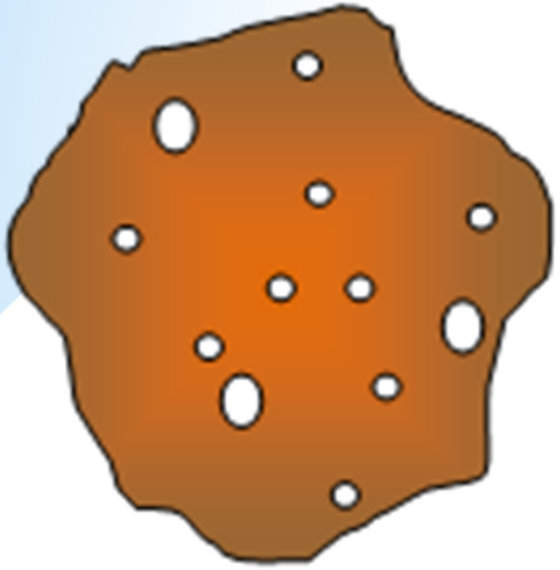
*Star Life Cycle

Main Sequence Stars

- Generally speaking, there are two main life cycles for stars.
- The factor which determines the life cycle of the star is its mass.
- 1 solar mass = size of our Sun
- Any star less than about three solar masses will spend almost all of its existence in what is called the "Main Sequence".

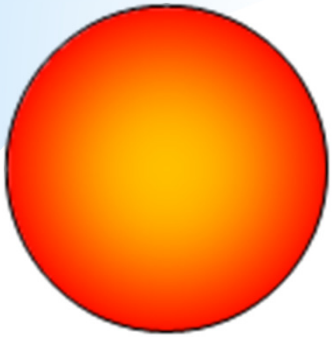


* Space may seem empty, but actually it is filled with thinly spread gas, mostly hydrogen, and dust.
* The dust is mostly microscopic grains of carbon and silicon. In some places, this material is collected into a big cloud of dust and gas, known as a **nebula**.
* Stars form from collapsing clouds of gas and dust. All stars begin in a nebula.

* Stellar Nebula (a star nursery)

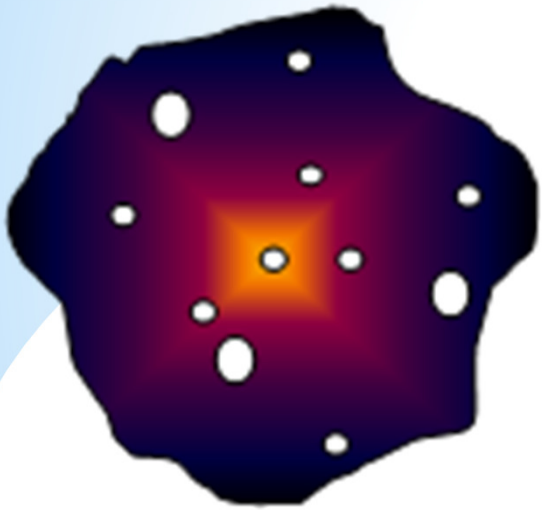
Sun-like Stars

* Some gas and dust is pulled by gravity to the core. As the region of condensing matter heats up, it begins to glow. This is called a protostar.
* Temperature rises, and nuclear fusion begins. This is the "birth" of the star. Nuclear fusion is the atomic reaction that fuels stars. Fusion in stars is mostly converting hydrogen into helium.
* Stars that are up to 1.5 times the mass of the Sun are called "Main Sequence" stars and will burn for a long time.



* A red giant is a large star that is reddish or orange in color.
* It represents the phase in a star's life when its supply of hydrogen has been exhausted and helium is being fused into carbon. This causes the star to collapse, raising the temperature in the core. The outer surface of the star expands and cools, giving it a reddish color.
* Red giants are very large, reaching sizes of over 100 times the star's original size.

* Red Giant



* Planetary nebulae form when a main sequence star grows into a red giant and throws off its outer layers and the core collapses.
* The term "planetary" comes from the 19th century, when astronomers saw what looked like a new planet in their primitive telescopes.
* This was a time before people knew that there were different types of galaxies. The name has stuck ever since.

* Planetary Nebula

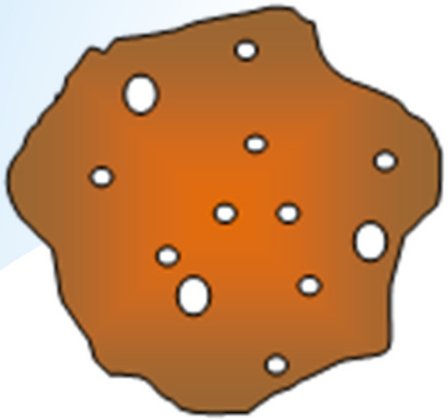
White Dwarf

* The collapsed core left when a red giant loses its outer layers is called a white dwarf.
* It is made of pure carbon that glows white hot with leftover heat from the spent fuel. It will drift in space while it slowly cools.
* It is the size of Earth, but very dense. A teaspoon of the material would weigh as much as an elephant.

Black Dwarf

* A black dwarf is a white dwarf star that has cooled completely and does not glow.
* It will drift in space as a frozen lump of carbon. The star is considered “dead”.

* Massive Stars

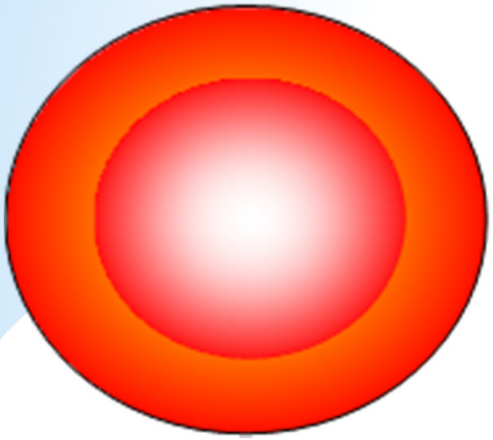


* All stars form from collapsing clouds of gas and dust found in a nebula.

* Stellar Nebula (a star nursery)

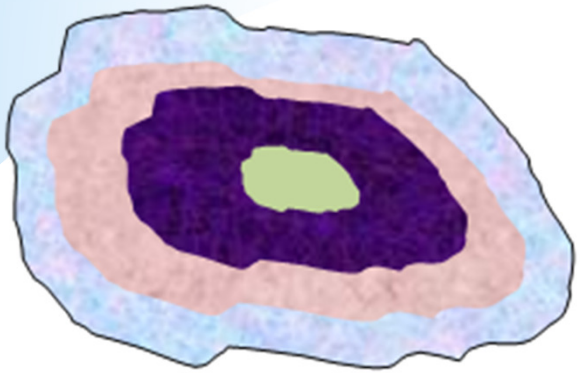
Massive Stars

* Massive stars are stars that are between 1.5 to 3 times the mass of the Sun.
* A star with a much greater mass will form, live, and die more quickly than a main sequence star.
* Massive stars follow a similar life cycle as small and medium stars do, until they reach their main sequence stage.
* This occurs because the gravity squeezes the star's core and creates greater pressures, resulting in a faster fusion rate.



* A red supergiant glows red because its outer layers have expanded, producing the same amount of energy over a larger space. The star becomes cooler.
* Red stars are cooler than blue or white stars. A supergiant has the pressure needed to fuse carbon into iron.
* This fusion process takes energy, rather than giving it off. As energy is lost, the star no longer has an outward pressure equal to gravity pushing in. Gravity wins, and the core collapses in a violent explosion.

* Red Supergiant



* A supernova is an explosion of a massive star at the end of its life; the star may briefly equal an entire galaxy in brightness.
* At this point, the mass of the star will determine which way it continues in the life cycle.

*Supernova

Neutron Star

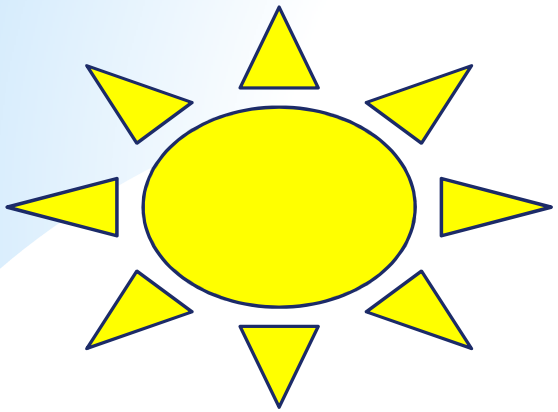
- If the star is at least 1.5 but less than 9 times larger than the Sun, the core left after the supernova will collapse into a neutron star. This is a star composed only of neutrons.

Black Hole

- If the star is at least 9 or more times larger than the Sun, the core will continue to collapse into a black hole, an extremely dense area with a strong gravitational pull that light can not escape.

Neutron Star or Black Hole?

Our Sun



* Our Sun is a medium sized, main sequence star.

* It is the closest star to Earth