Las Cumbres Observatory Global Telescope

Life Cycle of Stars

The Circle of Life

FAULKES TELESCOPE

Author: Daniel Duggan

Life Cycle of Stars

The Circle of Life

Introduction

All stars in the Universe begin as clouds of gas and dust called Nebulae (single Nebula). Over time, gravity causes this matter to collapse in on itself; becoming a dense region called a Protostar.

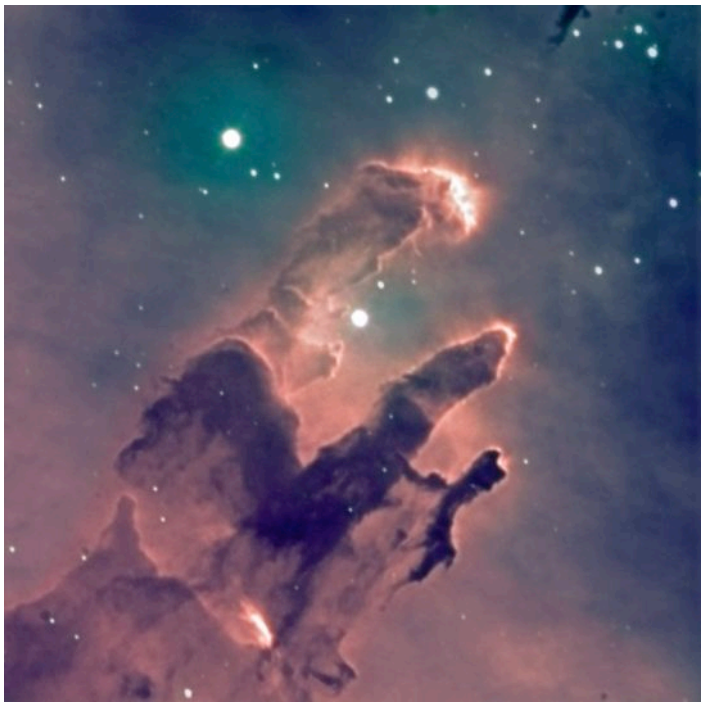
As the Protostar gets denser, it heats up and eventually it reaches a critical mass and nuclear fusion begins. This is the stable Main Sequence phase of a star where it will spend most of its life.

Small Stars

The life span of a star depends on its initial size. Smaller stars will exist for billions of years as they burn their fuel very slowly.

When a star begins to run out of fuel, it expands into a Red Giant and will exist in this phase until the rest of its fuel is gone. At this point, the outward pressure of the nuclear reactions in the star is not strong enough to equalize the inward gravitational force, so the star begins to collapse.

Most stars (including our Sun) will blow away their outer layers to form a planetary nebula; their cores remain behind and live as White Dwarfs. No nuclear reactions occur in a white dwarf so they spend the rest of their lives slowly leaking out energy that was formed during it's nuclear fusion phases.



M16 - The Eagle Nebula.

This is an active region of star formation.

When all the energy from white dwarfs is lost, they stop emitting light and become Black Dwarfs. No black dwarfs are thought to currently exist since the calculated time for a white dwarf to lose all its energy is longer than the age of the Universe.

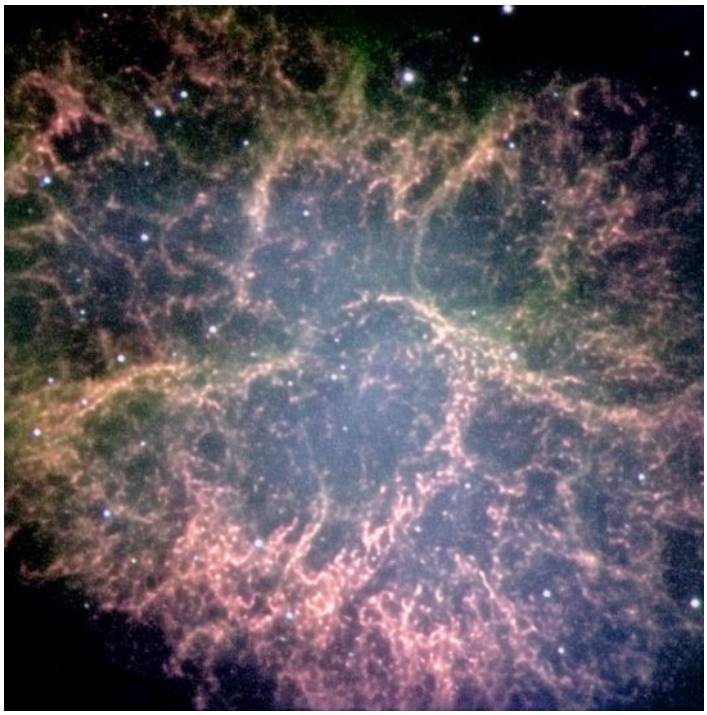
Massive Stars

Massive stars burn their fuel very quickly and remain on the main sequence for only a few hundred thousand years, when their fuel runs out they expand into Red Supergiants.

If the star is massive enough, the collapse will trigger a violent explosion known as a Supernova (plural Supernovae).

If the remaining mass of the star is about 1.4 times that of our Sun, the core is unable to support itself and it will collapse further to become a Neutron Star; as the name suggests, this star is made up entirely of neutrons due to the pressure that was exerted on the core during the collapse. A single tea spoon of this matter will weigh as much as an elephant on Earth.

If the remaining mass of the star is more than about 3 times that of the Sun, it will collapse so completely that it forms a singularity - a point of infinite smallness. What is left behind is an intense region of gravity called a Black Hole, the gravitational pull of these monsters is so intense that anything going over the Event Horizon, even light, cannot escape.



M1 - The Crab Nebula

This is a supernova first observed by Chinese astronomers back in 1054.

Eventually, the gravity of a passing star or the shockwave from a nearby supernova may cause it to contract, starting the entire process all over again. This process repeats itself throughout the Universe in an endless cycle of birth, death, and rebirth.

It is this cycle of stellar evolution that produces all of the heavy elements required for life. Our Solar System formed from such a second or third generation nebula, leaving an abundance of heavy elements here on Earth and throughout the Solar System. This means that we are all made of star stuff - every atom in our bodies was created either in the nuclear furnace of a star or in the cataclysmic explosion of a supernova.

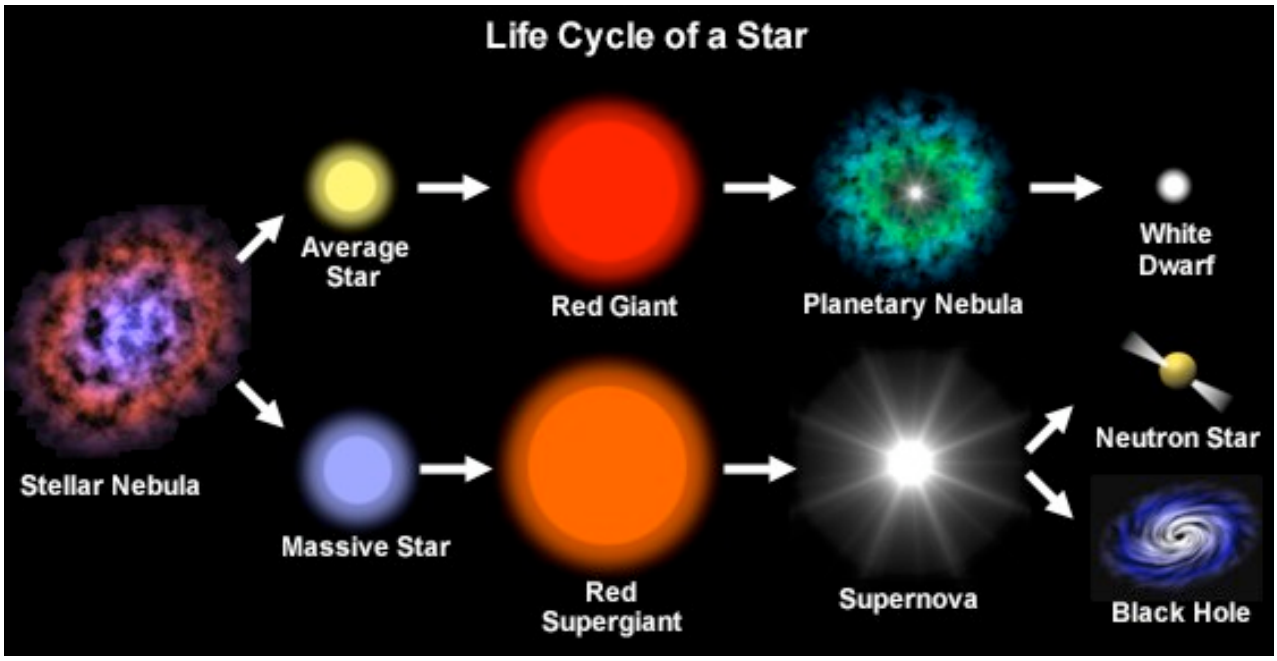


Image Credit: The Sky