

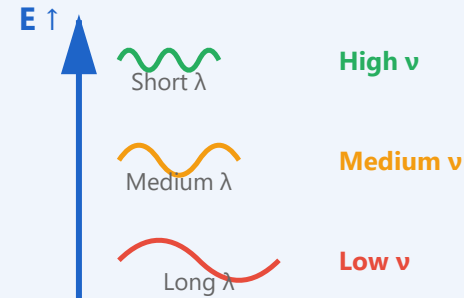
# Energy, Wavelength, Frequency Relationships

Planck-Einstein Relation

$$E = h\nu = hc/\lambda$$

$h = 6.626 \times 10^{-34}$  J·s (Planck constant)

Higher frequency → Higher energy  
Shorter wavelength → Higher energy



## 💡 Energy in eV

$$E \text{ (eV)} = 1240 / \lambda \text{ (nm)}$$

## 📐 Wavelength Conversion

$$\lambda \text{ (nm)} = 10^7 / \nu \text{ (cm}^{-1}\text{)}$$

## 🌐 Frequency Relation

$$\nu \text{ (Hz)} = c / \lambda \text{ (m)}$$

## ✨ Photon Flux

$$\Phi = P / (h\nu)$$

photons per second

## ⚡ Biological Energy Scales

~2 eV

Visible light  
photosynthesis

~0.1 eV

IR vibrations  
molecular bonds

~4 eV

UV damage  
DNA breaks

~25 meV

kBT at 25°C  
thermal energy