

INTEGRATING SPACE SCIENCE**● The Life Cycle of a Star**

The life cycle of most stars lasts billions of years, and nuclear reactions play an important role in this cycle. The first stage of the cycle occurs when a cloud of gases, mostly hydrogen with some helium and trace amounts of the heavier elements, gathers together because of gravitational attraction. As the density of the cloud increases, pressure builds at the center. This stage takes millions of years.

Nuclear Fusion Reactions Take Place in Stars

In the second stage of a star's life, the intense pressure at the center causes a fusion reaction to occur. In this reaction, the nuclei of hydrogen atoms at the center of the star fuse to form helium atoms. Some of the mass of the hydrogen atoms is converted to energy, producing intense light and heat.

As the hydrogen at the core is transformed into helium, the fusion reaction continues outward. The density of the star's interior increases. Eventually, the force of gravity is so strong that the helium fuses to form heavier elements, such as carbon, oxygen, and—if the star is massive enough—iron.

Stars of Different Mass Die Differently

After elements heavier than helium are formed, several things may happen, depending on the original mass of the star. A relatively small star will eventually become a white dwarf, a very dense star that radiates little energy. A larger star will explode as a supernova, creating heavier elements such as uranium in the process.

If the core remaining after a supernova is large enough, it can become a neutron star—a small, dead star as dense as the nucleus of an atom. An even larger core will collapse to form a black hole, an object so massive and dense that nothing, not even light, can escape from its gravity.

Your Turn to Think

1. What is the primary element in stars at the beginning of their lives?
2. Explain what happens to some of the mass when hydrogen fuses to form helium.
3. Explain why only very massive stars can form heavy elements.