

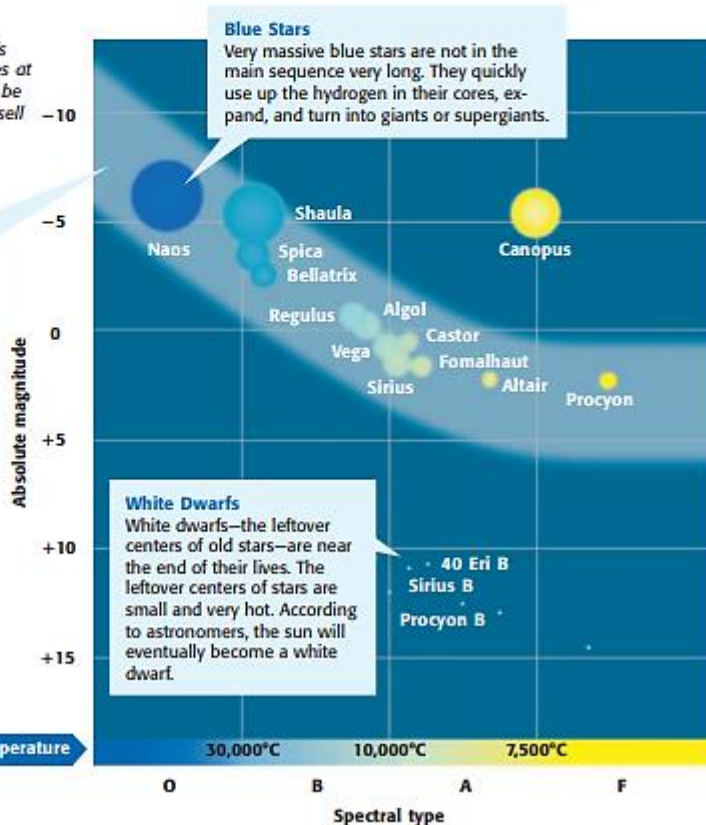
A Tool for Studying Stars

In 1911, a Danish astronomer named Ejnar Hertzsprung (IE nahr HERTS sproong) compared the brightness and temperature of stars on a graph. Two years later, Henry Norris Russell, an American astronomer, made some similar graphs. Although these astronomers used different data, their results were similar. The combination of their ideas is now called the *Hertzsprung-Russell diagram*, or *H-R diagram*. The **H-R diagram** is a graph that shows the relationship between the surface temperature and absolute magnitude of a star. Over the years, the H-R diagram has become a tool for studying the life cycles of stars. It shows not only how stars are classified by brightness and temperature but also how stars change over time.

H-R diagram (AYCH AHR DIE uh GRAM) Hertzsprung-Russell diagram, a graph that shows the relationship between a star's surface temperature and absolute magnitude

Figure 3 The stages of a star's life cycle—and a star's properties at each stage in its life cycle—can be plotted on the Hertzsprung-Russell diagram.

Main-Sequence Stars
Stars on the main sequence form a band that runs across the H-R diagram. The sun is a main-sequence star. The sun has been shining for about 5 billion years. Scientists think that the sun is in the middle of its life and will remain on the main sequence for another 5 billion years.



The H-R Diagram

The modern H-R diagram is shown in **Figure 3**. Temperature appears along the bottom of the diagram, and absolute magnitude, or brightness, appears along the left side. Hot (blue) stars are on the left, and cool (red) stars are on the right. Bright stars are at the top, and dim stars are at the bottom. The diagonal pattern, where most stars lie, represents the main sequence. A star spends most of its lifetime in the main sequence. As main-sequence stars age, they move up and to the right on the H-R diagram to become giants or supergiants. Then, they move to the left and down to become white dwarfs if their mass is eight times the sun or less.

Standards Check Explain how the H-R diagram can be used to determine the temperature and brightness of stars.

Giants and Supergiants

When a star runs out of hydrogen in its core, the center of the star shrinks inward and the outer parts expand outward. For a star that is the size of our sun, the star's atmosphere grows very large and becomes cool. When this change happens, the star becomes a red giant. If the star is very massive, it becomes a red supergiant.

