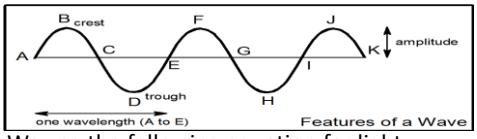
Light – What is it Really?

- Light is really electromagnetic radiation, meaning it has both wave and particle characteristics.

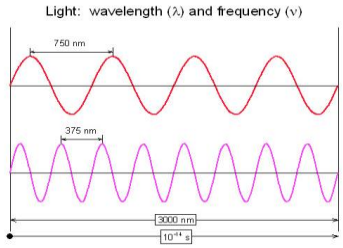


- We use the following equation for light:

$$c = \lambda f$$

C = Speed of light 3.00×10^8 m/s	λ = Wavelength Must always be in meters	f = frequency Must always be in Hertz (Hz)

Energy of Light



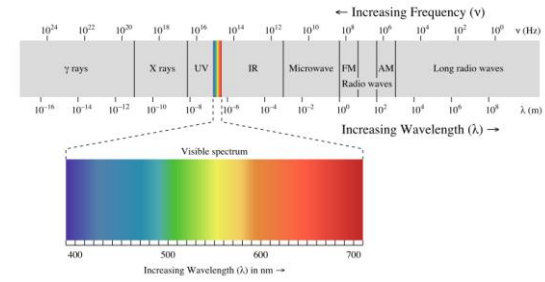
Red Light: Longer wavelength and lower frequency

Violet Light: Shorter wavelength and Higher frequency

Wavelength and frequency are inversely related!

Shorter wavelengths and higher frequency = MORE ENERGY!!!

The Electromagnetic Spectrum



Energy Increases

Light… not just a wave?

- Light also has characteristics of particles
  - When we heat substances we see different colors of light at different temps
    - The more energy added, the higher the energy of light emitted
- We now know that atoms absorb / release energy in incremental amounts
  - These amounts are known as **quantums**
    - A quantum is the minimum amount of energy that can be gained or lost by an atom

Energy of Light

- To define the amount of energy released we use Planck's equation, which relates frequency with energy of light

$$E_{quantum} = h f$$

Quantum energy

Planck's constant: 6.63×10^{-34} J• s

Frequency: Must be in Hertz (Hz)

Note: as ν increases, energy increases

This equation relates frequency to Energy…

Energy of Light

- We can also rearrange Planck's equation to relate wavelength to the energy of light

$$E_{quantum} = \frac{h\,c}{\lambda}$$

Quantum energy

Planck's constant: 6.63×10^{-34} J• s

This equation relates wavelength to Energy…

Practice Problems

1. Calculate the energy (E) of a beam of light with a frequency of 20 Hz. (Use the equation: $E = hf$)

   Planck's constant = 6.63 x 10^{-34} J*s

Practice Problems

2. Calculate the energy (E) of a beam of light with a wavelength of 499 x 10^{-7} m.

(Use the equation: $E = \frac{h\,c}{\lambda}$)

Planck's constant = 6.63 x 10^{-34} J*s

c = 3.00 x 10^{8} m/s

Practice Problems

3. Ultraviolet radiation has a frequency of 6.8 × 10^{15} Hz. Calculate the wavelength.