STUDENT REFERENCE SHEET

Life Cycle of a Star

Cycle Descriptions

Low to Medium Mass Stars

Stage 1: A Star Forms

Gravity pulls particles from an enormous cloud of dust and gas together in a mass. Once enough dust and gas have collected to form a giant ball, the pressure at the center of the ball causes the temperature to climb to about 15 million °C. At this temperature, nuclear fusion of hydrogen begins and the ball starts to glow. A star is born!

Stage 2: Main Sequence

As the force of gravity pulls the star together as a mass, the force of the energy from the fusion of hydrogen to helium attempts to push the star apart. The two forces are balanced during the main part of the star's cycle. This stage of a star is the longest. As long as the star has its fuel (hydrogen), it will continue to fuse it into new, heavier elements (helium).

Stage 3: Red Giant

Once all of the hydrogen within a star has been converted to helium, there is no more outward push from the force of energy from the core to balance the inward pull of gravity. The shell of the star collapses inward. This creates greater pressure and temperature, which generate a force greater than the pull of gravity. The outer layers of the star expand out to form a red giant. The increase in temperature triggers the star to begin using helium as the fusion source for other elements. Energy continues to be released as fusion continues.

Stage 4: Planetary Nebula

As fusion causes the helium atoms within the star's core to fuse together to form carbon, the outer layers of the star continue to expand. The core begins to contract inward, but the strength of the carbon stops and stabilizes the core. The outer layers move away from the core and form a diffuse cloud or planetary nebula.

Stage 5: White Dwarf

Once the star is reduced to only 20 percent of its original mass, the star begins to cool and shrink. When the star becomes only a few thousand kilometers in diameter it becomes a white dwarf.

STUDENT REFERENCE SHEET

Life Cycle of a Star

Cycle Descriptions

High Mass or Massive Stars

Stage 1: A Star Forms

Gravity pulls particles from an enormous cloud of dust and gas together in a mass. Once enough dust and gas have collected to form a giant ball, the pressure at the center of the ball causes the temperature to climb to about 15 million °C. At this temperature, nuclear fusion of hydrogen begins and the ball starts to glow. A star is born!

Stage 2: Main Sequence

As the force of gravity pulls the star together as a mass, the force of the energy from the fusion of hydrogen to helium attempts to push the star apart. The two forces are balanced during the main part of the star's cycle. The main sequence stage is much shorter for massive stars than for low and medium mass stars.

Stage 3: Red Supergiant

Once all of the hydrogen within a star has all been converted to helium, there is no more outward push from the force of energy from the core to balance the inward pull of gravity. The shell of the star collapses inward. This creates greater pressure and temperature, which generate a force greater than the pull of gravity. The outer layers of the star expand out to form a red supergiant. The increase in temperature triggers the star to begin using helium as the fusion source for other elements. The fusion process of converting all of one fuel into a new element continues. Each time, as the fuel source is depleted, the shell collapses into the core, creating a rise in pressure and temperature and triggering a new fuel source to ignite.

Stage 4: Supernova

Once all the elements used as a fuel have fused to form iron, the fusion process stops. The structural properties of iron do not allow it to fuse into heavier elements. Without the balance of the outward push from the energy generated by fusion, the inward pull of gravity causes the star to collapse inward. The extreme pressure created by the collapse results in a rapid increase of the core temperature to over 100 billion °C. Energy from the core explodes outward in a supernova. The shell is pushed outward and forms a planetary nebula.

STUDENT REFERENCE SHEET

Life Cycle of a Star

Cycle Descriptions

High Mass or Massive Stars, continued

Stage 5: Neutron Star or Black Hole

If the original mass of the star is less than 15 solar masses, the core of the star may remain intact after the supernova. The core survives as a dense ball of neutrons and becomes a neutron star. Neutron stars are the most dense objects known and also have very strong magnetic fields. Sometimes, however, even if the original mass is less than 15 solar masses, the core collapses and forms a black hole.

The cores of stars with an original mass 15 solar masses or greater cannot survive the supernova. The entire core collapses and forms a black hole. Black holes are extremely dense objects with such strong gravity, light cannot travel outside of the black hole.