

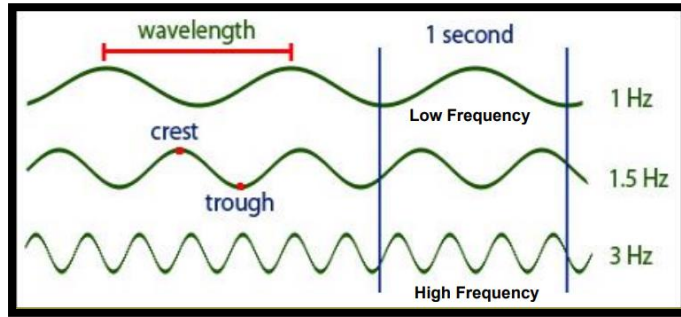
# Notes for Electromagnetic Spectrum

- Energy from the Sun

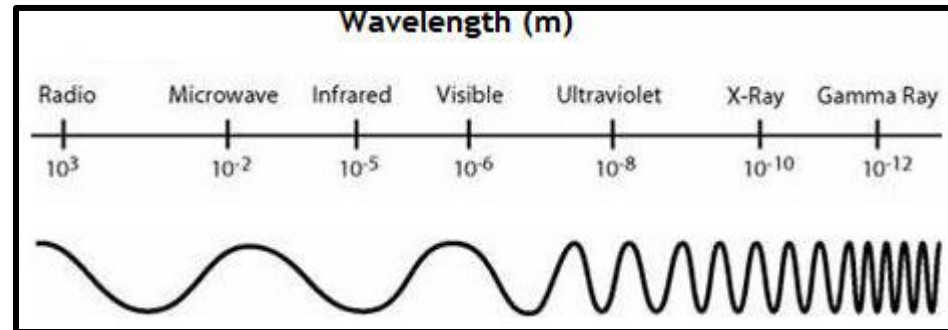
- During nuclear fusion reactions inside the Sun, energy is released that travels to Earth in the form of electromagnetic waves.
- Since electromagnetic waves just rely upon alternating magnetic and electrical fields, they can travel through the vacuum of space at the speed of light (300,000 km/s).

- Properties of Electromagnetic Waves

- Wavelength is measured from the crest of one wave to the crest of another wave.
- Frequency is measured according to how many waves can pass a single point in one second.
- As energy and frequency increases, wavelength decreases.



- **Electromagnetic Spectrum**



- **Radio Waves** – Longest wavelengths, lowest frequencies. Used for radios, cell phones, televisions, RADAR, communication in space, and listening to space, and MRIs in medicine.
- **Microwaves** – Microwave ovens use a frequency that causes water molecules in food to vibrate and generate heat through friction.

- **Visible Light Waves** – Only waves humans can see. All light waves combined produces white light. Different wavelengths produce different colored lights – ROYGBIV – with red being the longest wavelengths and violet being the shortest. Pigments absorb some light waves and reflect others. We see only reflected light. Plants use the energy in light waves to convert H<sub>2</sub>O and CO<sub>2</sub> into chemical energy (carbohydrates) that is passed up through the food chain.
- **Ultraviolet Waves** – Most of the UV waves are absorbed by the Ozone layer in Earth's atmosphere, but some UVB and most of UVA waves make it to Earth. UVB waves cause sunburns. UVA waves cause longer lasting damage like freckles, moles, wrinkles, and skin cancer. Broad spectrum sunscreen absorbs and blocks both UVA and UVB waves. Welding equipment and tanning beds release UV radiation. UV light is used to kill bacteria and viruses at sewage treatment plants.

- **Fluorescent materials absorb UV waves from blacklights and emit visible light waves.**
- **X Rays – Unable to penetrate through Earth’s atmosphere. Used on Earth to examine internal structures. Blocked by lead.**
- **Gamma Rays – shortest wavelengths, highest frequencies. Can penetrate most substances, including lead. Produced during solar flares in the Sun but are blocked by Earth’s atmosphere. On Earth, they are released from radioactive material and during nuclear fission reactions in nuclear bombs and at nuclear power plants. Short term exposure to large amounts of gamma rays can cause 3<sup>rd</sup> degree burns, hair loss, vomiting, and death. Long term to smaller amounts of gamma rays can damage DNA, resulting in tumors, cancer, and birth defects.**