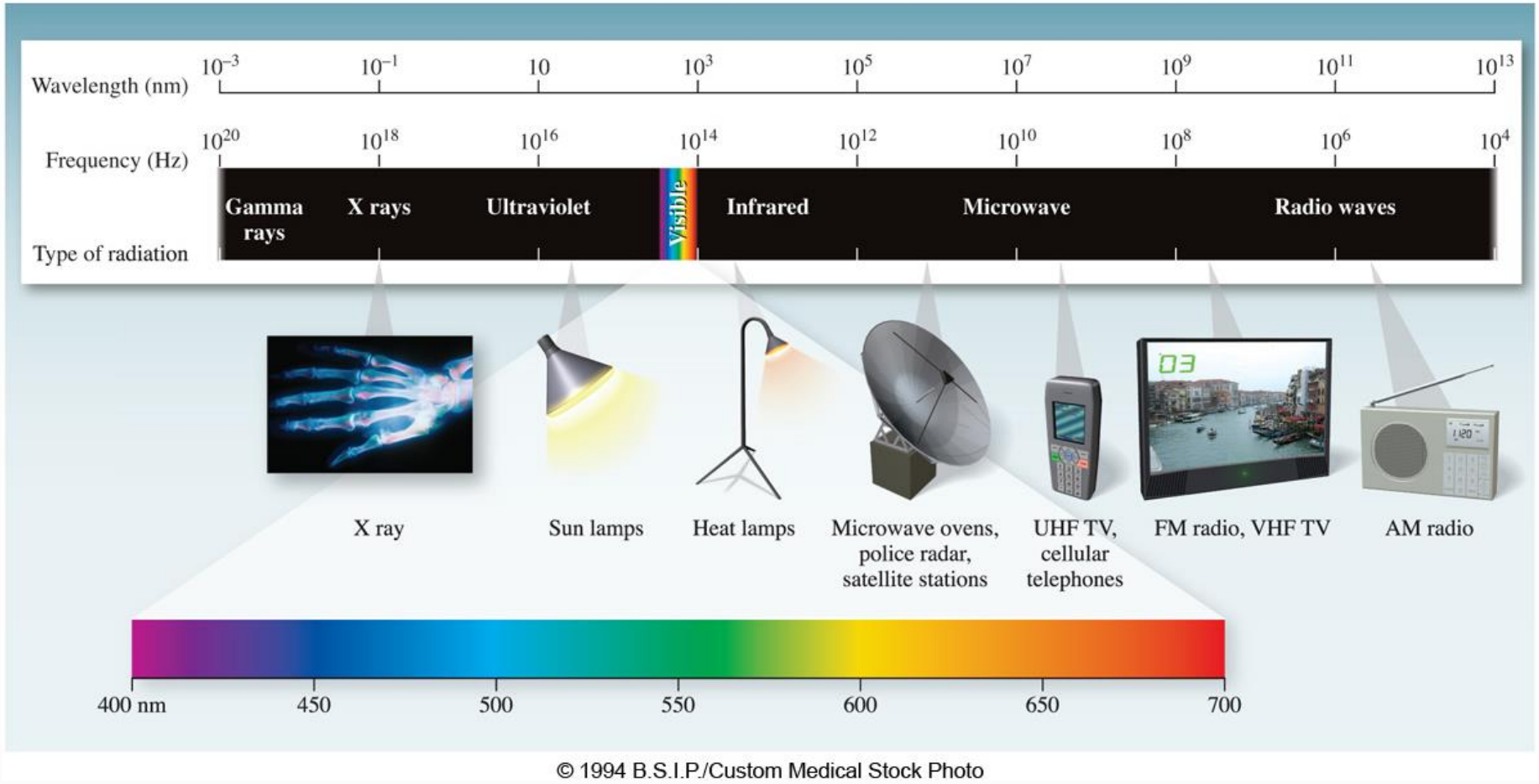
Wave theory of electromagnetic radiations

The Nature of Light

- The electromagnetic spectrum includes many different types of radiation.
- Visible light accounts for only a small part of the spectrum
- Other familiar forms include: radio waves, microwaves, X rays
- All forms of light travel in waves

Electromagnetic Spectrum



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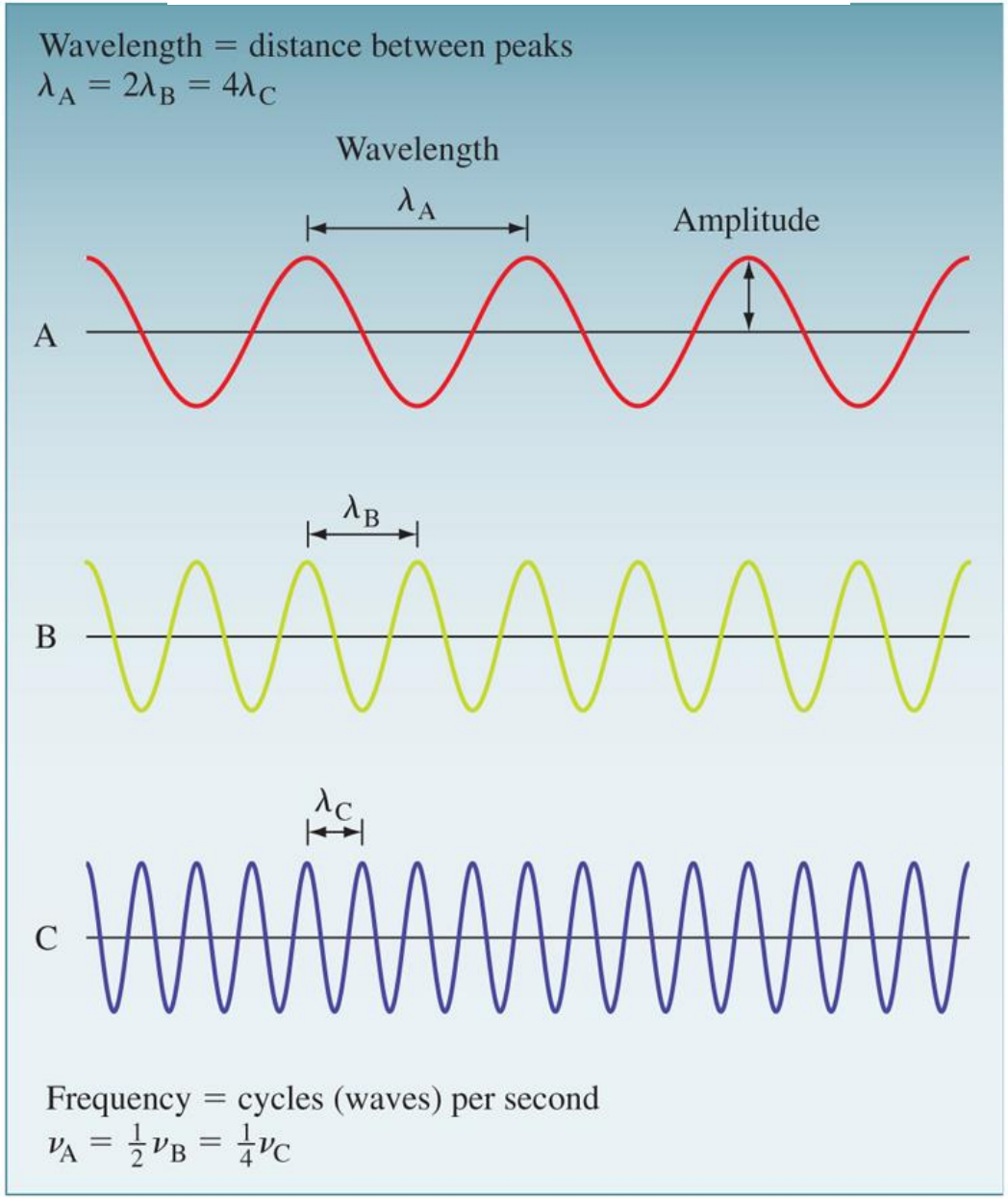
Wave Characteristics

- **Wavelength**: λ (lambda) distance between identical points on successive waves…peaks or troughs
- **Frequency**:ν (nu) number of waves that pass a particular point in one second
- **Amplitude**: the vertical distance from the midline of waves to the top of the peak or the bottom of the trough



Wave Characteristics

- Wave properties are mathematically related as:

$$c = \lambda\nu$$

where

c = 2.99792458 x 10^8 m/s (speed of light)

λ = wavelength (in meters, m)

ν = frequency (reciprocal seconds, s^{-1})

Wave Calculation

The wavelength of a laser pointer is reported to be 663 nm. What is the frequency of this light?

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$$\upsilon = \frac{c}{\lambda}$$

$$\lambda = 663\ \text{nm} \times \frac{10^{-9}\,\text{m}}{\text{nm}} = 6.63 \times 10^{-7}\,\text{m}$$

$$\upsilon = \frac{3.00 \times 10^{8}\,\text{m/s}}{6.63 \times 10^{-7}\,\text{m}} = 4.52 \times 10^{14}\,\text{s}^{-1}$$

Calculate the wavelength of light, in nm,

of light with a frequency of $3.52 \times 10^{14}\ s^{-1}$.

$$\lambda = \frac{c}{\upsilon}$$

$$\lambda = \frac{3.00 \times 10^{8}\ \text{m/s}}{3.52 \times 10^{14}\ \text{s}^{-1}} = 8.52 \times 10^{-7}\ \text{m}$$

$$\lambda = 8.52 \times 10^{-7}\ \text{m} \times \frac{10^{9}\ \text{nm}}{\text{m}} = 852\ \text{nm}$$

References:

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