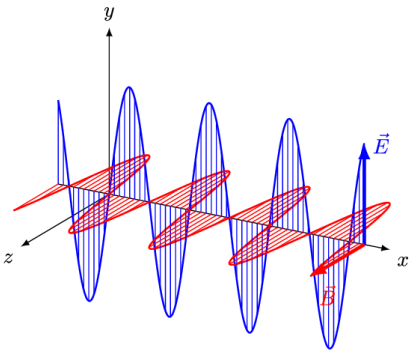
Electromagnetic and Visible Light Spectrum
Lesson Notes

Learning Outcomes

- How are the various regions of the electromagnetic spectrum organized with respect to frequency, wavelength, and energy?
- How are wavelength and frequency related to the various colors of the visible light spectrum?

Electromagnetic Waves

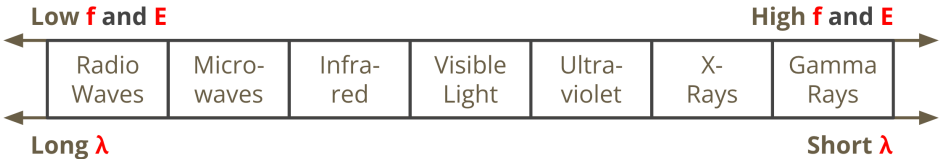
- An electromagnetic (EM) wave is created by a vibrating electric charge.
- As an EM wave propagates through space, there is an oscillating electric (**E**) and magnetic (**B**) field.
- Electromagnetic waves are not mechanical waves; mechanical waves require a physical medium.
- Electromagnetic waves can travel through solids, liquids, gases, and *empty space*. A medium is not required for EM wave propagation.



Animation Credit: https://commons.wikimedia.org/wiki/File:EM-Wave.gif

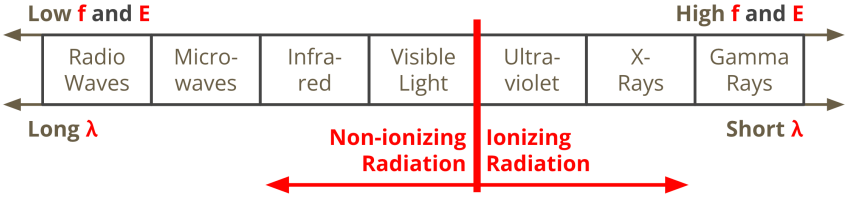
The Electromagnetic Spectrum

- There is a vast range of frequencies and wavelengths for electromagnetic waves.
- This spectrum of electromagnetic wave frequencies can be divided into regions, with waves within each region having similar behaviors and/or uses.
- Wavelength (**λ**) varies inversely with frequency (**f**).
- Energy (**E**) varies directly with frequency (**f**).
- All waves have the same speed (**v**) in the same medium.



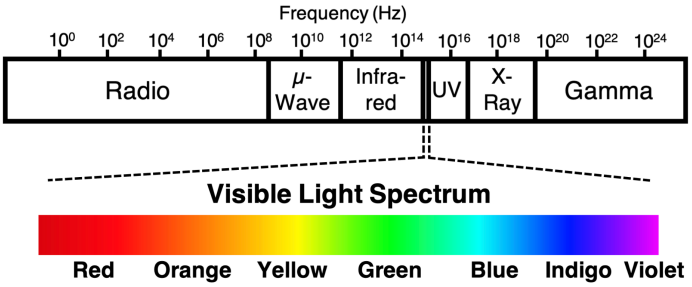
Regions of the EM Spectrum

- The behavior of an EM wave is dependent upon its **λ**, **f**, and **E**.
- **Radio waves** (long **λ**) are used for communication because of their ability to diffract around obstacles.
- **X-rays** (high E) can pass through tissue and are blocked by bones, teeth, etc. They are used for medical imaging.
- Ultraviolet and higher frequencies are ionizing forms of radiation that can cause genetic mutations and damage to human tissue. All other parts of the spectrum are non-ionizing.



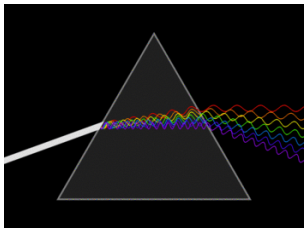
The Visible Light Spectrum

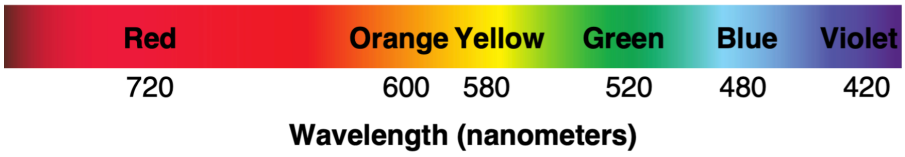
The visible light portion of the EM spectrum consists of wave frequencies our eyes can detect. It is the narrowest range of the entire EM spectrum.



ROYGBIV

- Visible light (a.k.a, white light) is dispersed (separated) into its component colors by a triangular prism.
- Each color of the visible light spectrum corresponds to a specific wavelength (or range of wavelengths).
- White light = **R** + **O** + **Y** + **G** + **B** + **I** + **V**.
- The color "black" = no visible light frequencies





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Wavelength, Frequency, and Energy