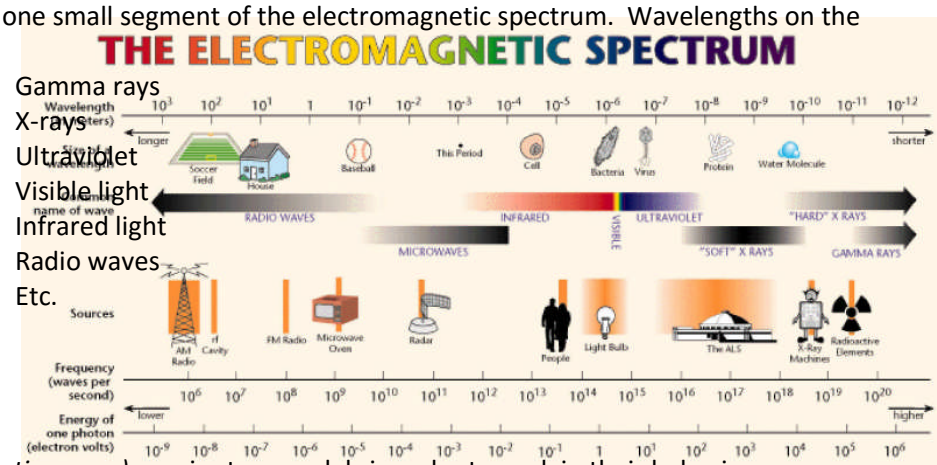
Chapter Outlines

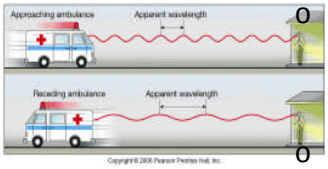
NOTE: This is intended to help students "organize" their understanding of each topic. It is <u>not</u> a comprehensive study guide for quizzes or midterms, i.e. <u>study your text!</u>

Light, Astronomical Observations, our Sun

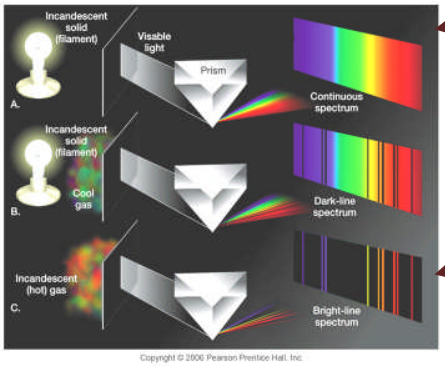
- **Electromagnetic Radiation**
  - All forms or radiation travel at the speed of light *(300,000 kilometers per second)*
  - The electromagnetic spectrum
    - Visible light is only one small segment of the electromagnetic spectrum. Wavelengths on the spectrum include:
      - ✓ Gamma rays
      - ✓ X-rays
      - ✓ Ultraviolet
      - ✓ Visible light
      - ✓ Infrared light
      - ✓ Radio waves
      - ✓ Etc.



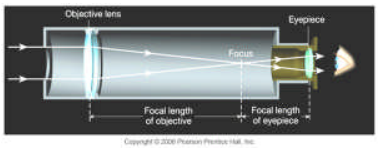
    - Light (*electromagnetic waves)* require two models in order to explain their behavior:
      - ✓ **Wave model** – light behave as waves that vary from radio wavelengths of several kilometers to gamma ray wavelengths of less than a billionth of a cm.
      - ✓ **Particle model** – behave as individual particles called photons, which can vary in energy levels and can exert pressure on matter.

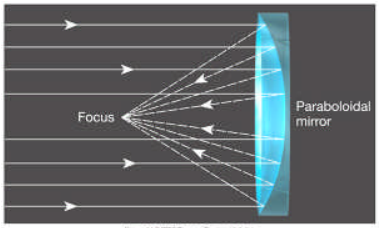


  - **The Doppler Effect** – states that the wavelength (*true for both light and sound waves)* will seem longer if the emitter *(star)* is moving away from you and shorter if the emitter is moving closer to you. This will cause the light shade *(or sound pitch)* to shift depending on the emitter's velocity and direction.
  - Types of spectra – the light pattern produced by passing light through a prism



    - **Continuous spectrum** – the collection of all colors *(rainbow)*
      - ✓ Produced by a standard light bulb, or hot high pressure gas
      - ✓ Uninterrupted band of color
    - **Dark-line** *(absorption)* spectrum
      - ✓ Produced when light is passed through a cool, low -pressure gas
      - ✓ Appears as a continuous spectrum with dark lines running through it.
    - **Bright-line** *(emission)* spectrum
      - ✓ Produced by hot gas under low pressure
      - ✓ Appears as a series of bright lines of particular wavelengths depending on the gas that produced them
- Light *(and other wavelengths)* collection
  - **Optical Telescopes**…
    - work by gathering a large area of light – much larger area than the human eye. This area can be as large as 10's of meters in diameter
    - the optics in a telescope can focus this light to magnify it and to make a clear image of the objects being observed
    - When viewing objects outside our solar system even the largest stars appear only as points of light



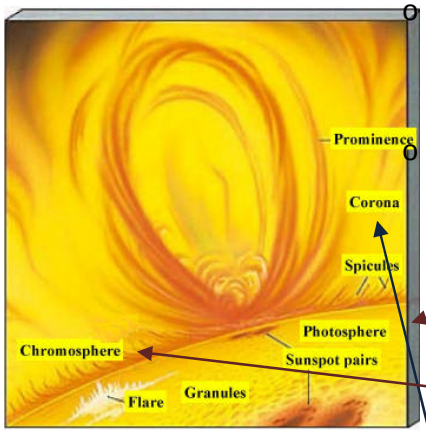


- Two types of optical telescopes
  - ✓ **Refracting** – uses a lens to bend the light to a focus point and a second lens in line with the first to observe the image. This type is very limited in size, and can distort the light when it travels through the lens.
  - ✓ **Reflecting** – light reflects off a large mirror to a focus point. Large diameter telescopes are possible and the light does not travel through a lens, making for less distortion.

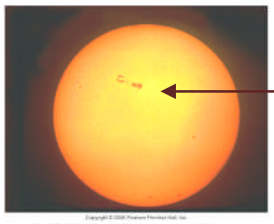
- **Radio Telescopes** – are used to detect electromagnetic radiation outside the visible range such as: radio, ultraviolet, infrared waves, etc
  - Advantages include: can operate day and night, can see through clouds, less expensive, can be huge
  - Disadvantages include: poor resolution, hindered by man-made radio interference.

- **Orbiting Telescopes** – by being above Earth's atmosphere, these telescopes can see more wavelengths and with better resolution. They are not affected by impurities in Earth's atmosphere

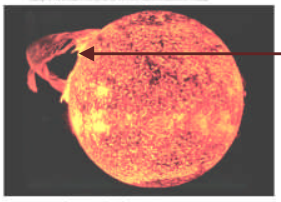
➢ **Our Sun** *(it is a star)*



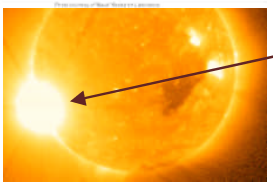
- Is about average in size compared to the other 200 billion stars in our Milky Way galaxy. It is the only star near enough to study closely. The fusion reactions in the Sun consume 600 million tons of hydrogen every second, but it should still be able to supply us with light and heat for another 5 billion years or more
- The Sun's Structure:
  - **The interior** – fusion reactions occur in the deep interior which consume hydrogen and produce helium, and converts matter into energy, temperature here is 15 million K
  - **Photosphere** – it has a very grainy texture and appears to us as the Sun's surface, it consists of a layer incandescent gas approx 500 km thick and at approx 6,000 K
  - **Chromosphere** – just above the photosphere, relatively thin hot layer of incandescent gas containing numerous spicules *(narrow jets of rising material)*
  - **Corona** – outermost portion of the solar atmosphere, ionized gases escape from here to produce the solar wind, temperature here exceeds 1 million K



- Sun details
  - **Sunspots** – small temporary areas on the solar surface that are only slightly cooler than the surrounding area, usually appear in pairs with opposite magnetic poles, they increase and decrease in numbers on an eleven year cycle



  - **Prominences** – huge arching flaming cloudlike structures that temporarily extend into the corona



  - **Solar flares** – explosive events that last approx an hour, they eject particles that interact with Earth's atmosphere causing auroras, and occasionally communication interferences