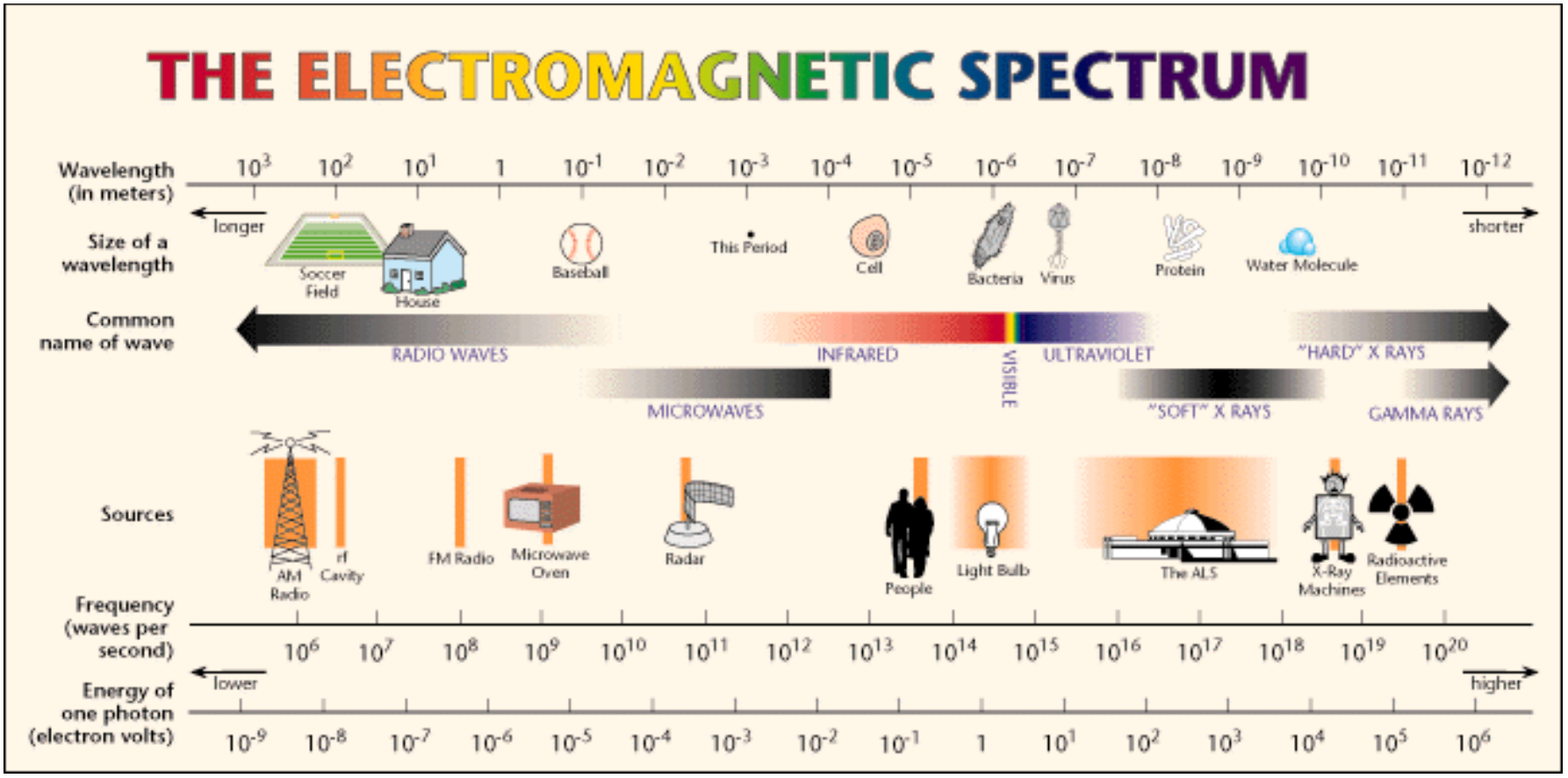
The Physics of Light

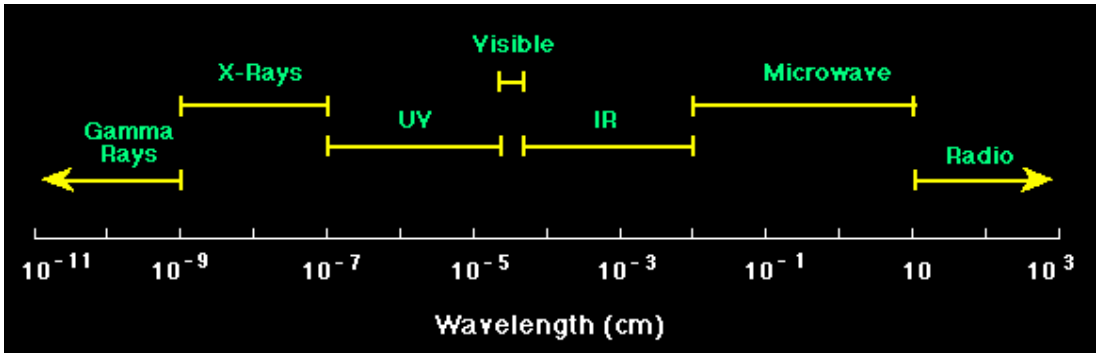
In order to understand the next part of chemistry we first need to know a little about light, or more precisely the electromagnetic spectrum.

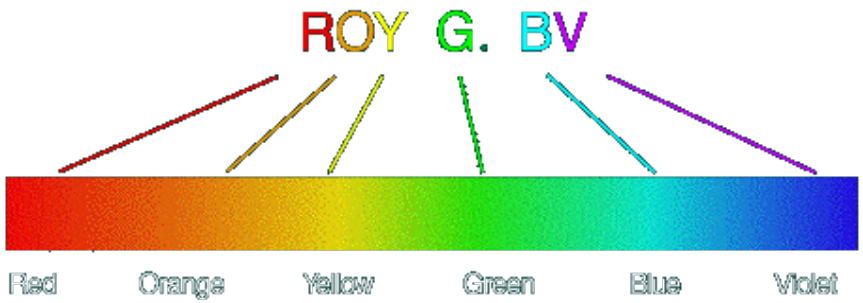
Light is a form of energy that travels as waves in both the electric and magnetic fields.

The Electromagnetic Spectrum

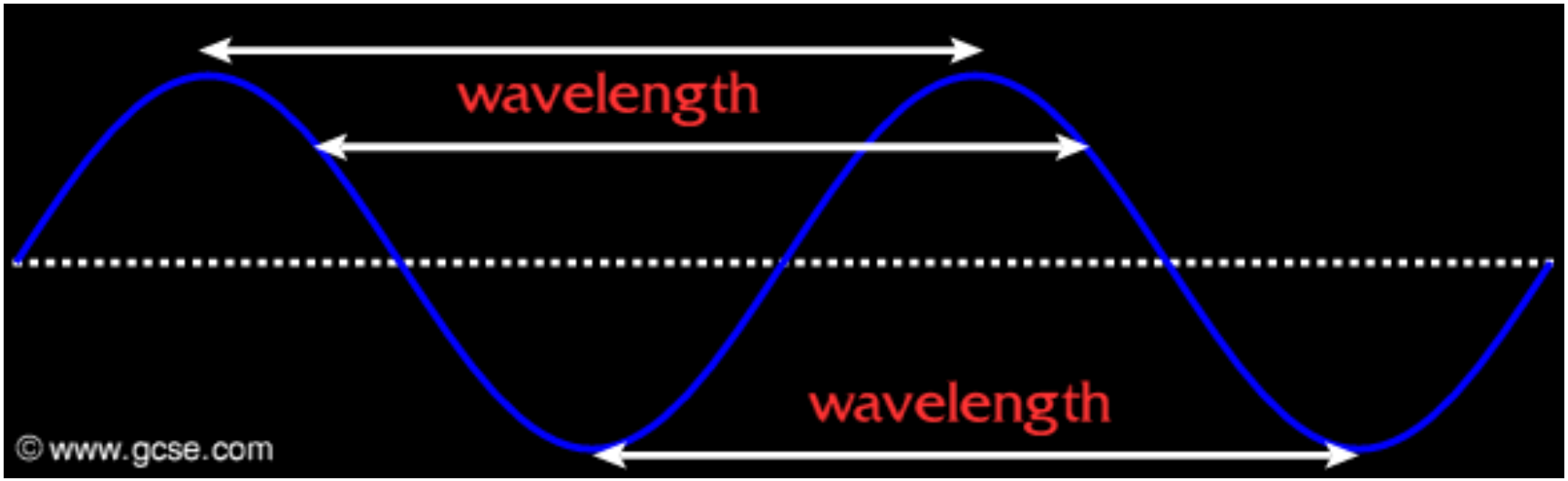


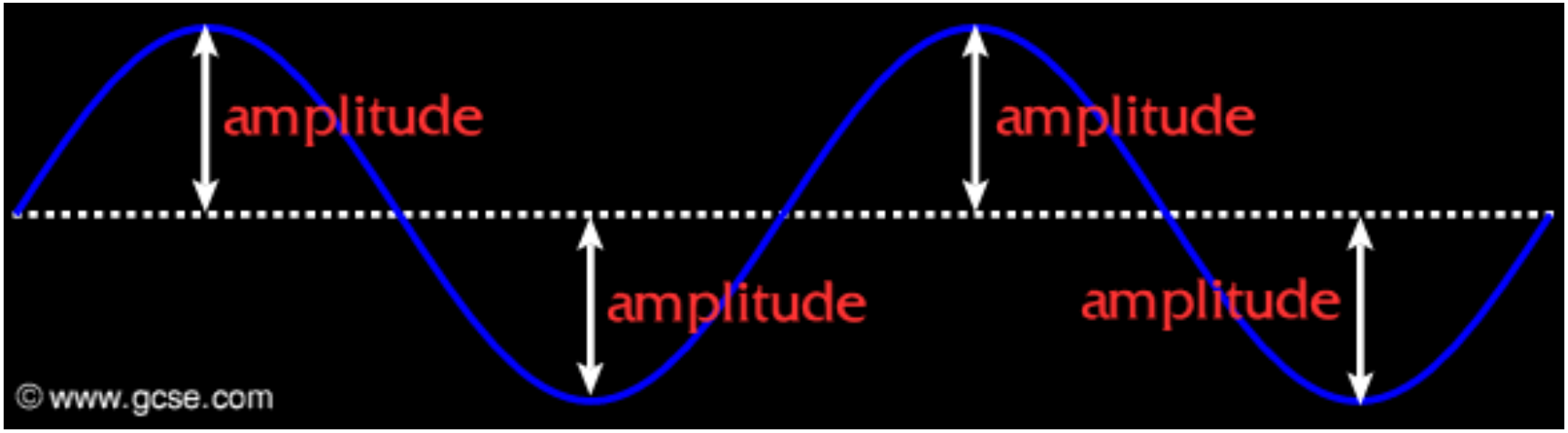
Visible Light





Transverse Waves





Wave Relationships

speed (or velocity) $v=f\lambda$

v is the velocity, for light it is given a special symbol of c. $c=3.00x10^{8}m/s$

f is frequency, the number of waves per second or hertz (Hz).

λ is the wavelength

Light and Energy

In the late 1800's Max Plank discovered that light is quantized, meaning that it comes in "packets" of a minimum size called photons.

He also discovered that each of these photons contain energy that depends on the frequency.

$E=hf$

E is the energy of the photon of light

f is the frequency

h is a constant, now called Plank's constant

$h=6.626 \times 10^{-34}$ J/Hz

Light and Energy

The color of the light is determined by measuring the wavelength.

The shorter the wavelength the greater the frequency ($c=f\lambda$). Shorter wavelengths of light are on the blue end, longer wavelengths of light are on the red end.

The greater the frequency, the greater the energy ($E=hf$).

This means that light on the blue end has more energy than light on the red end.

Where does light come from?

Light is electromagnetic radiation. It is the result of changes in both the electric and magnetic field.

Example: when an electron moves in the presence of a magnetic field light is produced.

It may not be visible light, the color (and visibility) depends on the amount of energy change.

On the atomic level, when an electron moves closer to the nucleus it releases energy in the form of light.

When an electron moves further away from the nucleus energy must be added to the electron.

Energy & Light

We see light from a candle because electrons are given energy in the reaction that causes the candle to burn. When the electrons lose their energy to get closer to the nucleus light is released.

We see light from light bulbs (in a very simple sense) because electrical energy is added to the electrons pushing them further from the nucleus. When the electrons move back toward the nucleus energy is released in the form of light. The color of the light depends on the amount of energy.