

# Waves of the Electromagnetic Spectrum

Electromagnetic waves can be thought of as stream of particles, where each particle is moving with the speed of light. Each particle contains a bundle of energy. This bundle of energy is called a photon.

The sun's energy arrives as radiation with a wide range of wavelengths, including infrared, visible, and ultraviolet, and that white light is made up of a spectrum of many different colors.

Identify and compare characteristics of the electromagnetic spectrum such as wavelength, frequency, use, and hazards and recognize its application to an understanding of planetary images and satellite photographs.

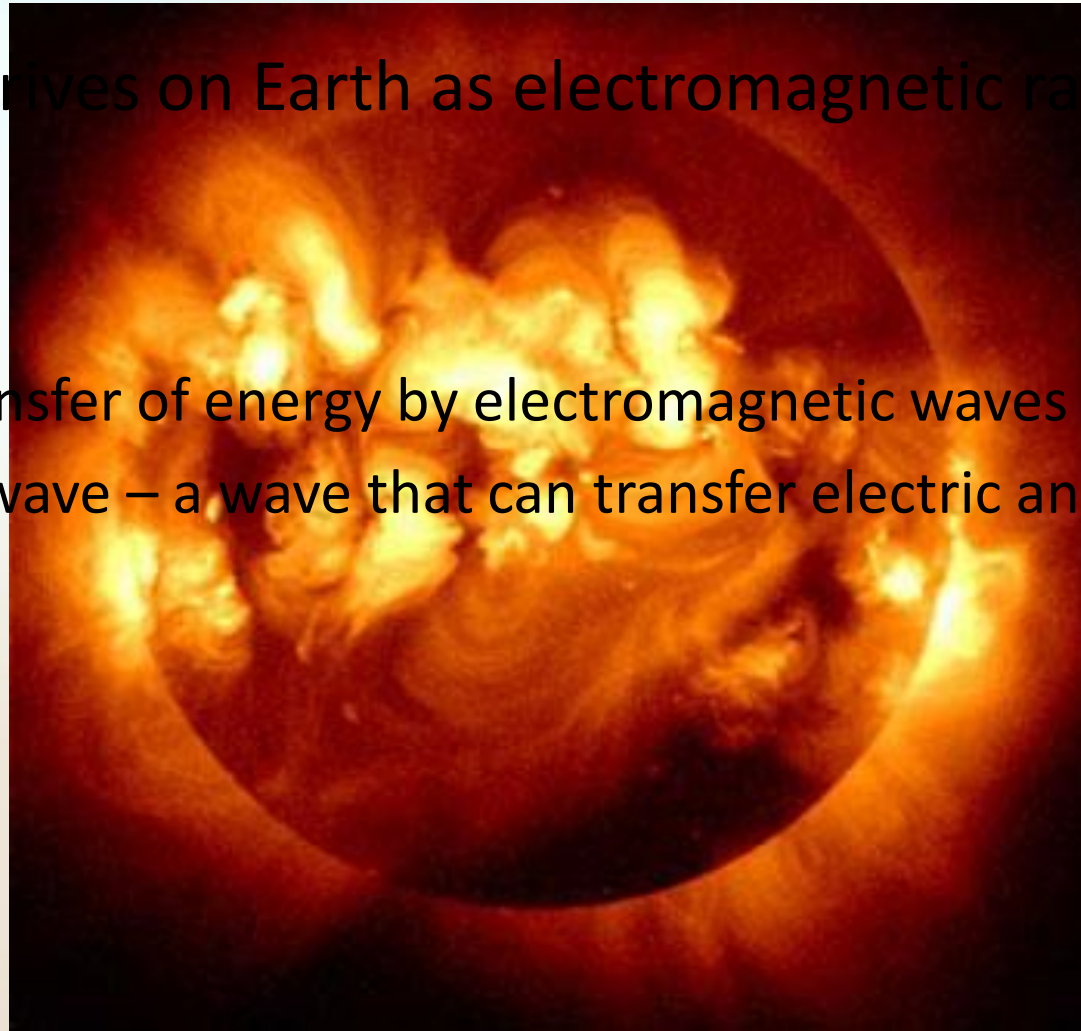
# How Does the Sun's Energy Arrive on Earth?



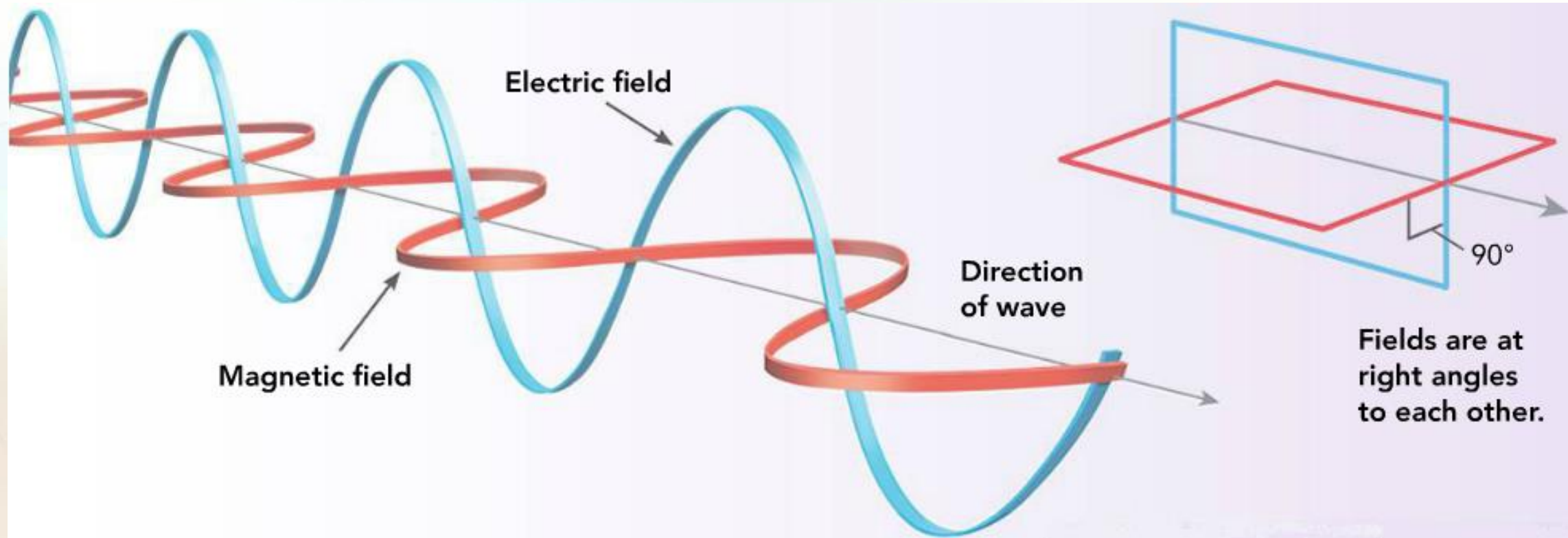
 The sun's energy arrives on Earth as electromagnetic radiation.

- Vocabulary

- Radiation – the transfer of energy by electromagnetic waves
- \*Electromagnetic wave – a wave that can transfer electric and magnetic energy



# How Does the Sun's Energy Arrive on Earth?



Electromagnetic Wave Animation

# How Does the Sun's Energy Arrive on Earth?

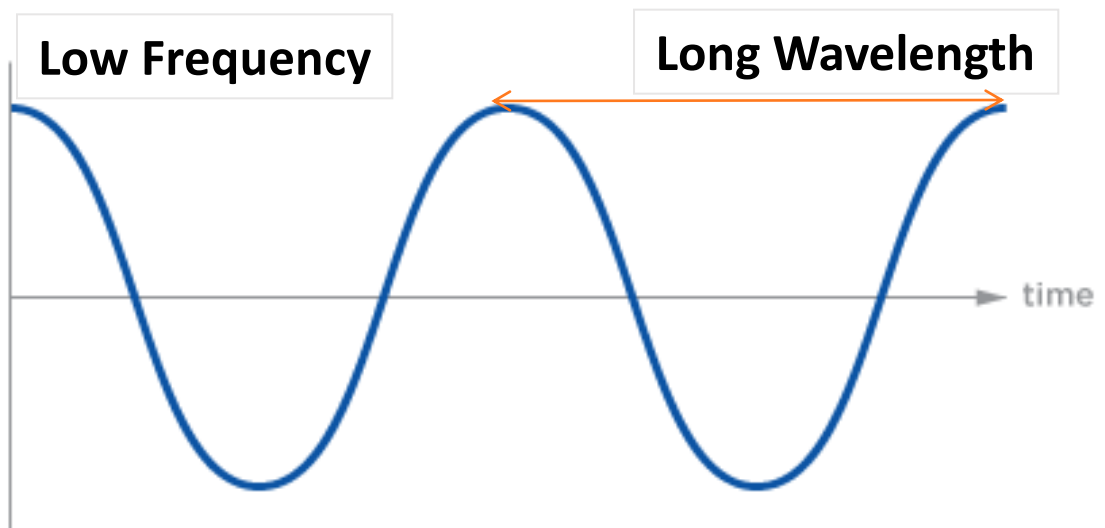
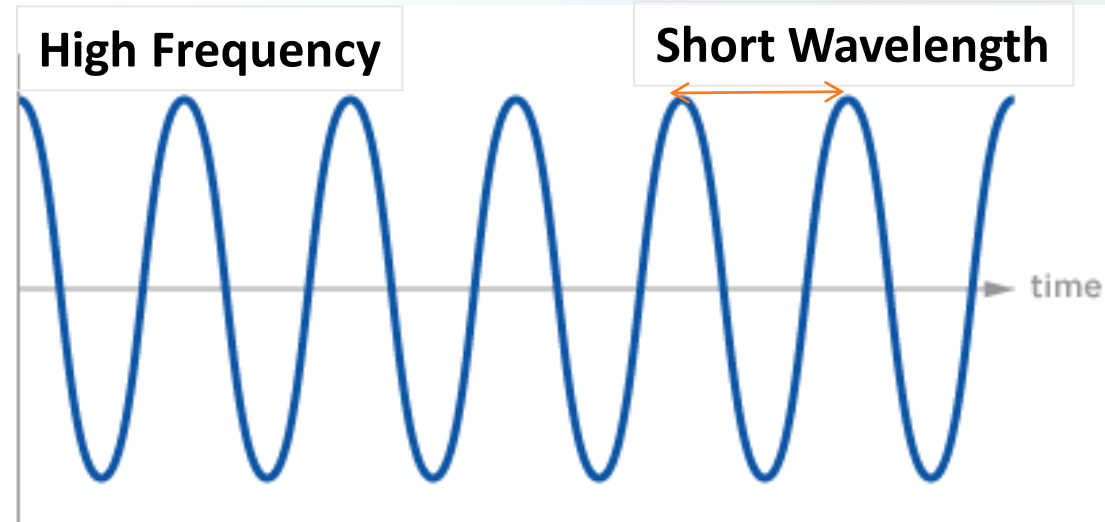
- What can electromagnetic waves travel through?
  - Empty Space
  - Gases (ex. Air)
  - Liquids (ex. Water)
  - Solids

# How Does the Sun's Energy Arrive on Earth?

- \*Characteristics of EM. Waves
  - Electrical and magnetic properties
  - Electric and magnetic field are at right angles ( $90^\circ$ ) to each other
  - Does not require a medium to travel through
  - Travels fastest in: vacuum (empty space) > gas > liquids > solids



# Characteristics of Waves



- \*Frequency - the number of complete waves that pass a given point in a certain amount of time.
- Wavelength - the distance between the crest of one wave to the crest of another wave



# What Makes Up the EM. Spectrum?

- 🔑 The EM. Spectrum is made up of radio waves, microwaves, infrared rays, visible light, ultraviolet rays, X-rays, and gamma rays.

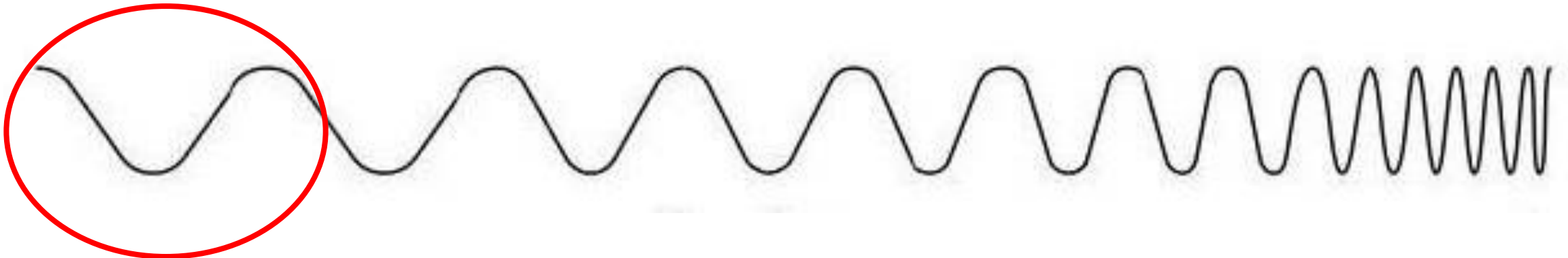


<b>Radiowaves</b>	<b>Microwaves</b>	<b>Infrared Rays</b>	<b>Visible Light</b>	<b>Ultraviolet Rays</b>	<b>X-rays</b>	<b>Gamma Rays</b>
-------------------	-------------------	----------------------	----------------------	-------------------------	---------------	-------------------



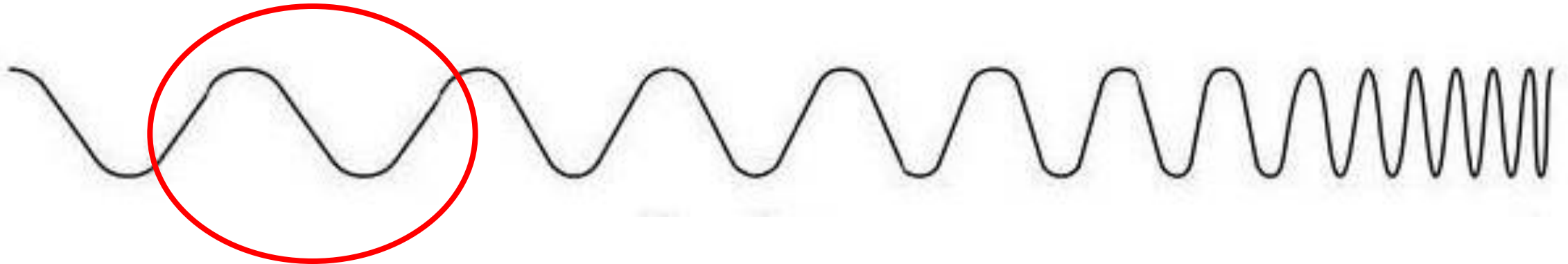
# Radiowaves

- A. Longest wavelengths, Lowest frequencies**
- B. Used in broadcasting to carry signals for radio programs**
- C. Useful**



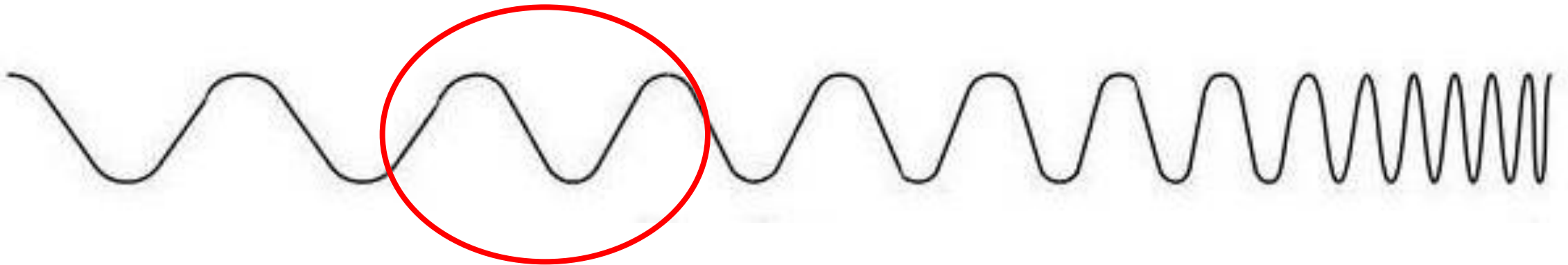
# Microwaves

- A. Have shorter wavelengths and higher frequencies than radio waves**
- B. Used in microwaves to cook food, cellular phones, radar guns**
- C. Useful**



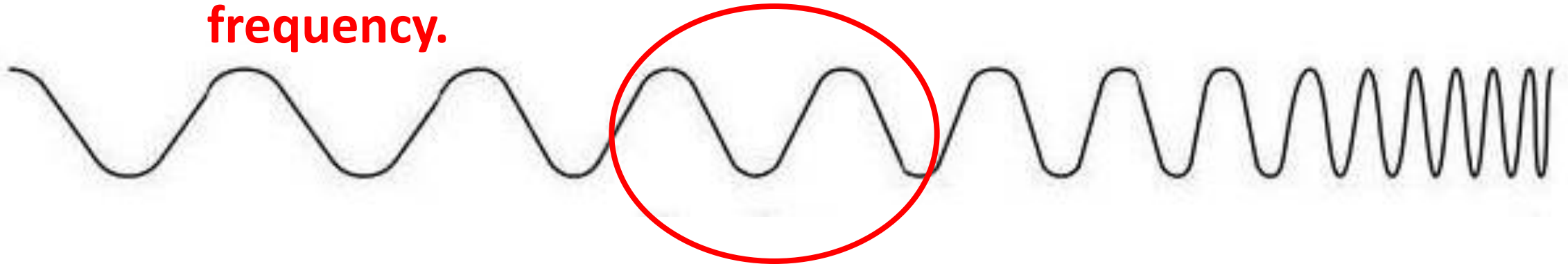
# Infrared Rays

- A. Have shorter wavelengths and higher frequencies than microwaves**
- B. Used in heat lamps to keep things warm. Also used in infrared cameras to detect heat.**
- C. Useful**



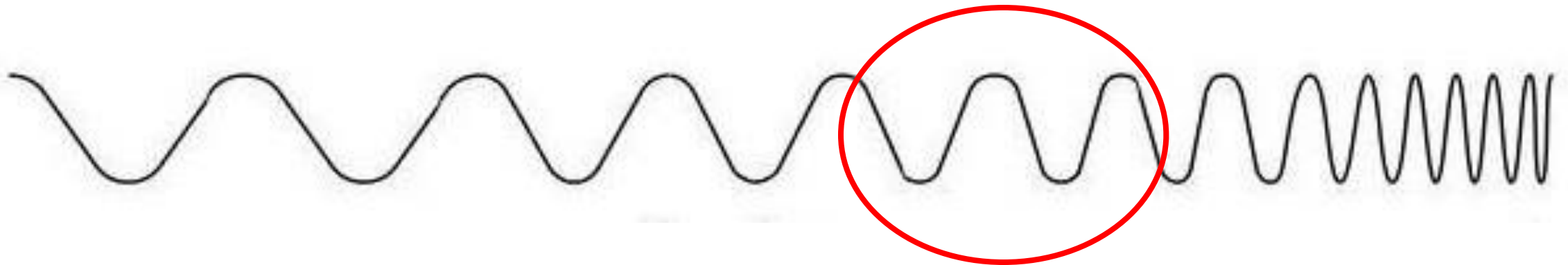
# Visible Light

- A. Have shorter wavelengths and longer frequencies than infrared rays.
- B. White light can be separated into red, orange, yellow, green, blue, and violet (ROY G BIV)
- C. Red has the longest wavelength and lowest frequency. Violet has the shortest wavelength and highest frequency.



# Ultraviolet Rays

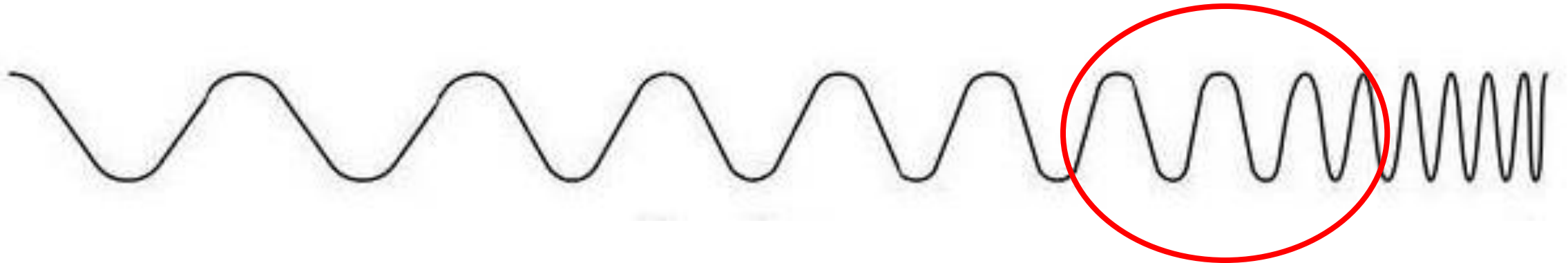
- A. Shorter wavelengths and higher frequencies than visible light.**
- B. Energy is great enough to damage or kill living cells. Too much exposure can burn your skin. Small doses can cause skin cells to produce vitamin D.**
- C. Useful and Hazardous**





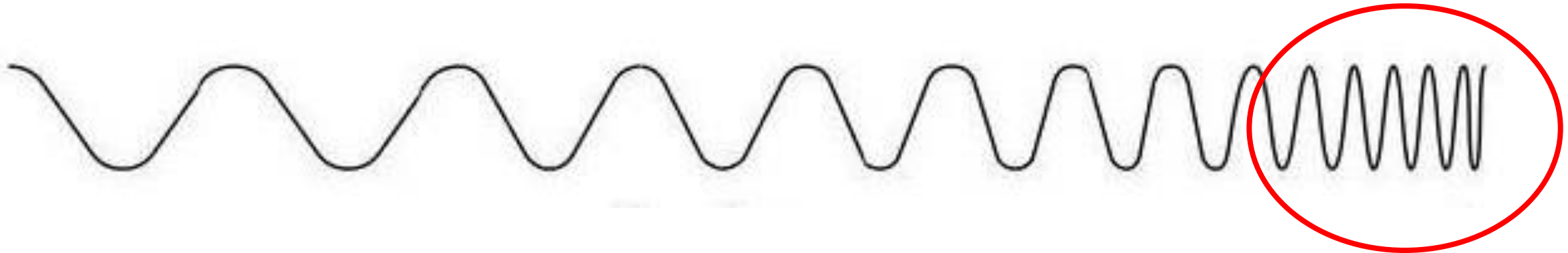
# X-rays

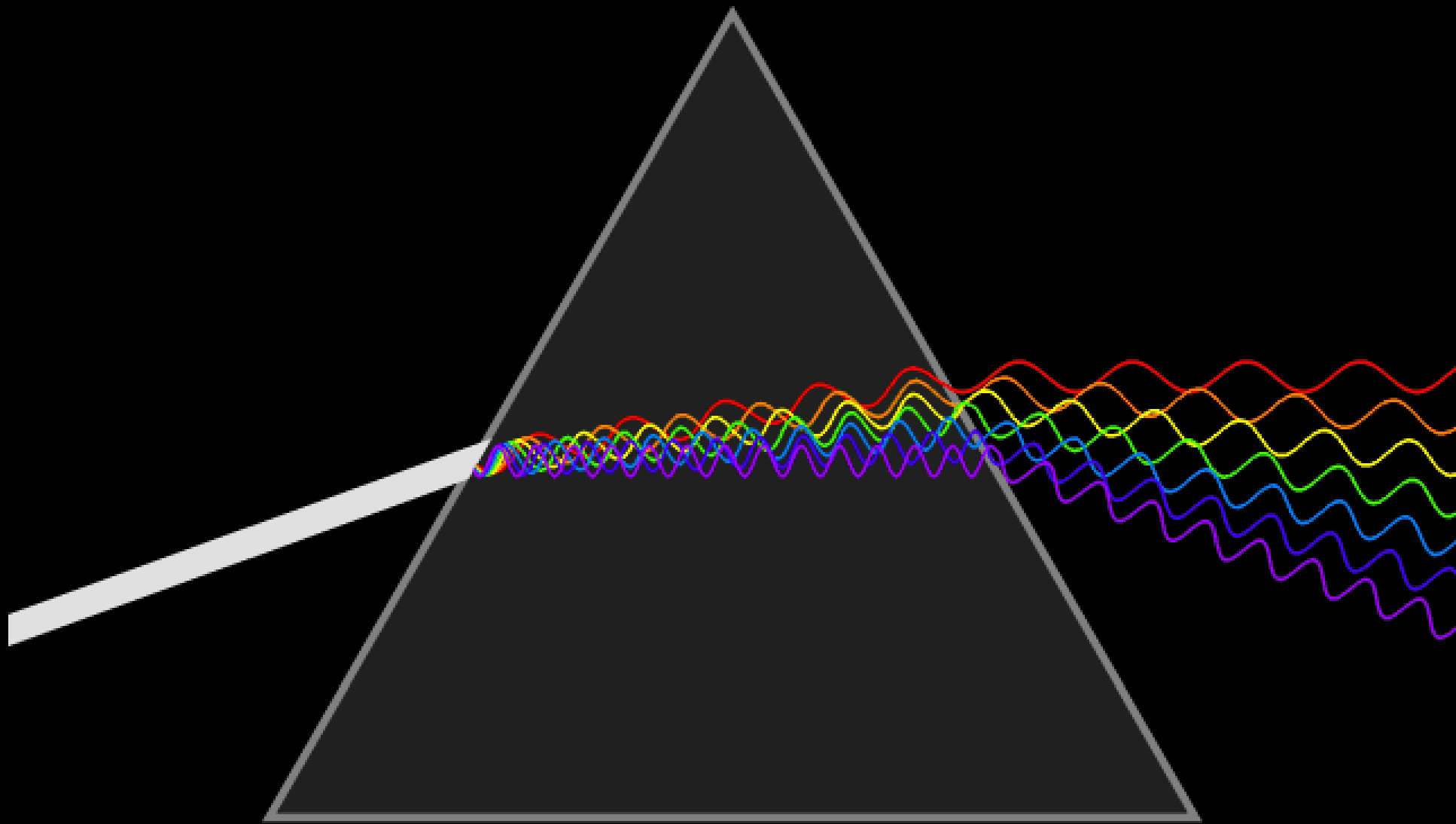
- A. Shorter wavelengths and higher frequencies than ultraviolet rays**
- B. Can penetrate most matter. Can be used to make images of bones and teeth. Too much exposure can cause cancer.**
- C. Useful and hazardous**



# Gamma Rays

- A. Shortest wavelengths and highest frequencies**
- B. Most penetrating of all waves. Can be used to examine the body's internal structures.**
- C. Useful and hazardous.**

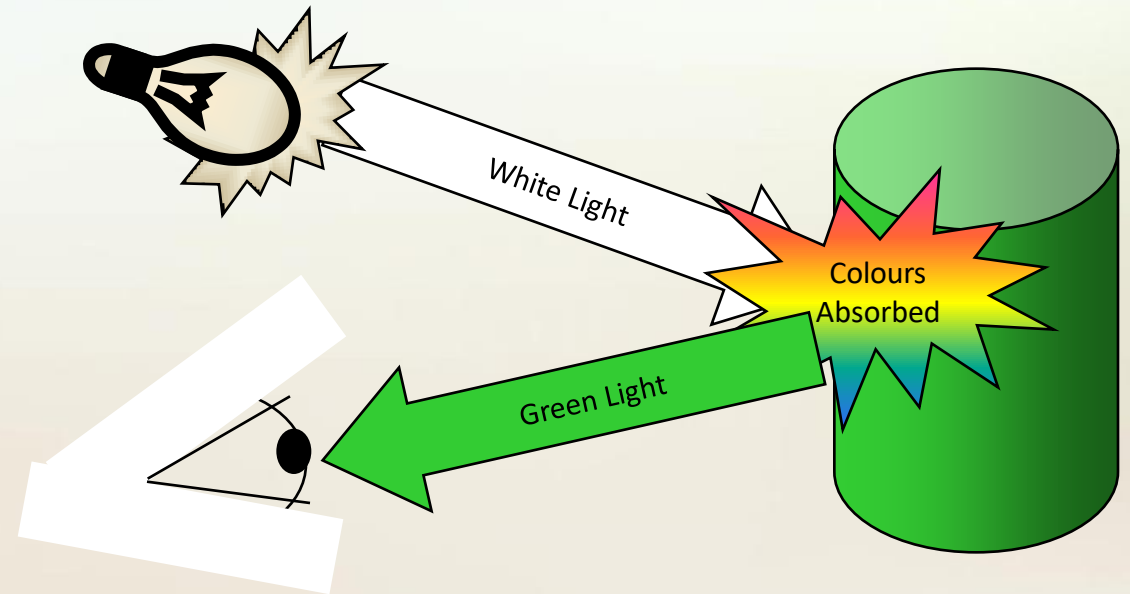




# Reflected Light

The colours that we perceive are determined by the nature of the light reflected from an object

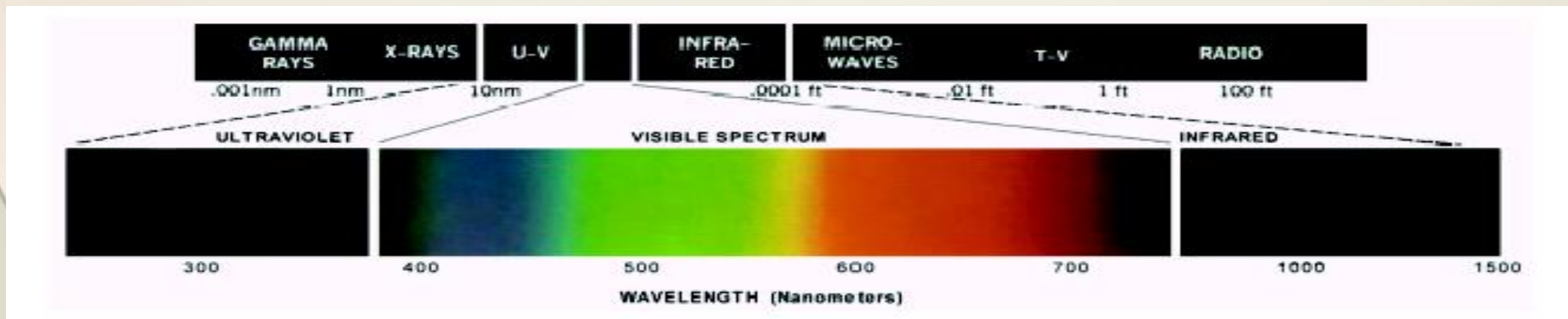
For example, if white light is shown(shone) onto a green object most wavelengths are absorbed, while green light is reflected from the object



# Light And The Electromagnetic Spectrum

Light is just a particular part of the electromagnetic spectrum that can be sensed by the human eye

The electromagnetic spectrum is split up according to the wavelengths of different forms of energy



- Image Processing field is an exciting one for number of reasons due to amazing diversity in applications
- Types of Images
  - Based on radiation from EM spectrum {Electromagnetic eg: MRI/Xrays}
  - Acoustic/Ultrasonic {Sound pressure wave with freq. > upperlimit of the human hearing range}
  - Electronic { electron beams used in eletro microscopes}
  - Synthetic {don't exist in nature → but exist in our minds by use of computer Graphics it can be given shape and form and they can be visualized}



Due to invention of microscopes and telescopes , we can see the images of size from nanometers to 100's and 1000's light years of Galaxy (Nano world to Galactic World)

