The Life Cycles of Stars Article

A star's life cycle is determined by its mass. The larger the mass, the shorter the life cycle. A star's mass is determined by the amount of matter that is available in its nebula (remember all stars start in nebulas), the giant cloud of gas and dust in which it is born. Over time, gravity pulls the hydrogen gas in the nebula together and it begins to spin. As the gas spins faster and faster, it heats up and is known as a protostar. Eventually the temperature reaches 15,000,000°C and nuclear fusion occurs in the cloud's core.

The cloud begins to glow brightly. At this stage, it contracts a little and becomes stable. It is now called a main sequence star and will remain in this stage, shining for millions or billions of years to come. As the main sequence star glows, hydrogen in the core is converted into helium by nuclear fusion.

When the hydrogen supply in the core begins to run out, the core becomes unstable and contracts. The outer shell of the star, which is still mostly hydrogen, starts to expand. As it expands, it cools and glows red. The star has now reached the red giant phase. It is red because it is cooler than it was in the main sequence star stage and it is a giant because the outer shell has expanded outward. All stars evolve the same way up to the red giant or super giant phase.

Death of a Low Mass Star

Throughout the red giant phase, the hydrogen gas in the outer shell continues to burn and the temperature in the core continues to increase. At 200,000,000°C the helium atoms in the core fuse to form carbon atoms. The last of the helium atoms in the core are fused into carbon atoms, the star begins to die. Gravity causes the last of the star's matter to collapse inward and compact. This is the white dwarf stage. At this stage, the star's matter is extremely dense. White dwarfs shine with a white hot light.

Death of a High Mass Star

Once massive high mass stars reach the super giant phase, the core temperature increases as carbon atoms are formed from the fusion of helium atoms. Gravity continues to pull carbon atoms together as the temperature increases forming oxygen, nitrogen, and eventually iron. At this point, fusion stops and the iron atoms start to absorb energy. This energy is eventually released in a powerful explosion called a supernova. A supernova can light up the sky for weeks. The temperature in a supernova can reach 1,000,000,000°C. The core of a massive star that has 8 or more times the mass of our Sun remains massive after the supernova. No nuclear fusion is taking place to support the core, so it is swallowed by its own gravity. It has now become a black hole which readily attracts any matter and energy that comes near it. Black holes are not visible. They are detected by the X-rays which are given off as matter falls into the hole.