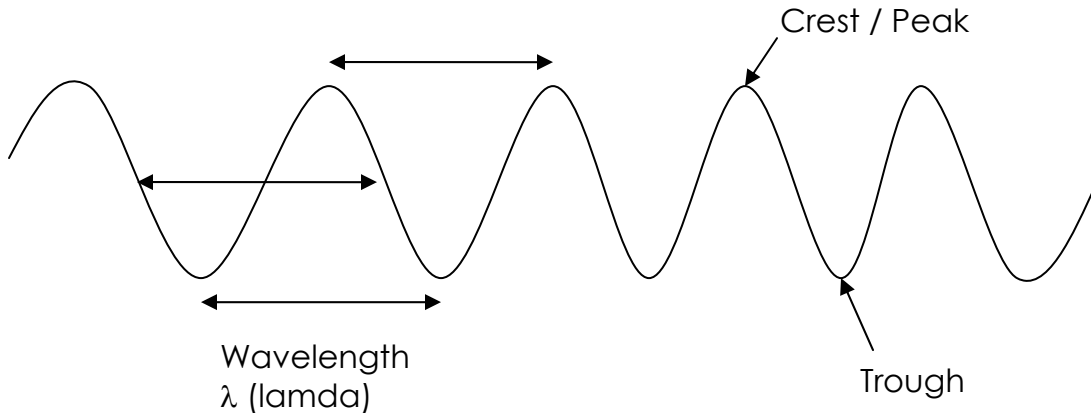
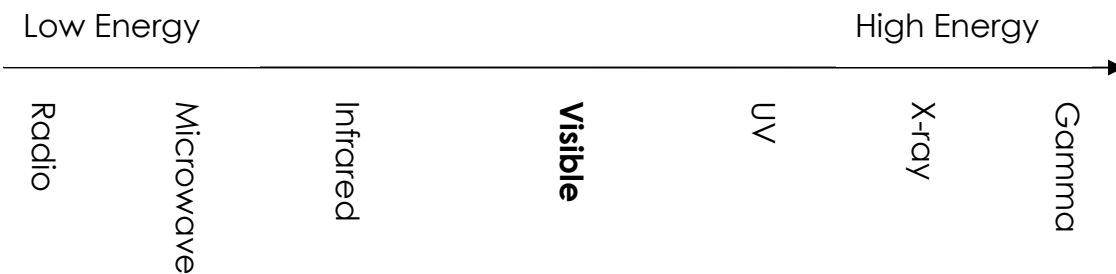


Light

- Light is electromagnetic radiation (abbr. EM)
- The light we see is only a small portion of the electromagnetic spectrum
- Isaac Newton (1400's) discovered that white light is made up of many different colors.
- 1801, Thomas Young performed slit experiment that showed light was a wave



- Our eyes register single wavelengths as a particular color
- As you move from red to violet the wavelength decreases, frequency increases and energy increases



- By the mid 1800's 4 phenomena had been observed:
 - Electricity
 - Magnetism
 - Light
 - Gravity
- Between 1864-1873 James Maxwell described electricity, magnetism and light in mathematical equations (abbr. eqtn).

- Today these 5 eqtns are known as Maxwell's Equations
 - An oscillating electric field (E) creates an oscillating magnetic field (B) and vice versa → electromagnetic radiation

 - Light is a form of electromagnetic radiation
- Maxwell and Boltzman (we'll hear more about him in future units...) showed that this model explained everything we knew about heat and Temp.
- Absorption of EM radiation increases temperature
 - Reflected EM radiation shows color (if in visible region)

But... What controls whether radiation is absorbed or reflected?

Spectra

- 1897 Max Karl Ernst Ludwig Planck proposed idea of quanta
 - $\lambda \rightarrow$ certain energy = **quanta** of energy
 - $E = h\nu = hc/\lambda$
 - h = Planck's constant (6.63×10^{-34} J s),
 - E = energy,
 - ν = frequency = c/λ
 - c = speed of light (3×10^8 m/s)

- Since 1859 scientists using spectral lines to identify elements
 - Each element has characteristic spectral lines

- 1913 Bohr puts two and two together (spectra + quantum)
 - Remember Question...
 - "Why don't electrons fall into the nucleus?"
 - Bohr's Answer
 - e- have certain energy levels/ orbits
 - Electrons can change orbits
 - Away from nucleus = Absorb energy
 - Closer to nucleus = Radiate (give off) energy
 - Because $E = hc\lambda$
 - λ depends on orbit jump
 - λ determines color
 - Spectra give info about allowed energy levels

 - Bohr worked out equations to map orbits. One of the terms in his equation he used **n = principle quantum number**
 - 4 quantum numbers resulting from spectral lines:
 - n = principle quantum number (energy level)
 - l = orbital quantum number (shape of orbit)
 - m_l = magnetic quantum number
 - m_s = spin quantum number

- 1902 Einstein found the **photon**: Photo-electric effect (Nobel Prize)

LIGHT IS BOTH WAVE and PARTICLE!!!!

Term: wave-particle duality

- 1924 deBroglie says: perhaps electrons are both wave and particle
- 1925 Erwin Schrödinger worked out equations that took wave nature of electrons into account.

Imagine tracing a wave around the nucleus. It doubles back on itself to form a "path" that looks like a wavy hoop about the nucleus. The smallest orbit would be that consisting of a single wavelength up and down. – Isaac Asimov, Atom

- Heisenberg Uncertainty principle:
Can't know both speed and position of electron at the same time
 - Bohr model: seems like you could predict exactly how fast and where an electron is
 - Wave model: fits in with uncertainty principle
 - Height of wave gives probability of electron's location

Heisenberg + Schrödinger + deBroglie = Quantum Mechanics