Lifestyles of the Stars

Essential Vocabulary:

* Giant Molecular Cloud
  + Large molecular gas clouds
  + Up to 1 Million solar masses
* Cloud Core
  + Densest part of a molecular cloud
  + Generally where star formation begins to take place
  + Usually the center of the cloud
* Protostar
  + The first phase of a star’s life
  + A star still in the process of forming
* Zero – Age Main Sequence
  + The time at which a star joins the main sequence
  + Hydrogen begins burning through fusion
  + Star enters stellar evolution
* Main Sequence Star
  + Stars burning hydrogen into helium
  + Stars in the main sequence on a HR – diagram
* Red Dwarf
  + A small, cool star in the main sequence
  + Generally spectral type of K or M
  + From .075 solar masses units to .5 solar masses
* Brown Dwarf
  + A star whose mass is insufficient for nuclear fission
  + Their masses are so low, it is generally measured in Jupiter masses
* Red Giant
  + A giant in a late phase of staller evolution
  + Low surface temperature, large radius
  + Generally fuse hydrogen into helium, other into carbon
* Planetary Nebula
  + Bright shell around a hot star
  + Generally composed of gas ejected from the star as a red giant
* White Dwarf
  + A small, dense star supported by electron degeneracy
  + Extremely dim
  + Final evolutionary state for smaller stars
* Supernova
  + Stellar explosion
  + Brightness increases by a factor of up to 1 Billion
  + Two types, Type 1 and Type 2
    - Type 1 – Caused by rapid fusion of carbon and oxygen in a white dwarf
    - Type 2 – Caused by the collapse of a star’s core
* Neutron Star
  + A star whose composition is primarily neutrons tightly packed together
  + Extremely dense
  + Supported against gravity by neutron degeneracy
  + Remains of a star after a Type 2 supernova
  + Final state of stars with a mass greater than the Chandrasekhar limit, but insufficient to overcome neutron degeneracy
* Black Hole
  + A region in space with infinite gravitational attraction
  + No matter or radiation can escape
  + Final evolutionary state for large stars
* Parts of the HR – Diagram
  + Main Sequence
    - Continuous spectrum of stars
    - Filled with stars who are producing helium by fusing hydrogen in their cores
    - Runs from hot, bright stars to cool, dim stars
    - Stars move down and towards the right as they age
  + Red Giants
    - Group of stars branching above the main sequence
    - Runs perpendicular and above the main sequence from around 4,000K to 1,000K
  + White Dwarfs
    - Group of stars branching of the bottom of the HR – Diagram
    - Runs from around 20,000K to 4,500K
    - Have low luminosities
  + Birth Line
    - Predicated path on an HR – Diagram taken by protostars at the end of initial accretion
    - Not a defined line – varies from star to star
* Evolutionary Track
  + Path in an HR – Diagram which shows stars as they evolve over their lives
  + Shows the changing properties of stars over time
* Vogt – Russell Theorem
  + The idea that the initial mass and composition of a star determine the course of its life
  + Never proven
  + Require the star to exist without external influences
* Thermo – Gravitational Equilibrium
  + A point at which a star is in equilibrium with internal and external pressures
  + Stars often fluctuate in and out of equilibrium
* Nuclear Processes
  + Proton – Proton Chain
    - A fusion reaction to convert hydrogen into helium
    - Often used by smaller stars, like the Sun
    - Requires high temperature to overcome Coulomb repulsion
  + CNO Cycle
    - Alternate to the Proton – Proton Chain
    - Catalytic Cycle
    - Used by larger stars

Advanced Vocabulary:

* T – Tauri Star
  + Pre – main sequence star
  + Small (less than three solar masses)
  + Intense emission lines
* Asymptotic Giant Branch (AGB)
  + Portion on an HR – Diagram above the Main Sequence, near the Red Giant Branch
  + Contains large, cool stars
  + Generally burn helium
* AGB Star
  + A star in the AGB
  + Pulsates due to changes in the thermo – gravitational equilibrium
  + These pulsations can burn of the outer shell, resulting in a planetary nebula
* Pulsar
  + ‘Pulsating star’
  + A rotating neutron star with an extremely strong magnetic field
  + Emits a powerful beam of electromagnetic radiation
  + The period of this beam’s visibility from Earth is often used to research pulsars
  + Originally thought to be alien communication
* Magnetar
  + A kind of neutron star with an extremely powerful magnetic field
  + This magnetic field results in the emission of energetic radiation
  + This field can heat up the surface of a magnetar to millions of degrees
* RR Lyrae Star
  + Also called RR Lyrae variables
  + Often used as standard candles for distance measurement
  + In the instability strip on an HR – Diagram
  + Brightness varies periodically due to changes in the size of the star
  + These variations come from changes in the thermo – gravitational equilibrium
* Classical Cepheid Variable Stars
  + Variable stars similar to RR Lyrae stars
  + Tend to be far brighter, and have longer periods
* Electron Degeneracy
  + Degeneracy pressure caused by the Pauli Exclusion Principle for Electrons
  + Pushes outward against gravitational collapse
  + Overcome in neutron stars and black holes
* Neutron Degeneracy
  + Degeneracy pressure from the Quantum Degeneracy Principle for Quarks
  + Pushes outward against gravitational collapse
  + Overcome in black holes
* Parts of the HR – Diagram
  + Instability Strip
    - A rectangular region perpendicular to the main sequence that lies above
    - Contains pulsating stars like RR Lyrae, Cephid Variables and W Virginia Variables
    - Pulsations are due to changes in the thermo – gravitational equilibrium of stars, and occasionally the path between Earth and the star
  + AGB
    - A portion of the HR Diagram that is asymptotic to the horizontal branch, which lies to the right of the main sequence
    - Stars here have a burning helium core, surrounded by a hydrogen shell
* Nuclear Processes
  + R – Process
    - Creates heavier elements during the core – collapse in a supernova
    - Creates most of the heavy elements (above iron)
  + S – Process
    - Creates heavier elements by neutron capture
    - Requires preexisting seed nuclei
    - Generally takes place in AGB stars