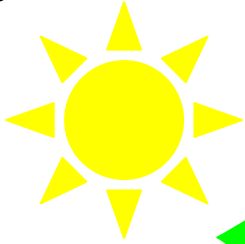


Color Lecture 2

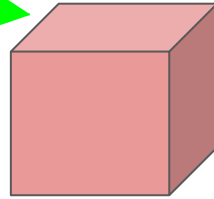
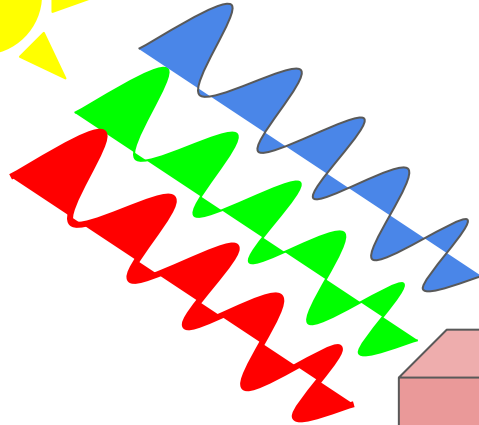
Maricor Soriano

Trinity of Color

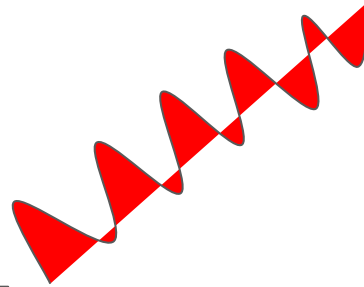
Light Source



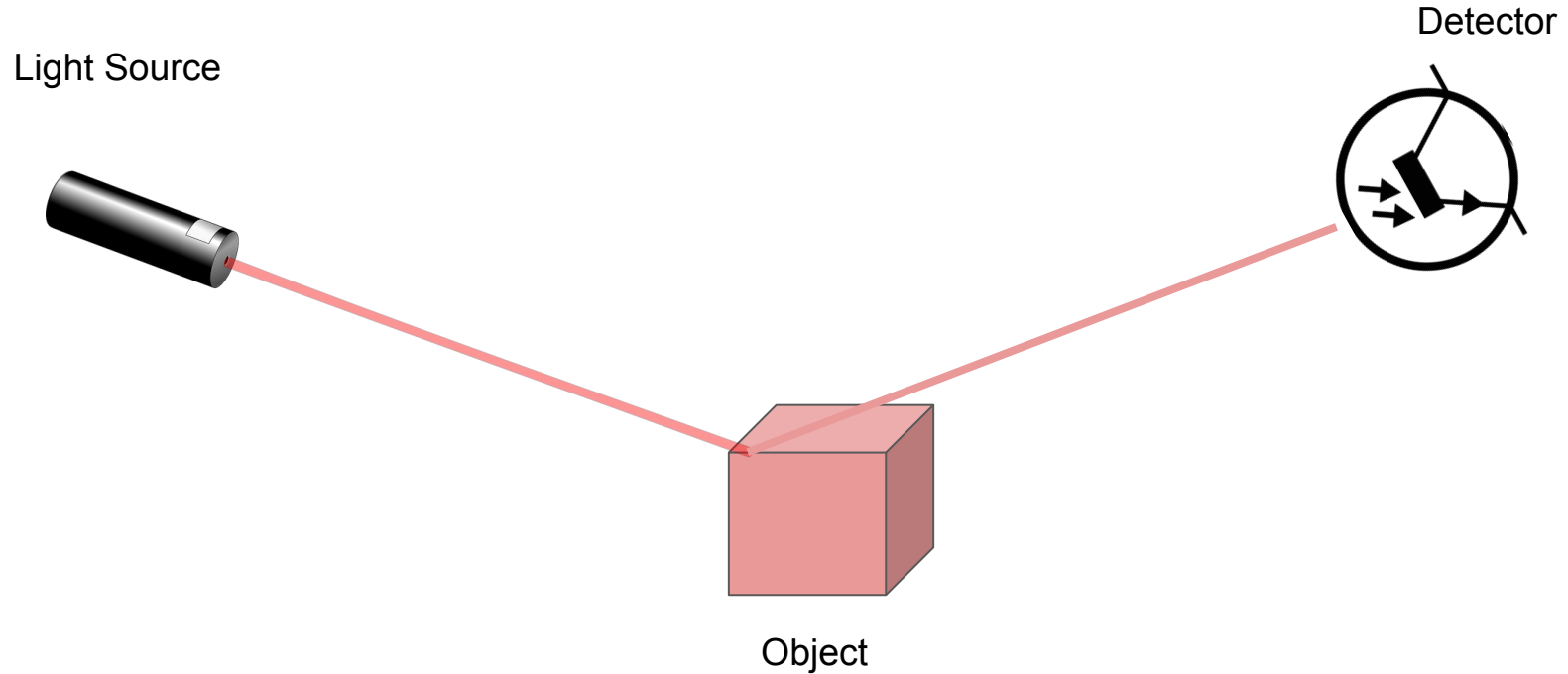
Eye



Object



Trinity of Optical Measurement



Light Sources

- Naturally occurring or man-made
- Spectral power distribution
 - Visible spectrum - plot of wavelength of visible light (350-750 nm) versus how much of each light the object
 - Emits (EMITTANCE)
 - Reflects (REFLECTANCE)
 - Absorbs (ABSORBANCE)
 - Transmits (TRANSMITTANCE)
- Polarization
 - Linear
 - Circular
 - Random
- Coherence

Daylight

Dawn or dusk



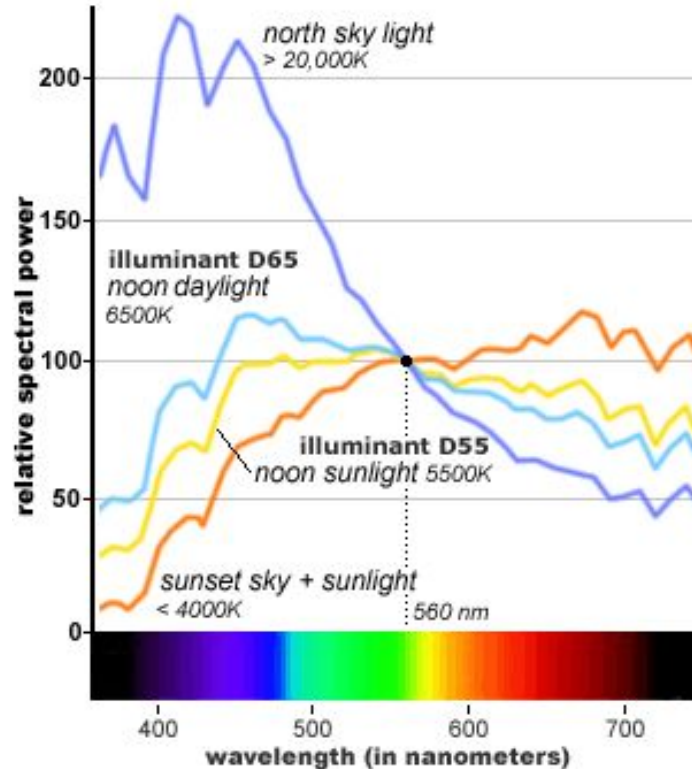
Daylight at high noon



Cloudy day

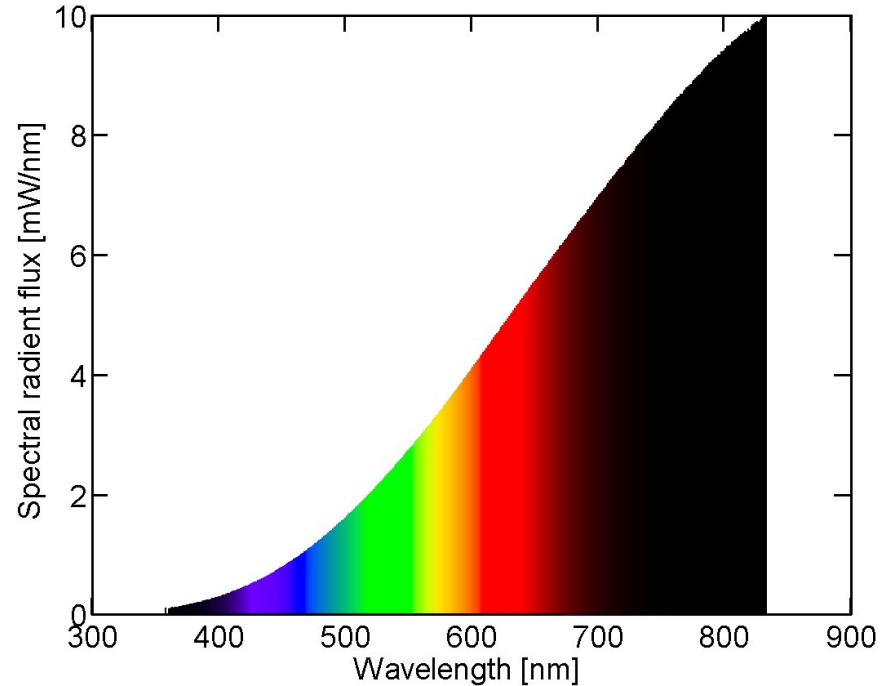
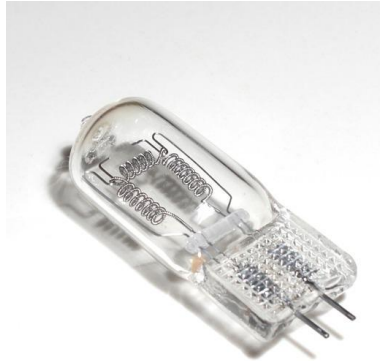
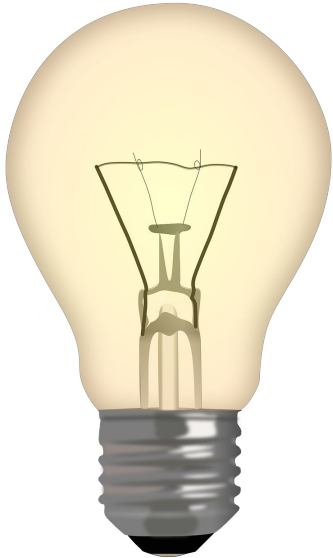


Spectral Power Distribution



Man-made Light Sources

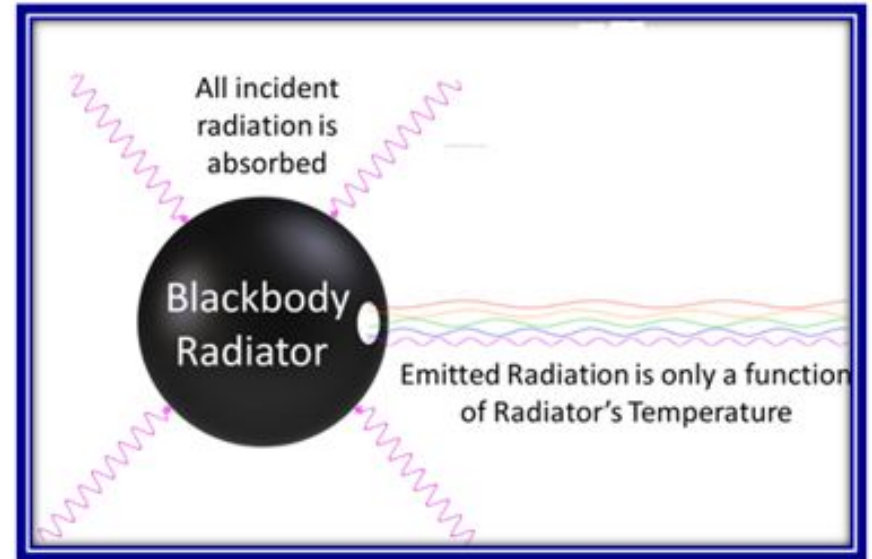
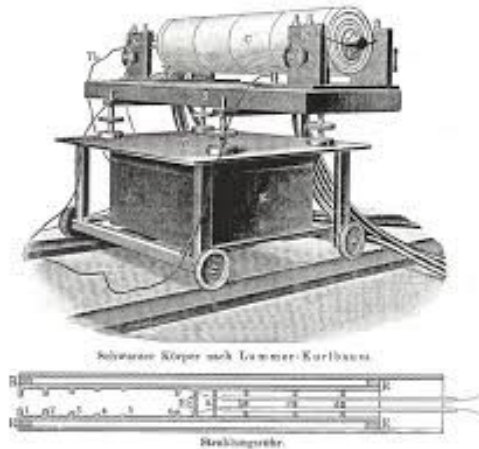
Incandescents



Blackbody Radiation

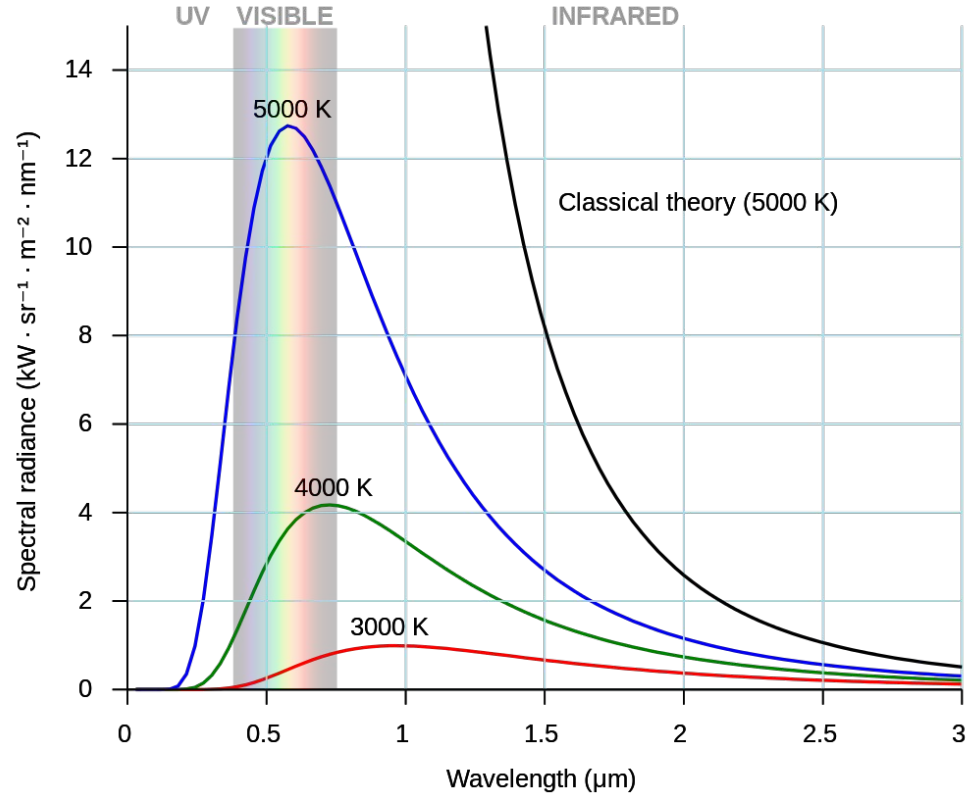
When objects are heated they spontaneously emit radiation. A blackbody was first defined by Kirchhoff in 1859 as an ideal object which is a perfect absorber of energy and at the same time a perfect emitter of radiation.

The first functioning blackbody radiator was built by Wien and Lummer in 1897.



Blackbody Radiation

When a blackbody is heated at T kelvins, color of emitted light will shift from red to yellot to white to blue.





Planck's Blackbody Radiation Formula

Max Planck won the curve fitting challenge by assuming the energy of individual oscillators in the cavity is quantized. Thus, the spectrum as a function of wavelength λ and temperature T in kelvins is given by

$$B(\lambda, T) = \frac{2hc^2}{\lambda^5 \left(\exp\left(\frac{hc}{\lambda kT}\right) - 1 \right)}$$

Where

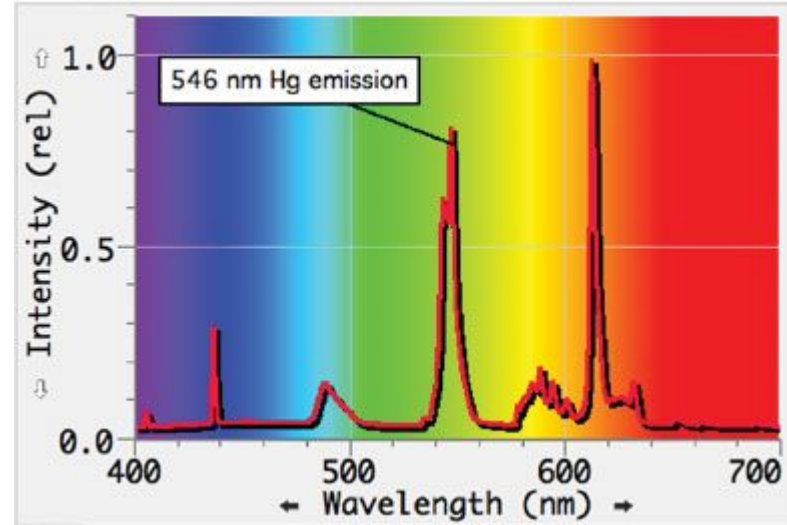
h = Planck's constant = 6.6262×10^{-34} Js

c = speed of light = 3×10^8 m/s

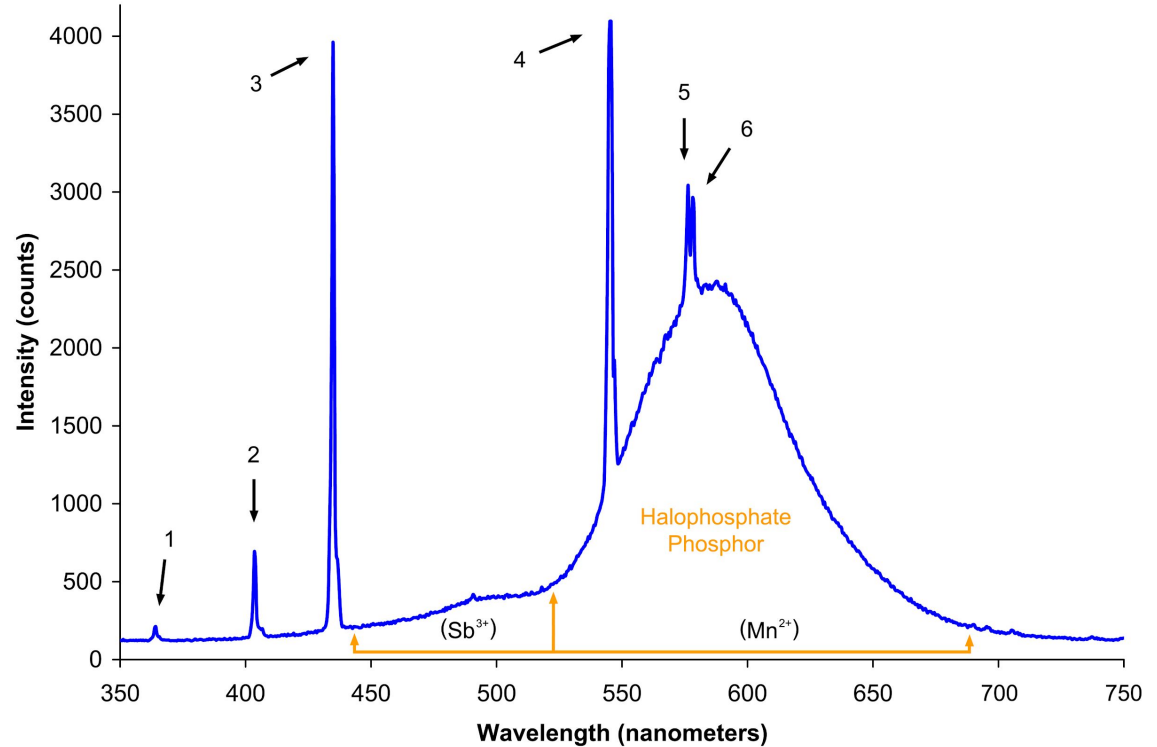
Blackbody Radiator Sources



Gas discharge tubes - elemental gases excited by electrons



Fluorescents

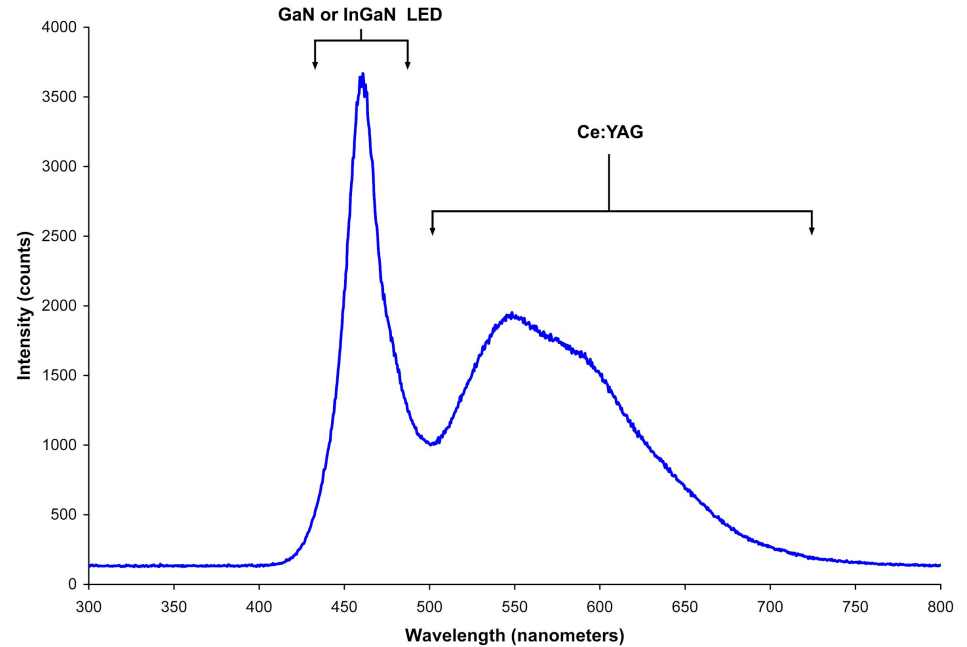
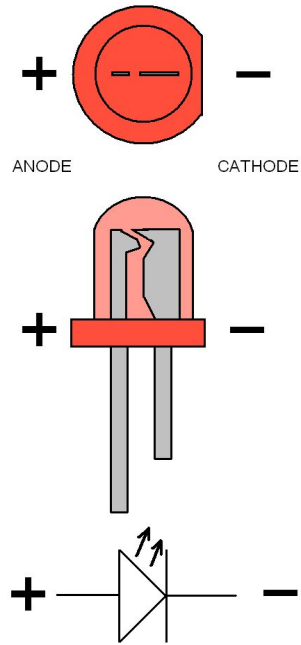


Correlated Color Temperature (CCT)

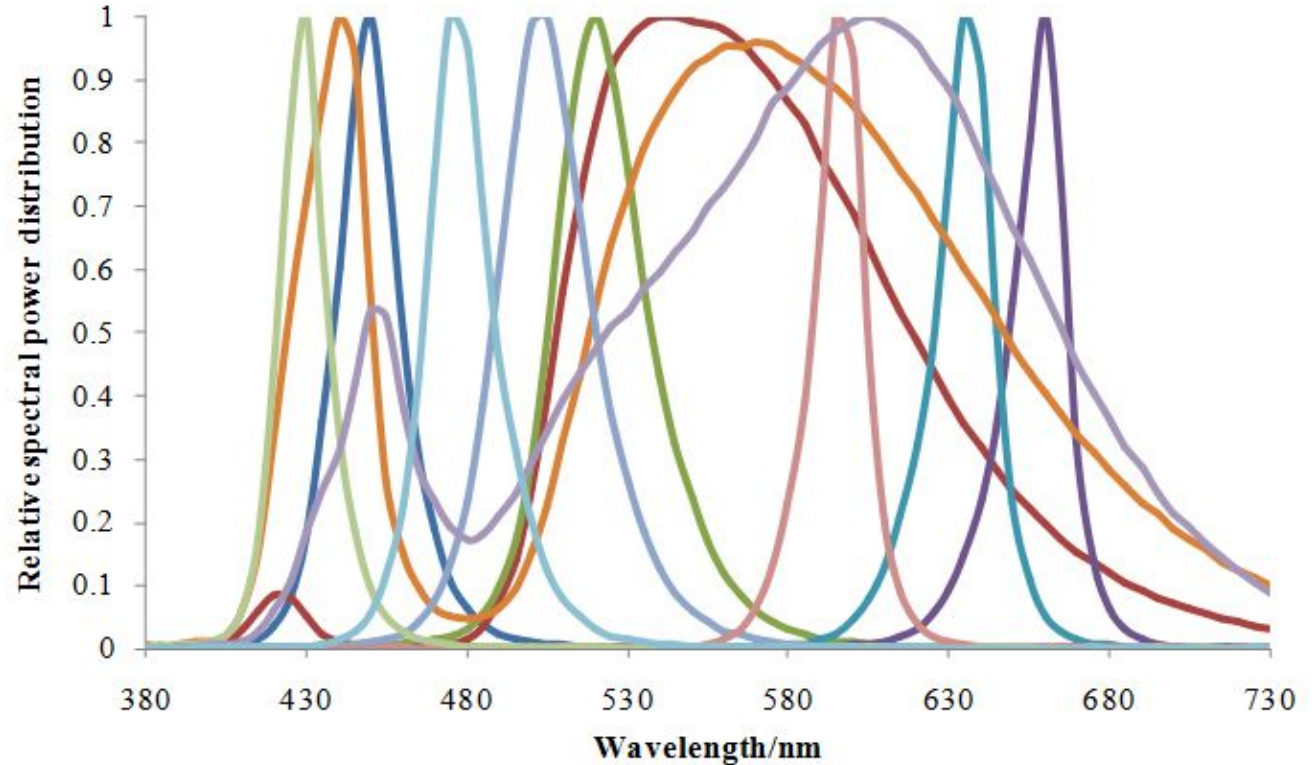
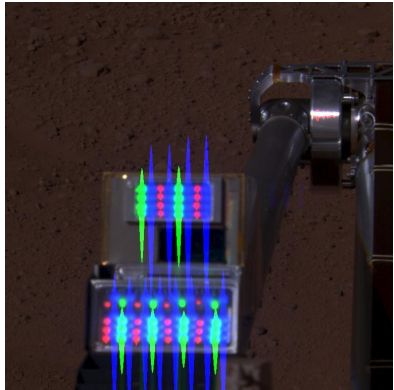
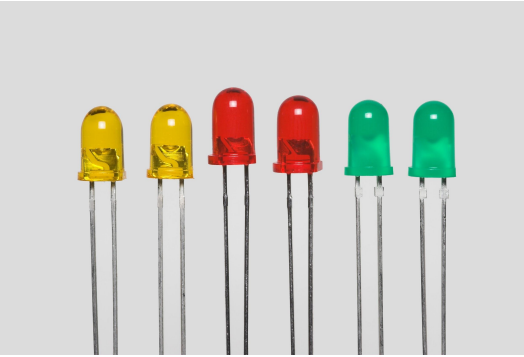
CCT - a measure for the light source which tells what the temperature of a blackbody should be to have the same color as the light source.



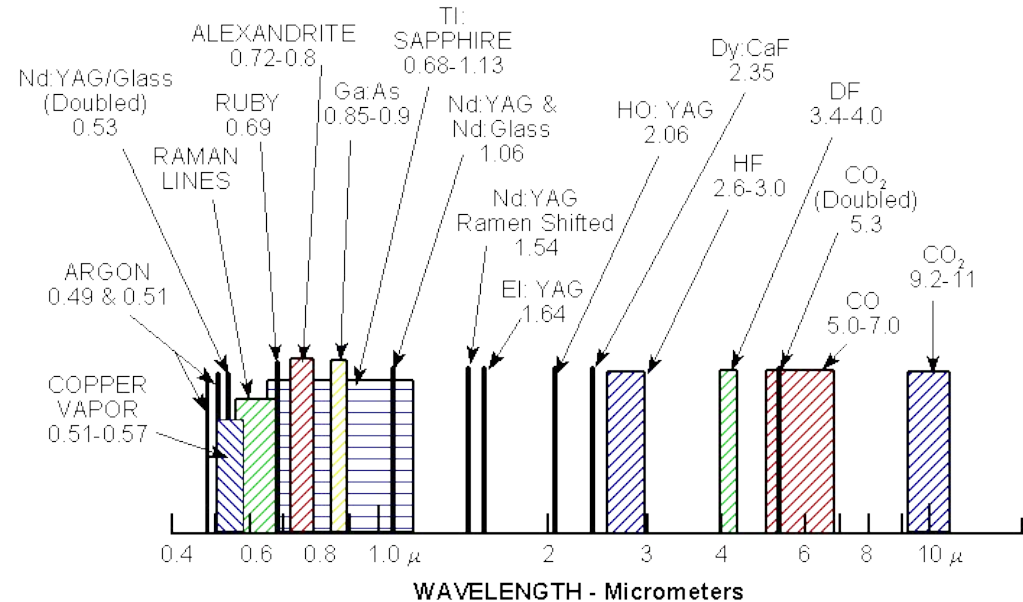
Light Emitting Diodes



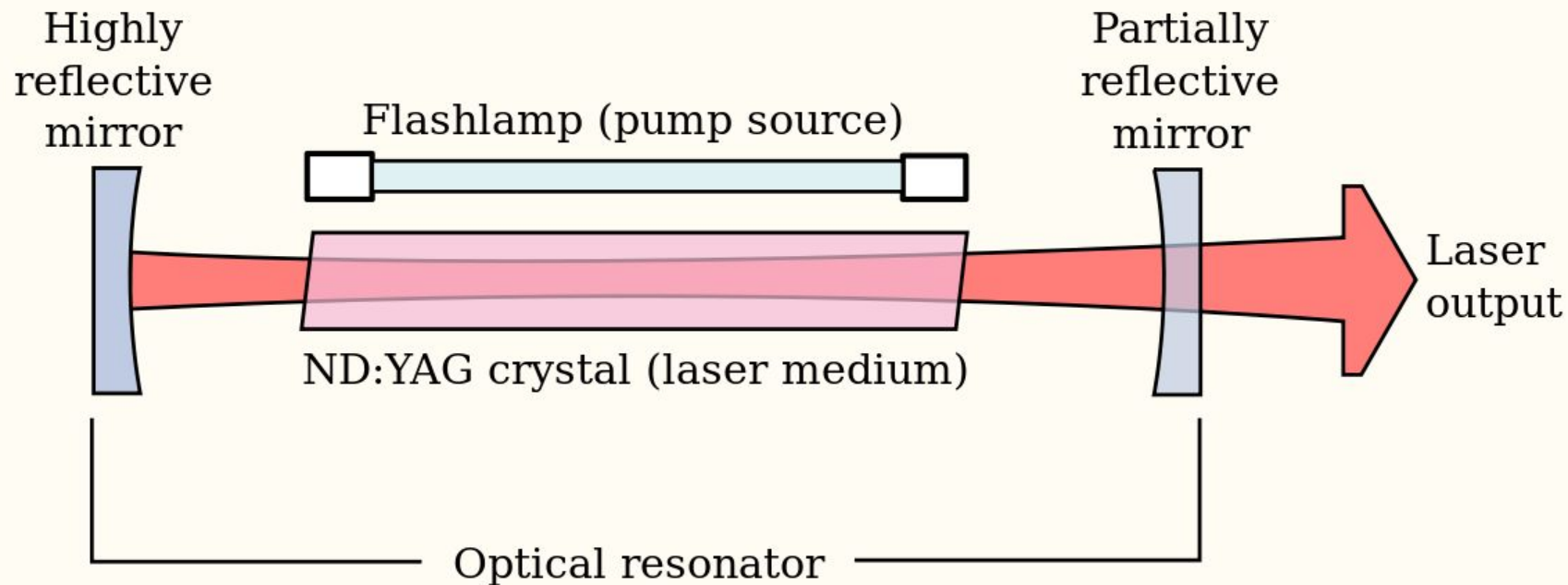
LED - many colors to choose from



Lasers - Highly monochromatic, highly coherent



Nd:YAG solid-state laser



Activity 2 - Familiarization with Properties of Light Sources

INDIVIDUAL WORK

GROUP WORK

(See PDF)