Stars

Stars

- Each star in the sky is a glowing ball of gas
- Our sun is a medium sized star
- Stars can live for billions of years

Distance

- Parallax (apparent shift) is used to determine a stars distance
- Nearest star – Proxima Centuri
  - part of Alpha Centuri
  - 4.3 light years or 300,000 x distance to Sun
  - Analogy: Sun = marble, Earth = grain of sand 1m away then Proxima Centuri (also marble sized) would be 270 km away (or 168 miles)

Luminosity vs. Apparent Brightness

- Luminosity-the total energy radiated by a star
- Apparent brightness-the brightness that a star appears to have as measured by an observer on Earth
- Apparent brightness = luminosity/distance^2
- Two stars of different luminosity can appear equally bright to an observer on Earth if one star is more distant

Star Types

- Stars are classified by their spectra (the elements that they absorb) and their temperature
- There are seven main types of stars. In order of decreasing temperature, O, B, A, F, G, K, and M
- O and B stars are uncommon but very bright
- M stars are common but dim
- An easy mnemonic for remembering these is: "Oh be a fine girl, kiss me"
- Astronomers further subdivide each lettered spectral classification into 10 subdivisions, denoted by the numbers 0–9
  - By convention, the lower the number, the hotter the star
  - Our Sun is classified as a G2 star (a little cooler than G1 and a little hotter than G3)

TABLE 17.2 Stellar Spectral Classes

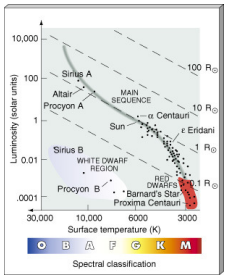
SPECTRAL CLASS	APPROXIMATE SURFACE TEMPERATURE (K)	PROMINENT ABSORPTION LINES	FAMILIAR EXAMPLES
O	30,000	Ionized helium strong; multiply ionized heavy elements; hydrogen faint	Mintaka (O9)
B	20,000	Neutral helium moderate; singly ionized heavy elements; hydrogen moderate	Rigel (B8)
A	10,000	Neutral helium very faint; singly ionized heavy elements; hydrogen strong	Vega (A0), Sirius (A1)
F	7000	Singly ionized heavy elements; neutral metals; hydrogen moderate	Canopus (F0)
G	6000	Singly ionized heavy elements; neutral metals; hydrogen relatively faint	Sun (G2), Alpha Centauri (G2)
K	4000	Singly ionized heavy elements; neutral metals strong; hydrogen faint	Arcturus (K2), Aldebaran (K5)
M	3000	Neutral atoms strong; molecules moderate; hydrogen very faint	Betelgeuse (M2), Barnard's Star (M5)

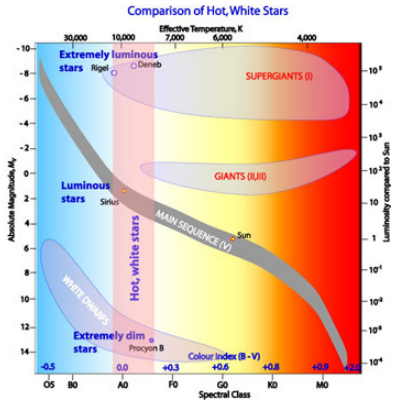
Stellar Size

- Radius-luminosity-temperature relationship
  - Knowledge of a stars luminosity and temperature can yield an estimate of a stars radius
  - Luminosity =radius^2 x temperature^4
- Giants and Dwarfs
  - Giants = 10 to 100 times our Sun
  - Supergiant = up to 1000 times solar radius
  - Dwarf = comparable to the Sun or smaller

Hertzsprung-Russel Diagram

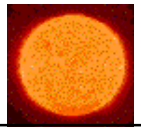
- Astronomers use luminosity and surface temperature to classify stars
- Note = temperature is decreasing across the bottom to correspond with OBAFGKM classification





Main Sequence Stars

- Most stars, including the sun
- Fueled by the nuclear fusion of hydrogen into helium
- The hotter they are the brighter
- These stars are in the most stable part of their existence, which generally lasts for about 5 billion years
- Yellow dwarfs-small, main sequence stars
  - The sun is a yellow dwarf
- A red dwarf-small, cool, very faint, main sequence star whose surface temperature is under about 4,000 K
  - Red dwarfs are the most common type of star
  - Proxima Centauri is a red dwarf



Giants and Supergiants

- What stars become as they begin to die
- Have depleted their hydrogen supply and are very old
- The core contracts as the outer layers expand
- These stars will eventually explode (becoming a planetary nebula or supernova, depending on their mass) and then become white dwarfs, neutron stars, or black holes
- Red giant-a relatively old star whose diameter is 10 to 100 times bigger than the Sun
  - They are frequently orange in color
  - Betelgeuse is a red giant-it is about 20 times as massive as the Sun about 14,000 times brighter than the Sun, and about 600 light-years from Earth
- Blue giant-a huge, very hot, blue star
  - A post-main sequence star that burns helium
- Supergiant-the largest known type of star
  - Some are almost as large as our entire solar system

Faint, Virtually Dead Stars

- White dwarf-small, very dense, hot star that is made mostly of carbon
  - These faint stars are what remains after a red giant star loses its outer layers
  - Their nuclear cores are depleted
  - They are about the size of the Earth (but tremendously heavier)
  - They will eventually lose their heat and become a cold, dark black dwarf
  - Our sun will someday turn into a white dwarf and then a black dwarf
- Brown dwarf-a "star" whose mass is too small to have nuclear fusion occur at its core
  - the temperature and pressure at its core are insufficient for fusion
  - A brown dwarf is not very luminous
- Neutron star-a very small, super-dense star which is composed mostly of tightly-packed neutrons
  - It has a thin atmosphere of hydrogen
  - It has a diameter of about 5-10 miles
- Pulsar-a rapidly spinning neutron star that emits energy in pulses

Binary Stars

- Binary star-a system of two stars that rotate around a common center of mass
  - About half of all stars are in a group of at least two stars
- Double star-two stars that appear close to one another in the sky
  - Some are true binaries
  - Others just appear together from the Earth because they are both in the same line-of-sight

Cepheid Variable Stars

- Stars that regularly pulsate in size and change in brightness
- As the star increases in size, its brightness decreases and then, the reverse occurs
- Cepheid Variables may not be permanently variable
- The fluctuations may just be an unstable phase the star is going through