

18-5

What is a star's life cycle?

Objective

Describe the stages in the life cycle of a star.

Key Terms

nova: explosion where the outer layers of a star are blown off

supernova: violent explosion where a star is blown apart

Life Cycle of a Star Stars change over time. This is called a life cycle. A star's complete life cycle takes many millions of years. As time passes, the star changes its mass into energy. The energy is given off as light and heat. Eventually, most of the mass is used up, and the star dies. By studying many different stars, astronomers have learned how stars change during their life cycle.

1 EXPLAIN: Where does a star's energy come from?

Protostar to Giant Stars are formed from nebulae. Gravity pulls the dust and the gas in the nebula together, forming a protostar. If the protostar becomes hot enough, nuclear reactions start to take place. In these reactions, hydrogen is changed into helium. Large amounts of energy are produced. These reactions turn the protostar into a star.

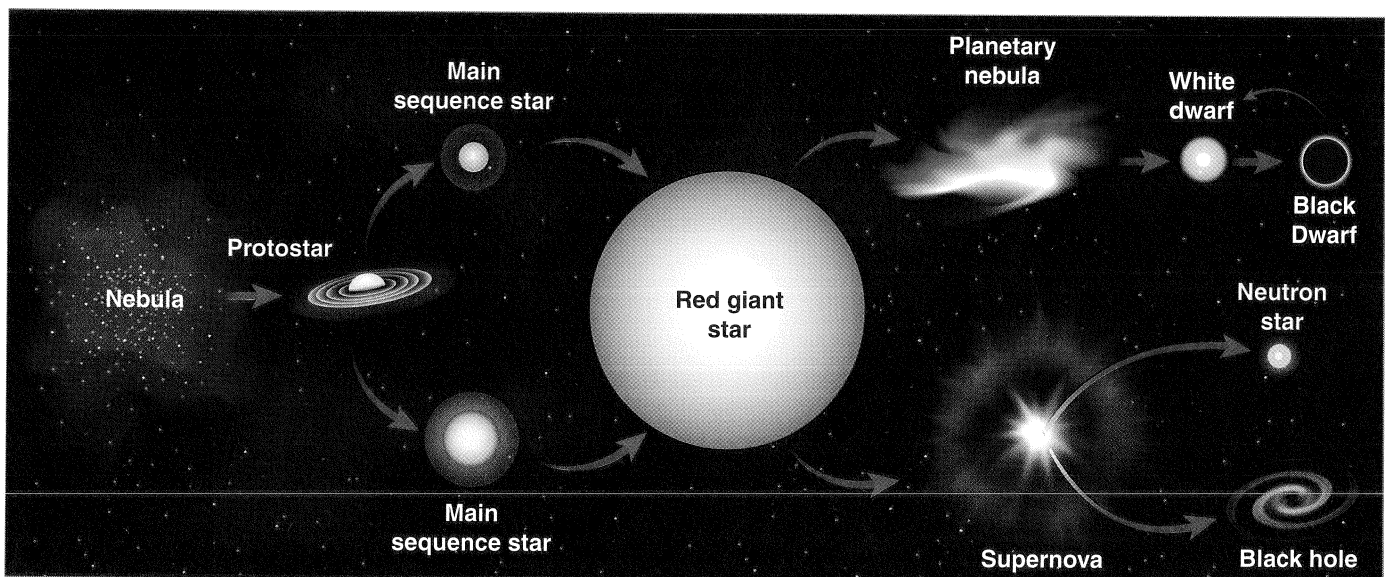
Now the star is on the main sequence. During this stage, hydrogen at the star's center continues to change into helium. When this process ends, small stars will stop shining and contract to become white dwarfs. Larger stars, however, will start new nuclear reactions that turn helium into carbon. The energy produced by these reactions expands the star and makes it cooler. It is now a red giant.

2 DESCRIBE: What is the main sequence stage?

Death of a Star The next stage in a star's life cycle depends on the star's mass. A medium-sized star loses mass and begins to contract. It becomes a white dwarf. For a brief time, the white dwarf becomes very hot. Then it begins to cool and becomes fainter and fainter with time. The end stage of a white dwarf is thought to be a small, cold, dark object called a black dwarf.

Sometimes, before it becomes a black dwarf, a white dwarf will blow off its outer layers in huge, bright explosion. This explosion is called a **nova**. A very massive star may blow itself apart in a **supernova**. During a supernova, or right after it, the star may collapse to become a neutron star or a black hole.

3 DESCRIBE: What happens when a medium-sized star runs out of hydrogen?



▲ Figure 18-11 The life cycle of a star

Supernova 1987A On February 24, 1987, a supernova was seen in the Large Magellanic Cloud. This is more than 160,000 light years from Earth. The so-called Supernova 1987A was the first to be seen by the naked eye from Earth in almost 400 years. Astronomers studied the light coming from the supernova as it slowly dimmed. Viewing the supernova helped them to learn more about the evolution of stars.

- 4 **INFER:** What was the likely energy source of Supernova 1987A?

✓ CHECKING CONCEPTS

1. A star changes _____ into energy.
2. The _____ stage is the briefest in a star's life cycle.
3. A main sequence star becomes a red giant or _____ when _____.
4. A white dwarf may blow off its outer shell in an explosion called a _____.
5. A supernova may occur in a very _____ star.



THINKING CRITICALLY

Use Figure 18-11 to complete the following exercise.

6. **SEQUENCE:** A flowchart shows a sequence of events. Create a flowchart showing the stages in the life cycle of a star. Begin with a protostar.

Web InfoSearch

Tycho Brahe Tycho Brahe was a 16th-century Danish astronomer. After studying law all day, he would go out at night to observe the stars. Brahe found that most of the astronomical information of the time was not accurate. He decided to devote his life to making accurate observations of the stars.

SEARCH: Use the Internet to find out more about Tycho Brahe's achievements. What did the king of Denmark give Brahe and why? Start your search at www.conceptsandchallenges.com. Key search words are **Tycho Brahe**, **Brahe King Denmark**, and **Tycho Brahe biography**.



How Do They Know That?

PULSARS

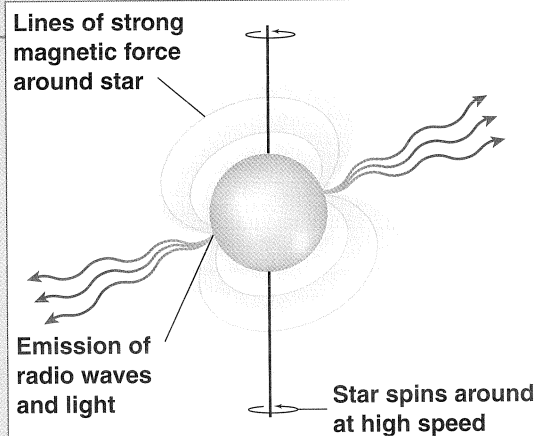
After a very massive star explodes, its core collapses. This collapse squeezes protons and electrons together until they become neutrons. This is how a neutron star is formed.

Neutron stars are incredibly dense. One teaspoonful of neutron star material would weigh over 2 billion tons. As they rotate, neutron stars send out radio waves and light that reach Earth in pulses. This is how pulsars got their name. Pulsars spin like the light atop a lighthouse. They emit radio or light waves or both that appear and then disappear in a regular pattern. The radio waves can be detected using a radio telescope.

The pulse of a pulsar tells us how fast the pulsar is spinning. The fastest pulsars discovered so far spin about 642 times per second. Some pulsars spin much more slowly, only once every few seconds.

Pulsars were first discovered in 1967 by Anthony Hewish and his graduate student, Jocelyn Bell. Hewish later received a Nobel Prize for identifying pulsars as a new class of stars.

Thinking Critically How did neutron stars get their name?



▲ **Figure 18-12** A pulsar spins like a light on a lighthouse.