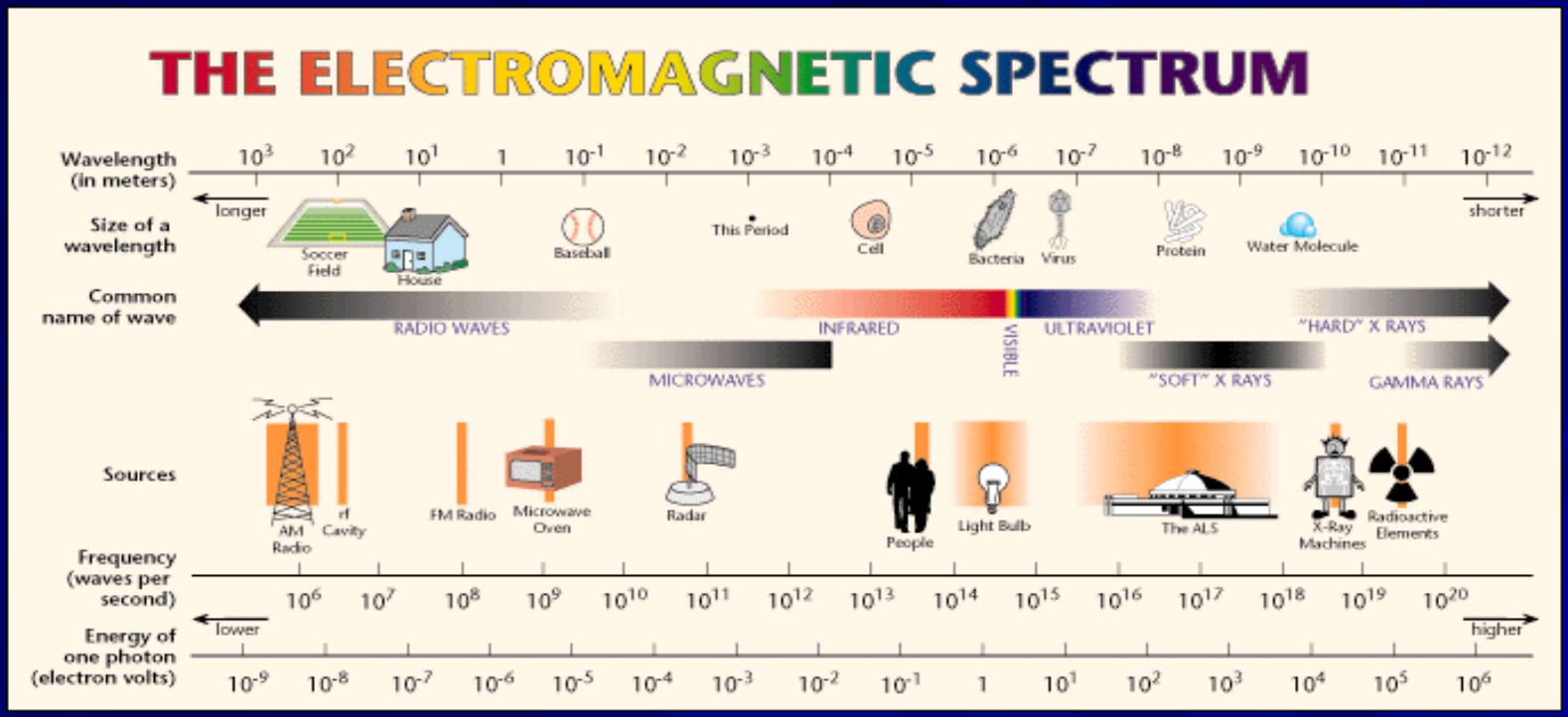
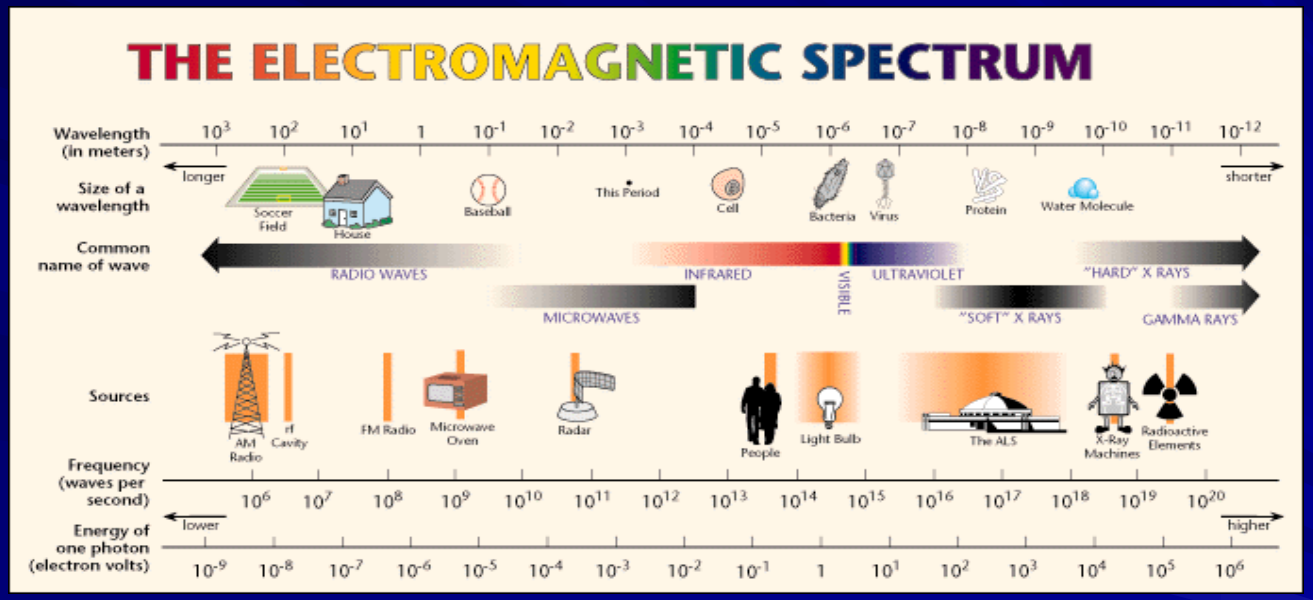


The Electromagnetic Spectrum

The Electromagnetic Spectrum

- The EM spectrum is the ENTIRE range of EM waves in order of increasing frequency and decreasing wavelength.



- As you go from left → right, the wavelengths get smaller and the frequencies get higher. This is an inverse relationship between wave size and frequency. (As one goes up, the other goes down.) This is because the speed of ALL EM waves is the speed of light (300,000 km/s).

Things to Remember

- The higher the frequency, the more energy the wave has.
- EM waves do not require media in which to travel or move.
- EM waves are considered to be transverse waves because they are made of vibrating electric and magnetic fields at right angles to each other, and to the direction the waves are traveling.
- Inverse relationship between wave size and frequency: as wavelengths get smaller, frequencies get higher.

The Waves (in order…)

Radio waves: Have the longest wavelengths and the lowest frequencies; wavelengths range from 1000s of meters to .001 m

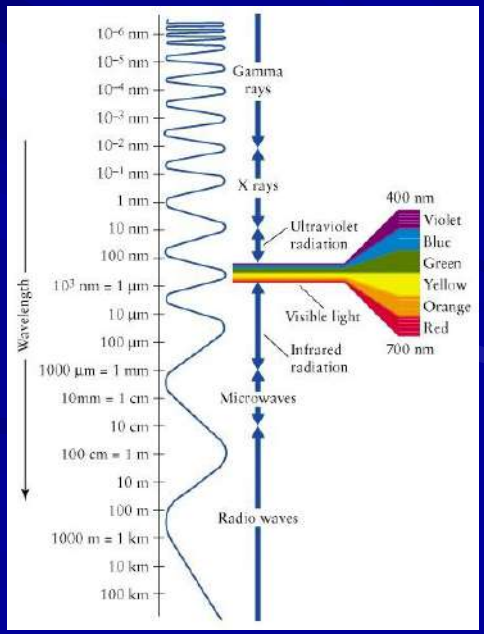
- Used in: RADAR, cooking food, satellite transmissions

Infrared waves (heat): Have a shorter wavelength, from .001 m to 700 nm, and therefore, a higher frequency.

- Used for finding people in the dark and in TV remote control devices

Visible light: Wavelengths range from 700 nm (red light) to 30 nm (violet light) with frequencies higher than infrared waves.

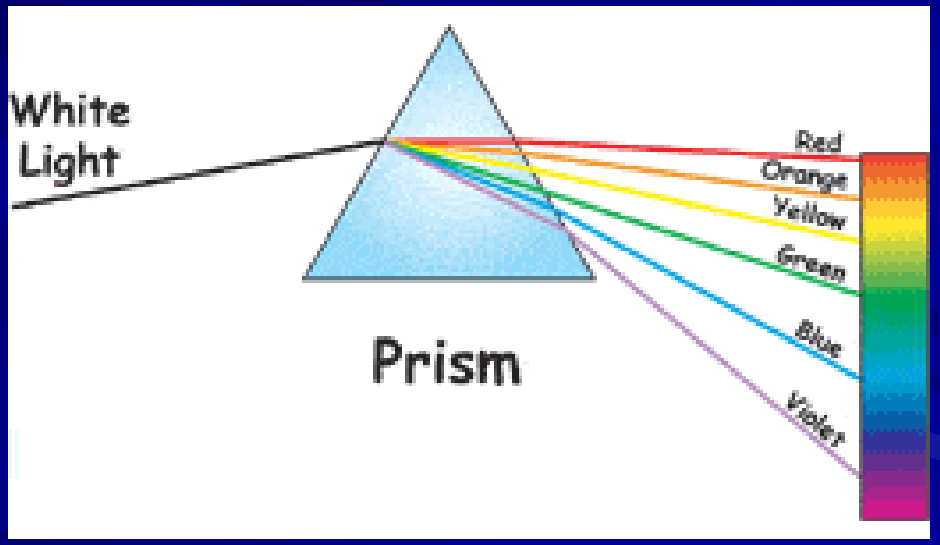
- These are the waves in the EM spectrum that humans can see.
- Visible light waves are a very small part of the EM spectrum!



Visible Light

Remembering the Order

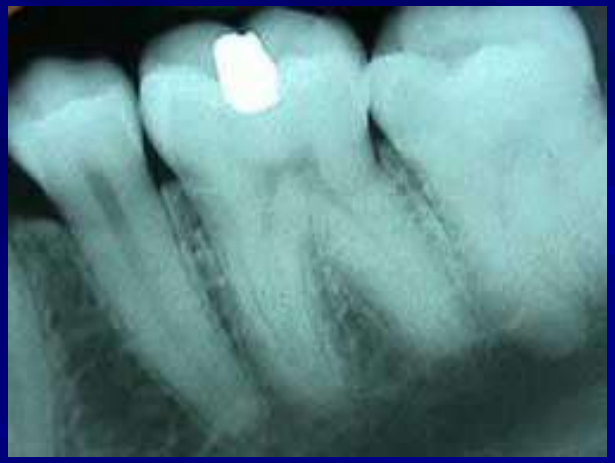
- ROY G. BV
  - red
  - orange
  - yellow
  - green
  - blue
  - violet



Ultraviolet Light: Wavelengths range from 400 nm to 10 nm; the frequency (and therefore the energy) is high enough with UV rays to penetrate living cells and cause them damage.

- Although we cannot see UV light, bees, bats, butterflies, some small rodents and birds can.
- UV on our skin produces vitamin D in our bodies. Too much UV can lead to sunburn and skin cancer. UV rays are easily blocked by clothing.
- Used for sterilization because they kill bacteria.

X-Rays: Wavelengths from 10 nm to .001 nm. These rays have enough energy to penetrate deep into tissues and cause damage to cells; are stopped by dense materials, such as bone.



- Used to look at solid structures, such as bones and bridges (for cracks), and for treatment of cancer.

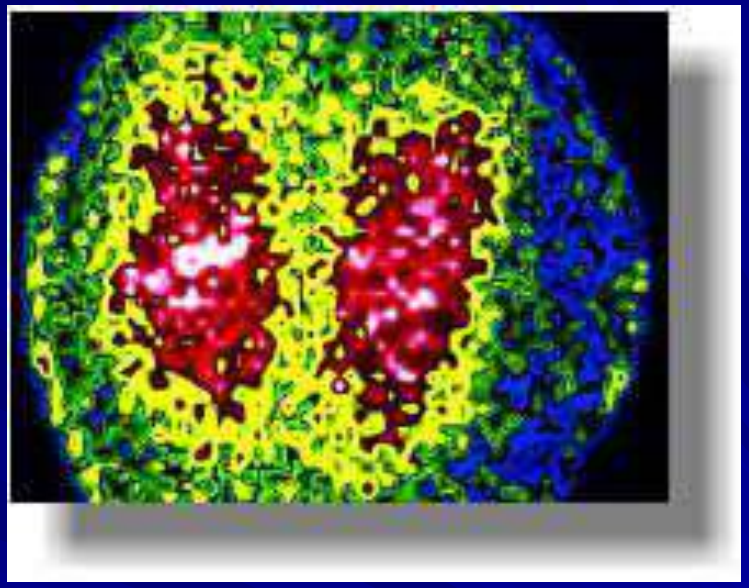
Gamma Rays: Carry the most energy and have the shortest wavelengths, less than one trillionth of a meter (10^{-12}).

- Gamma rays have enough energy to go through most materials easily; you would need a 3-4 ft thick concrete wall to stop them!

- Gamma rays are released by nuclear reactions in nuclear power plants, by nuclear bombs, and by naturally occurring elements on Earth.
- Sometimes used in the treatment of cancers.

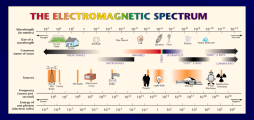
Gamma Rays

- This picture is a "scintigram" ➔
- It shows an asthmatic person's lungs.



- The patient was given a slightly radioactive gas to breath, and the picture was taken using a gamma camera to detect the radiation.
- The colors show the air flow in the lungs.

Image Sources



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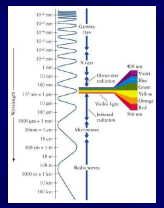

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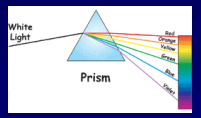

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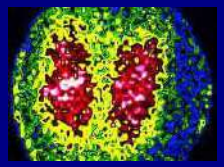

Andy Darvill, Broadoak Community School, Radioactivity Uses

http://www.northallertoncoll.org.uk/science/Additional%20Physics/Nuclear/Nuclear/Radioactivity/uses.htm