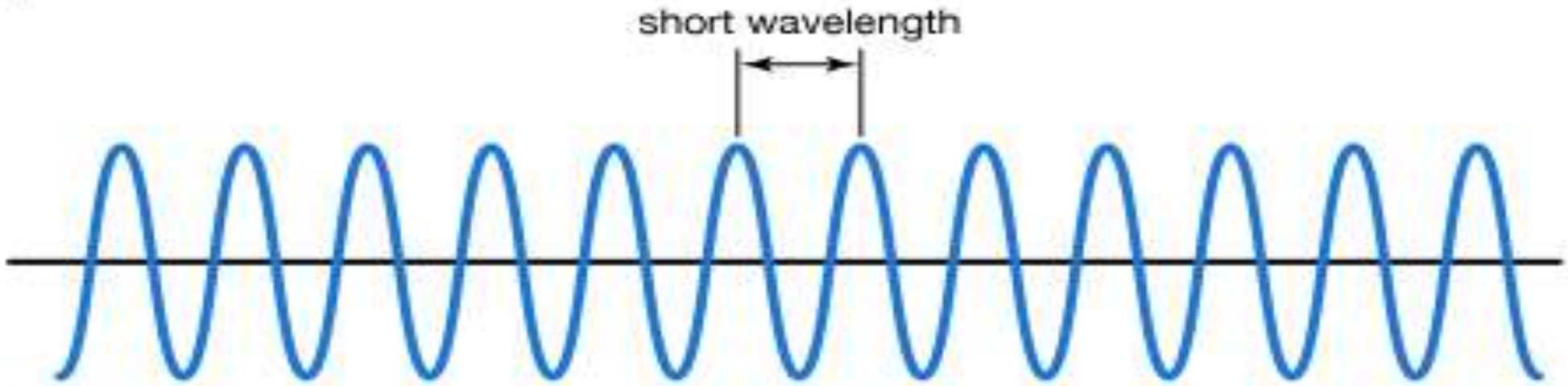


- Long Wavelength
- Low Frequency
- Low Energy

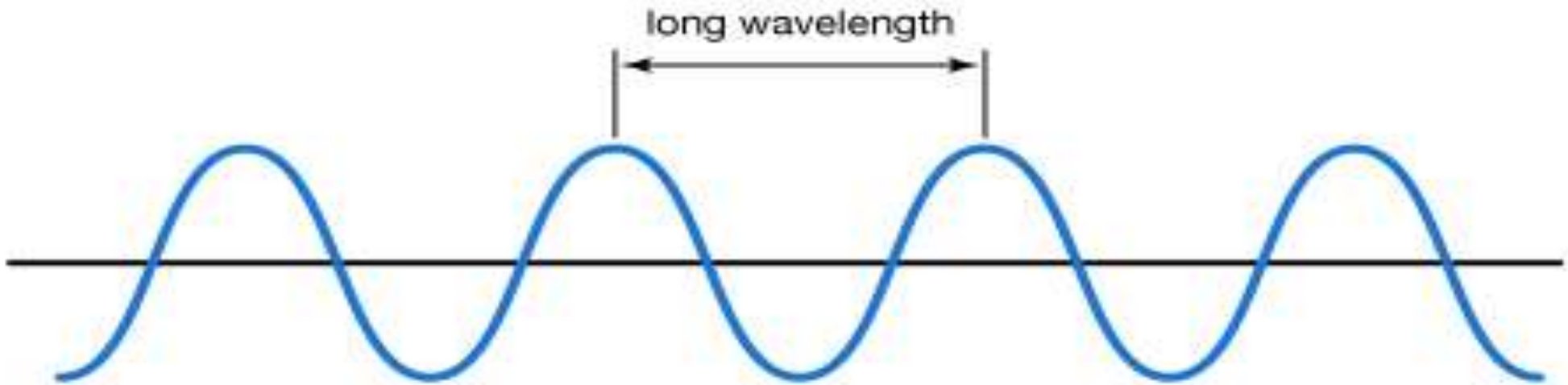


- Short Wavelength
- High Frequency
- High Energy

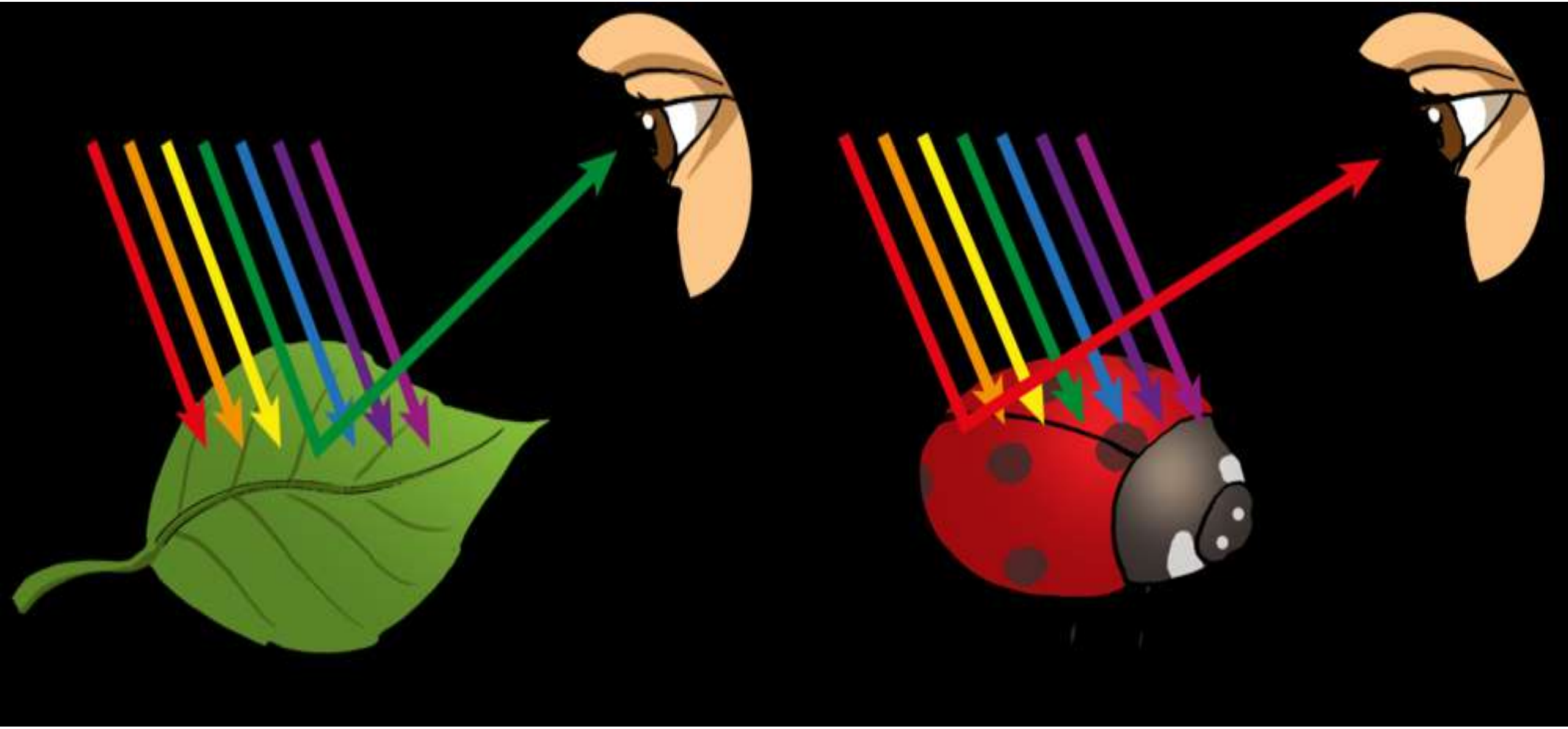
High frequency



Low frequency

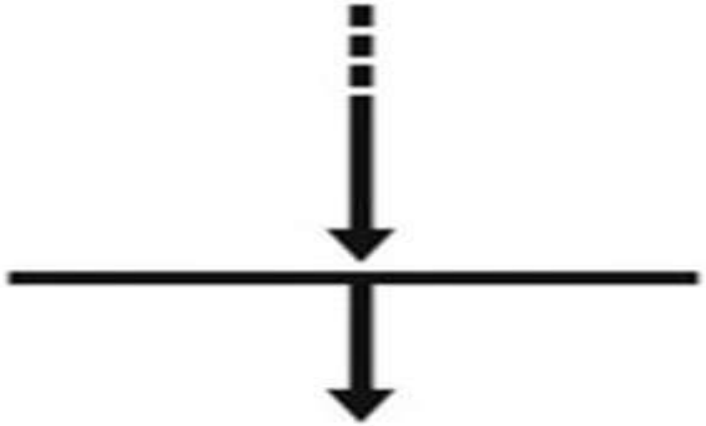


Wavelength (nm)	Region Name	Observed*
<380	Ultraviolet†	Invisible
380-440	Visible	Violet
440-500	Visible	Blue
500-580	Visible	Green
580-600	Visible	Yellow
600-620	Visible	Orange
620-750	Visible	Red
800-2500	Near-infrared	Not visible
2500-15,000	Mid-infrared	Not visible
15,000-1,000,000	Far-infrared	Not visible



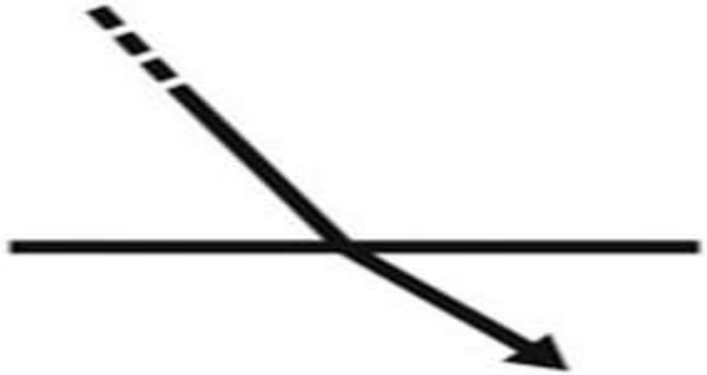
Behaviour of Light

Transmission

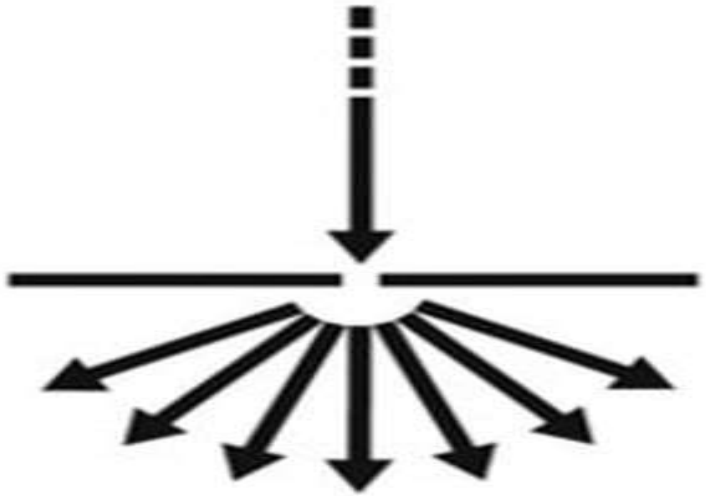


Reflection

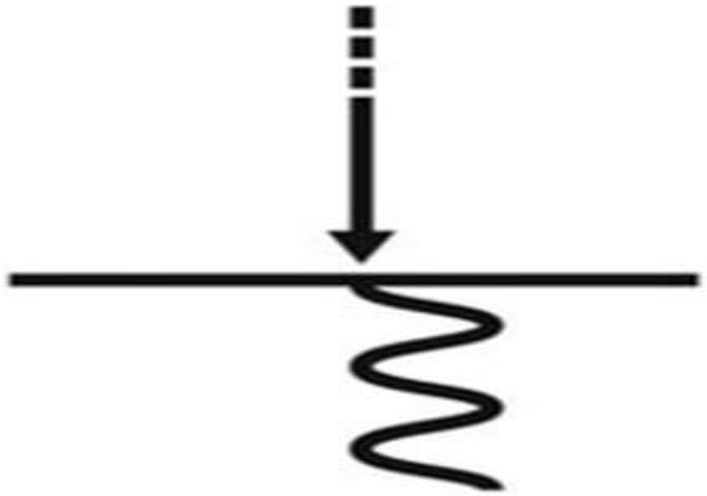
Refraction



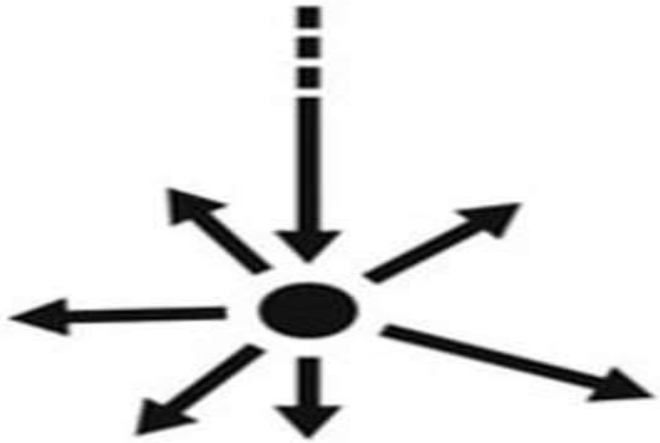
Diffraction



Adsorption



Scattering



Behaviour of Light

White light is a mixture of all of the wavelengths in the visible range

When light strikes an object, it may be

- **reflected,**
- **absorbed,**
- **transmitted, or diffracted**

A prism or a diffraction grating separates white light into its various colors. If some of the light is absorbed, the reflected or transmitted light has the complementary color of the absorbed light.P

Beers Law

- **Light absorption is directly related to the concentration of the compound in the sample**
- **As concentration increases the absorption increases linearly and light transmission decreases exponentially**

Beers Law: When a monochromatic light passes through an absorbing medium, its intensity decreases as the concentration of absorbing medium increases

- **Transmittance** is defined as the ratio of the amount of light transmitted to the amount of light that initially fell on the surface.

Transmittance = P/ P0 = intensity of transmitted light/ intensity of incident light

- **Absorbance** is defined as the negative logarithm of the transmittance

absorbance and transmittance bear an inverse relationship.

Absorbance = - log T = - log P/Po

Lamberts Law

- **The effect is measured either as Transmittance (T, the percentage of light that goes through the sample) or as the Absorbance (Abs, representing the amount of light absorbed by the sample):**

- **$T = 100(I/Io)$; $Abs = - \log10(T/100) = \log10(Io/I)$**

- **For example, a single sheet of the colored material transmits 70% of the light:**
- **$I/Io = 0.70$; $T = 70\%$; $Abs = - \log10(0.70) = 0.155$**

Lambert's Law, the absorbance is directly proportional to the thickness or path length of the absorbing material

Beer-Lambert law

- Light Absorbance: $(A) = \log (I_0 / I) = \varepsilon LC$
- Light Transmission $(T) = I/I_0 = 10^{-\varepsilon CL}$

- I_0: Light Intensity entering a sample
- I: Light Intensity exiting a sample
- C: The concentration of analyte in sample
- L: The length of the light path in glass sample cuvette
- ε: a constant for a particular solution and wave length