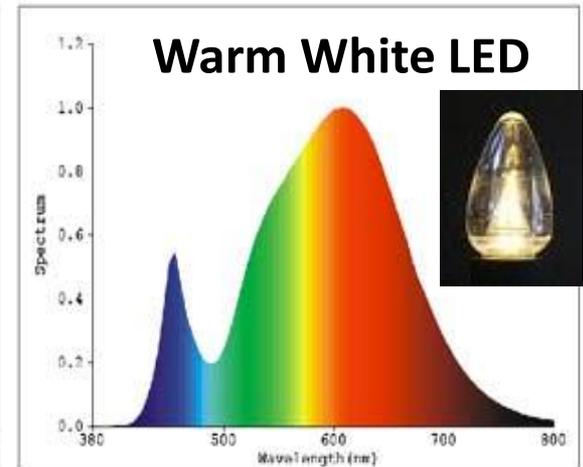
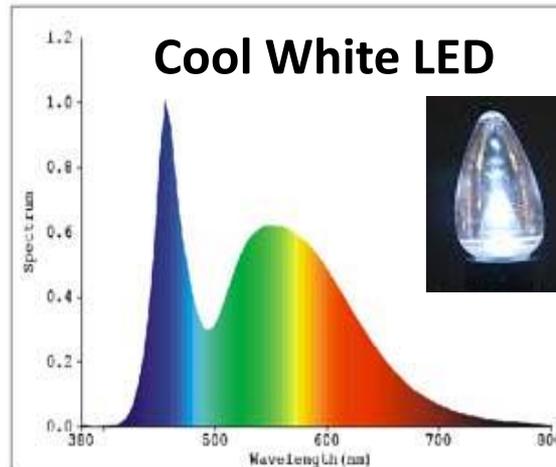


How to GRAPH light?

- “What color?”
The apparent color of light is determined by the wavelength(s) of light waves.
- “How much?”
The intensity of light is the amount of light energy falling on a surface per a unit of time.
- “How much of each color?”

The spectrum (spectral composition) of light is the relative light intensity for each wavelength present.



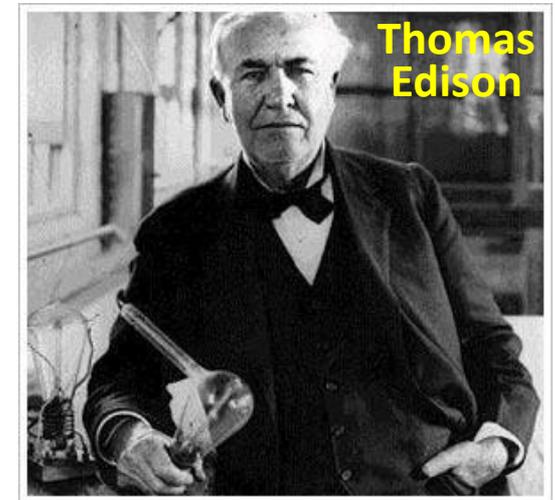
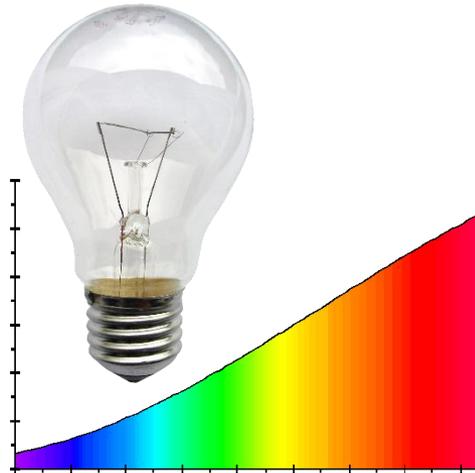
How to Make Light?



Incandescence

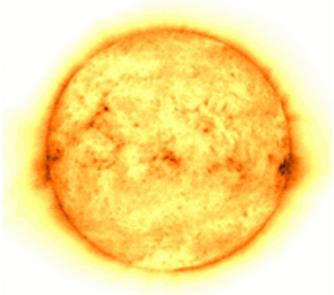
Incandescence (from Latin “glowing white”) is a special case of thermal radiation, specifically **emission of visible light by a hot body.**

Sunlight is the incandescence of the “white hot” surface of the Sun.



Incandescent bulb:

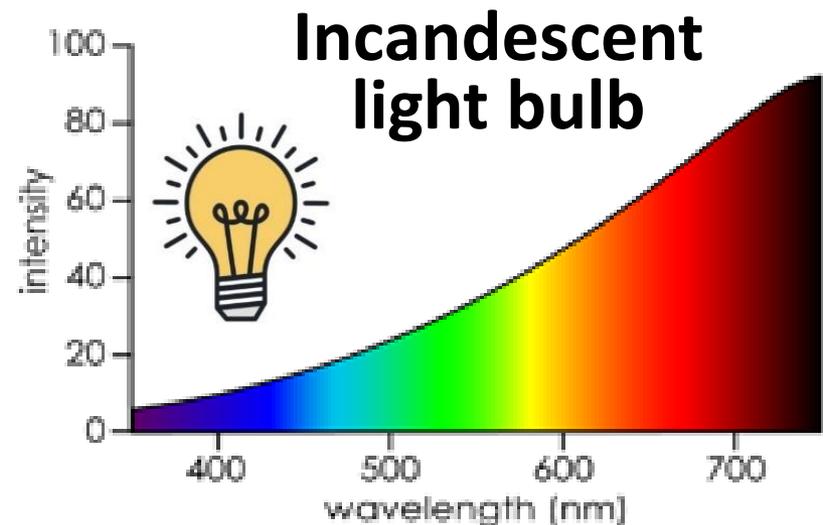
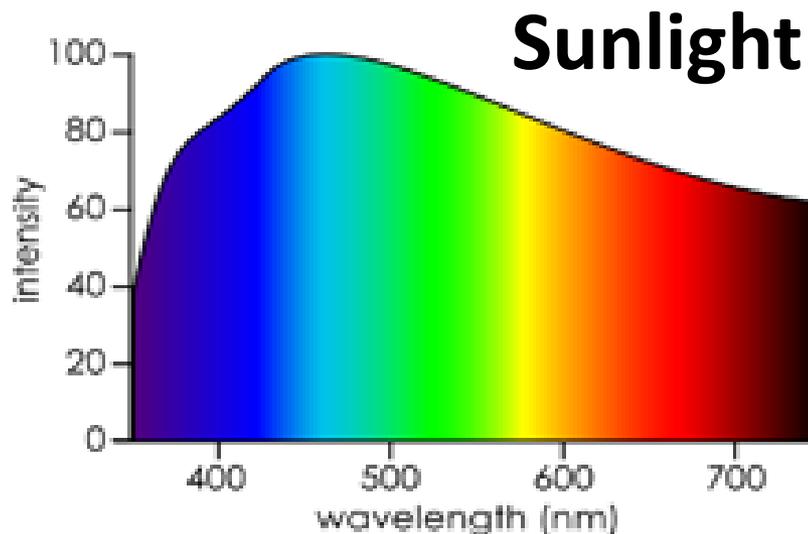
- electricity passes through a thin piece of metal wire called a filament
- the filament heats up and gives off thermal radiation composed of ~5% visible light and ~95% **infrared** light...
- ...**very low energy efficiency!**



Incandescent Spectrum

“How much of each color is made?”

- X-AXIS: wavelength
- Y-AXIS: relative light intensity



Incandescent light sources produce light waves in a wide continuous range of wavelengths with gradually changing intensities; the spectrum is smooth.

How to Make Light?



Luminescence

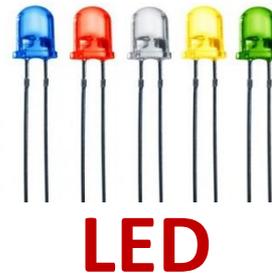
Luminescence is emission of light by a substance not resulting from heat:

- *Chemiluminescence* (including *bioluminescence*), a result of a chemical reaction.

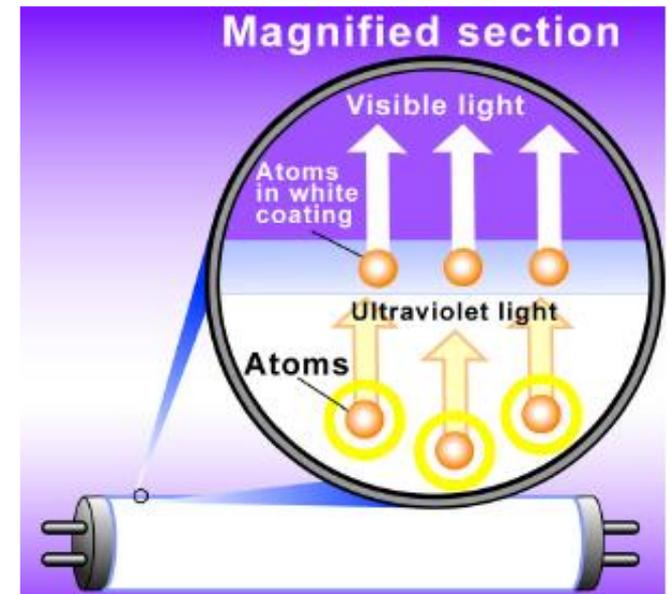


Glow Sticks

- *Electroluminescence*, emission of light due to electric current passed through a substance.



- *Photoluminescence* (*fluorescence* and *phosphorescence*) due to absorption of light with subsequent re-emission.

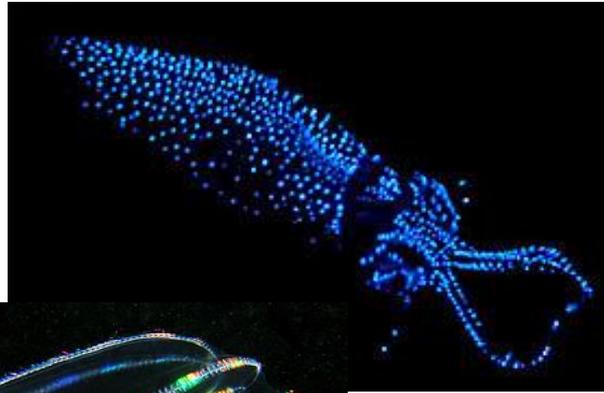


Fluorescent Lamps

- Some other types.

Bioluminescence

Bioluminescence is **emission of light by a living organism** by means of a chemical reaction (type of *Chemiluminescence*).

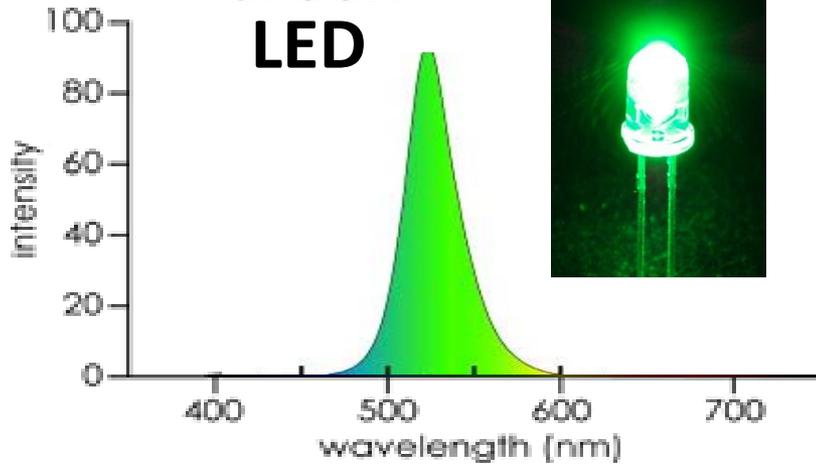


It occurs widely among animals (many creatures of the open sea, and insects) as well as in some fungi and bacteria.

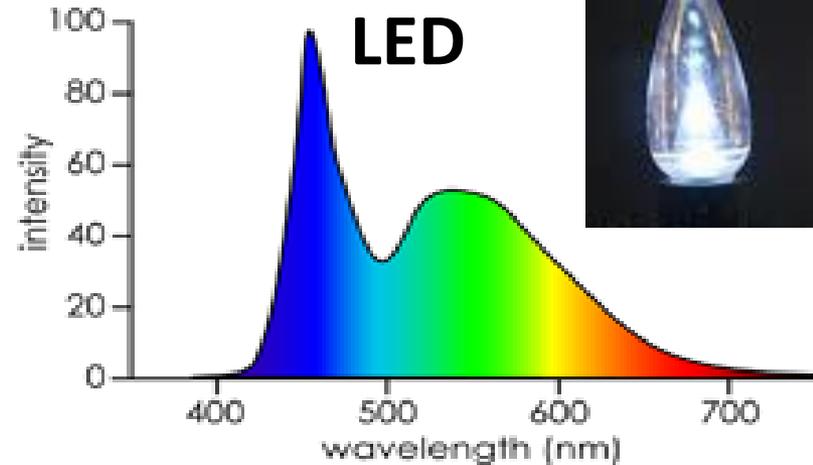


Luminescent Spectrum

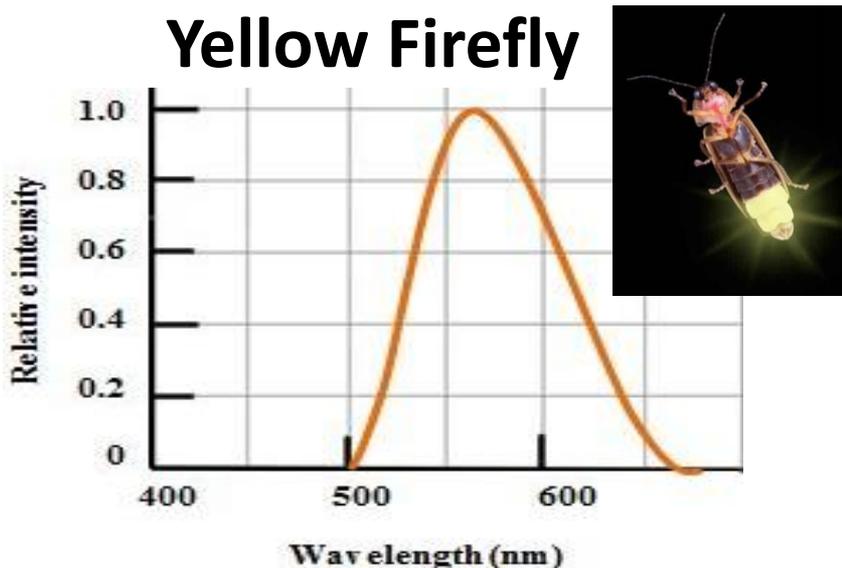
Green LED



Cool White LED



Yellow Firefly



Luminescent light sources produce light waves in rather narrow “peaks” of wavelengths; the resulting light often appears to have a “distinct color”.

Flame Test

- an **analytic procedure** used in chemistry to **detect the presence of certain elements**, primarily metal ions.



The idea:

- introduce a sample into flame to *heat*
- sample atoms *sublimate* (get *isolated*)
- since they are *hot*, they emit light
- specific colors are observed...

WHY?

Electrons in Atoms

Electrons in atoms exist in one or more energy levels (orbitals) around the nucleus.

- When matter gains energy, for example by **being heated**, the additional energy pushes the electrons in atoms to higher energy orbitals.
- Electrons tend to return back to their initial orbitals; their “extra” **energy is emitted** in the form of a *particle-like packet of electromagnetic radiation* called a **photon**.

