Waves, Light, Color of Stars

A rainbow of colors and more

Physics 090

2020-02-24

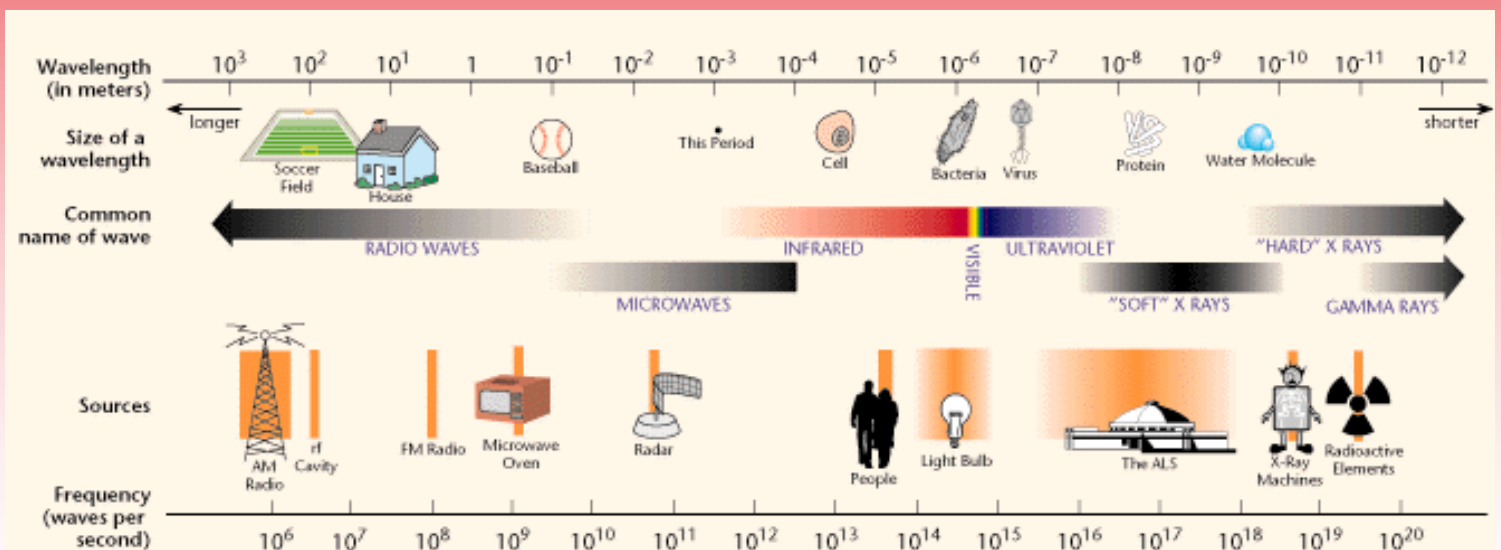# Wavelength, Frequency

Last time we covered:

- P (period), f (frequency), definition of Hz
- example, blink rate, using $P = 4s$
- c (the speed of light), λ (wavelength), $c = \lambda f$
- c is about $3 * 10^8$ m/s
- example, 5GHz cell phone wavelength, what is λ

Another example, with a little discussion on units conversion:

- c is actually known very precisely 299,792,458 m/s
- compare to Apollo 11 maximum speed of 25,000 mph.

The Electromagnetic Spectrum

Wavelength (in meters)	10^3	10^2	10^1	1	10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-6}	10^{-7}	10^{-8}	10^{-9}	10^{-10}	10^{-11}	10^{-12}

Size of a wavelength — longer ... shorter

Soccer Field, House, Baseball, This Period, Cell, Bacteria, Virus, Protein, Water Molecule

Common name of wave: RADIO WAVES, MICROWAVES, INFRARED, VISIBLE, ULTRAVIOLET, "SOFT" X RAYS, "HARD" X RAYS, GAMMA RAYS

Sources: AM Radio, rf Cavity, FM Radio, Microwave Oven, Radar, People, Light Bulb, The ALS, X-Ray Machines, Radioactive Elements

Frequency (waves per second)	10^6	10^7	10^8	10^9	10^{10}	10^{11}	10^{12}	10^{13}	10^{14}	10^{15}	10^{16}	10^{17}	10^{18}	10^{19}	10^{20}

This is all "Light"

- The speed of light is the same for all kinds of light.
- What is varying is in the chart above is wavelength and frequency.

Only three types of color sensitive "cone" cells in the eye
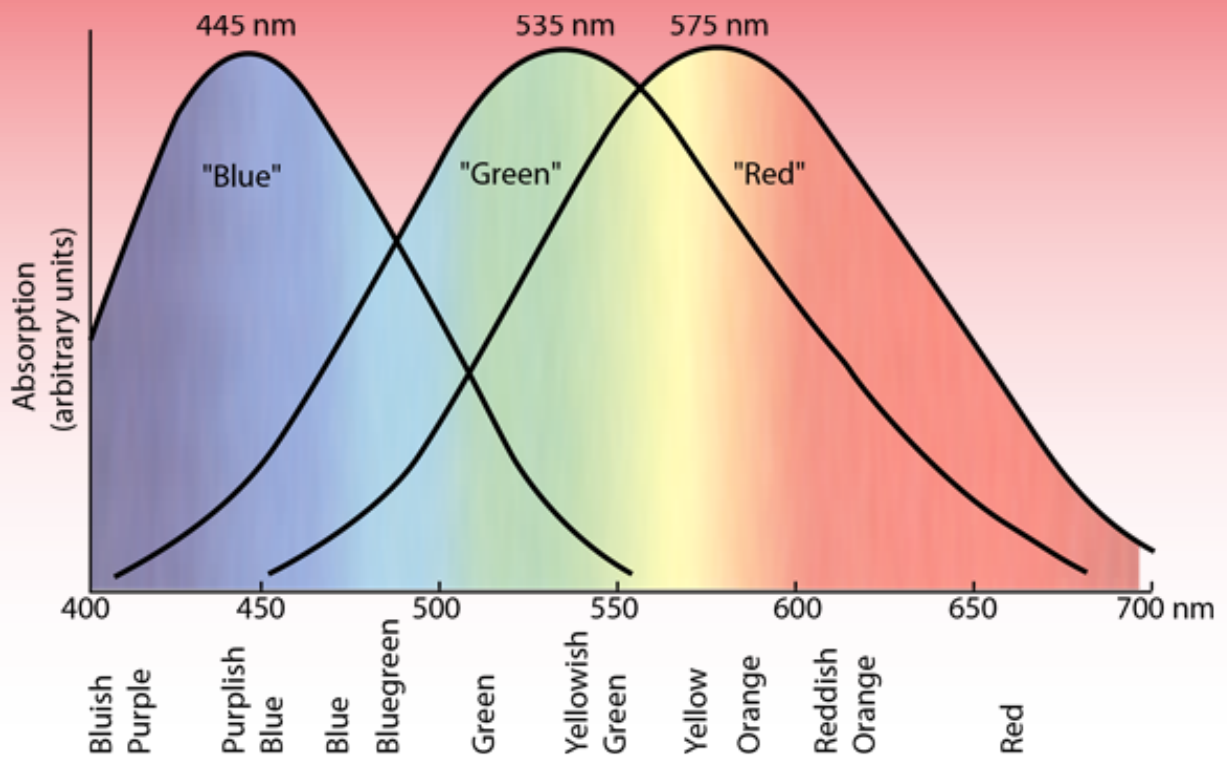
R. Nave, hyperphysics.phy-astr.gsu.edu

# Alberio - Double Star in Cygnus

Temperature

We are using the most popular scientific units for length (meter), time (second), and mass (kilogram). Now we will introduce the scientific unit for temperature.

- Discuss Fahrenheit
- Discuss Celsius aka Centigrade
- Introduce Kelvin
- 0 Kelvin is -273.15 Celsius

"Black-Body" Radiation, Wien's Law

- For objects in thermal equilibrium, there is a relationship between color and temperature.
- Wien's Law: $\lambda_{peak} = b / T$
- $b = 2.898 \times 10^{-3}$ m·K
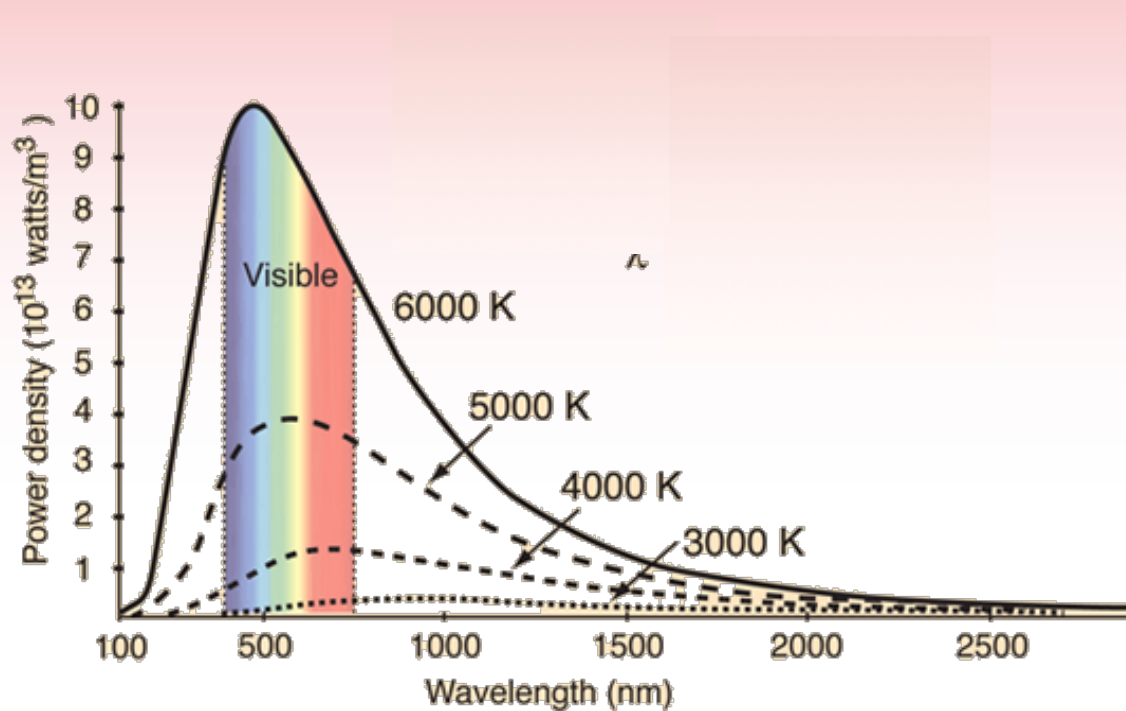
Akira Fujii, Sky & Telescope

Betelgeuse, ~3500K and Rigel, ~11,000K

BTW, Betelgeuse is dimming, from a high of 0.0 to a current value of about 1.5!