

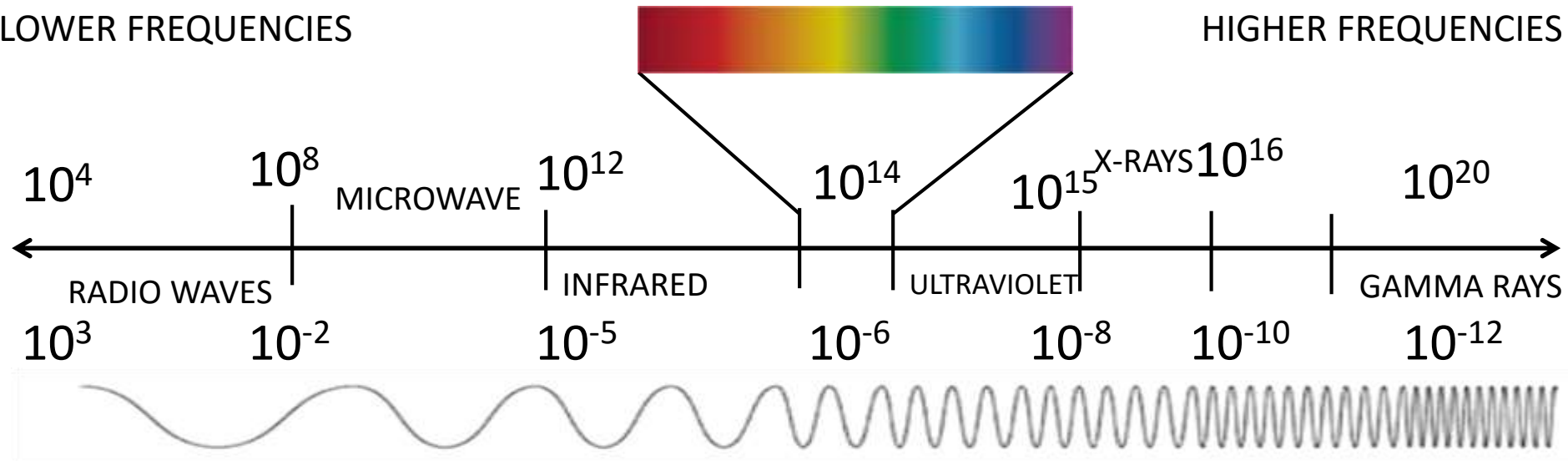
LIGHT, SOUND AND THE INTERACTION OF WAVES

THE ELECTROMAGNETIC SPECTRUM

VISIBLE LIGHT

LOWER FREQUENCIES

HIGHER FREQUENCIES



LONGER WAVELENGTHS

SHORTER WAVELENGTHS

VISIBLE LIGHT

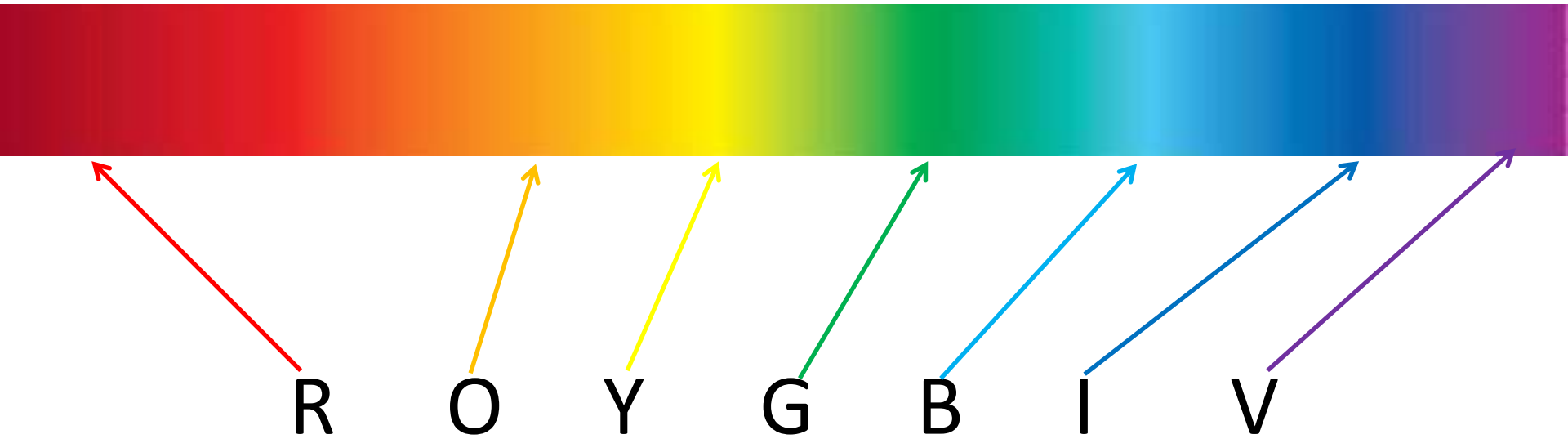
$$\lambda = 6.5 \times 10^{-7} \text{m}$$

$$f = 4.0 \times 10^{14}$$

The Speed of light is 3.0×10^8 m/s

$$\lambda = 4.0 \times 10^{-7} \text{m}$$

$$f = 7.35 \times 10^{14}$$



RED light has the longest wavelength, but the lowest frequency.

VIOLET light has the shortest wavelength, but the highest frequency.

Other important parts of the EM Spectrum

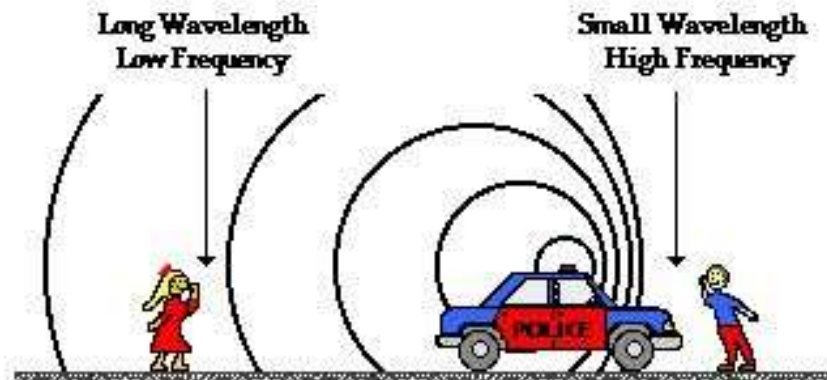
- Radio Waves (Longest wavelength, lowest frequency)
 - 93.9 Bob FM (93.9MHz or 93.9×10^6 Hz)
- Microwaves (3×10^9 - 3×10^{12} Hz)
 - Waves that cook your popcorn (excites the water molecules)
- X-rays (3×10^{17} - 3×10^{19})
 - Used in the medical field. Can pass through skin but not through bone
- Gamma rays (greater than 3×10^{19})
 - Used in Nuclear energy

SOUND

- Unlike light waves (the EM Spectrum) Sound travels in longitudinal waves (also known as compression waves)
- The speed of sound varies with temperature. At room temperature, the speed of sound is approximately 340 m/s.
- Most people can hear frequencies between **20 – 20,000 Hz**
- **Infrasonic**- sounds below 20 Hz (elephants can hear these sounds)
- **Ultrasonic**-frequencies above 20, 000 Hz. Dogs can hear above 25,000 Hz, dolphins and bats can hear above 100,000 Hz

EFFECT OF SOUND

- **Pitch**- the highness or lowness of a sound. The higher the frequency the higher the pitch.
- **Volume** – The relative intensity of a sound. Measured in decibels.
- The Doppler affect- A change in **frequency** (and pitch) of a sound due to the **motion** of the sound source or the listener.



INTERFERENCE OF WAVES

- What happens when 2 or more waves travel through a medium at the same time?
- Each wave affects the medium independently!
- This interaction can be constructive or destructive.

INTERFERENCE OF WAVES



Constructive Interference

The Amplitudes of the waves add together to form a larger wave.

INTERFERENCE OF WAVES



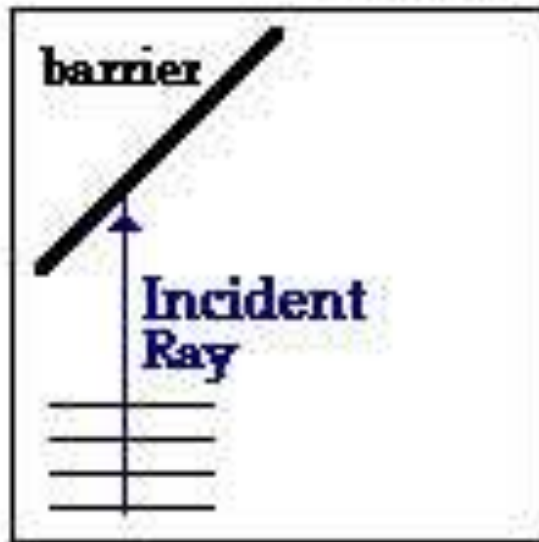
Destructive interference

The Amplitudes cancel each other out

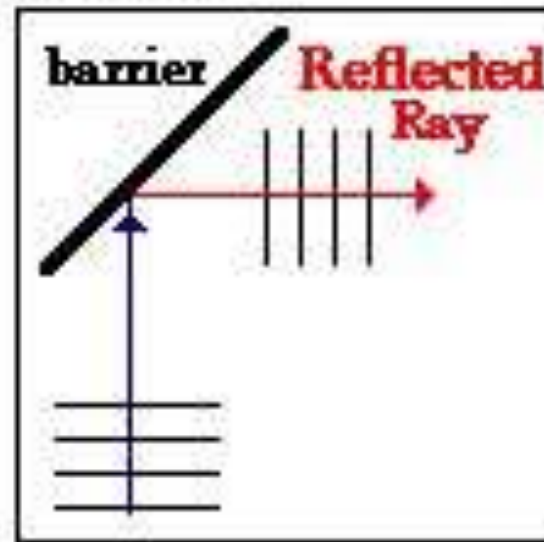
INTERACTION OF WAVES

- **Reflection**- A wave will reflect off of a barrier at the same angle (the angle of incidence) at which it hits the barrier.

The Law of Reflection



Before Reflection

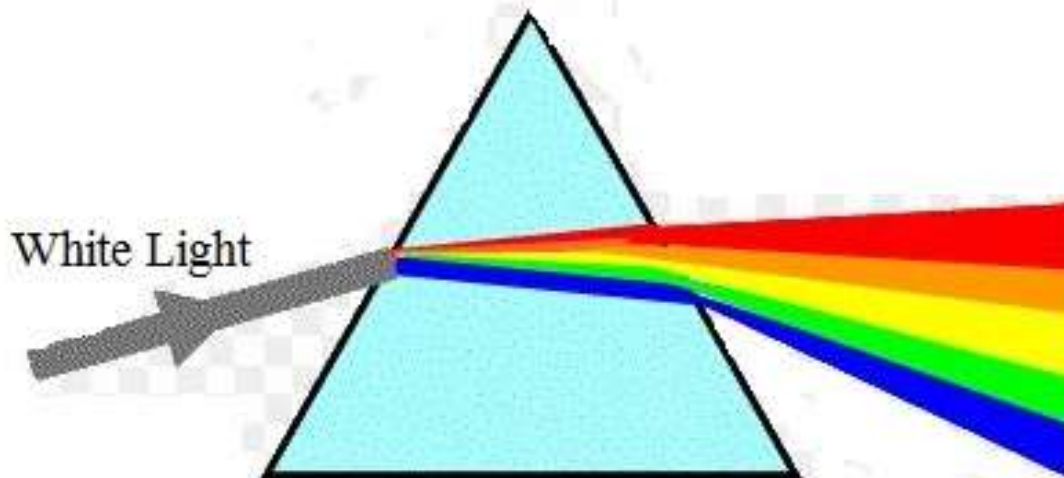


After Reflection

INTERACTION OF WAVES

- **Refraction**- A change in the direction of waves as they pass from one medium to another. The bending of the path of the waves.

Refraction through a prism



INTERACTION OF WAVES

- **Diffraction**- A change in direction of waves as they pass through an opening or around a barrier in their path.

