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