FYI

The Hertzsprung-Russell Diagram

In 1893, Dimitri Mendeleev published a paper that described an orderly grouping of the known elements of the day based on their chemical properties. It is now known as the **periodic table**. Subsequently, as new elements have been discovered, and in some cases created, each one fits a row or column of the periodic table. In fact, the initial ordering of elements helped chemists and physicists in predicting the nature and chemical properties of elements that were originally missing from the sequence. Good classification systems allow their users not only to organize what is known, but such systems also lead to the development of new patterns and the discovery of new knowledge.

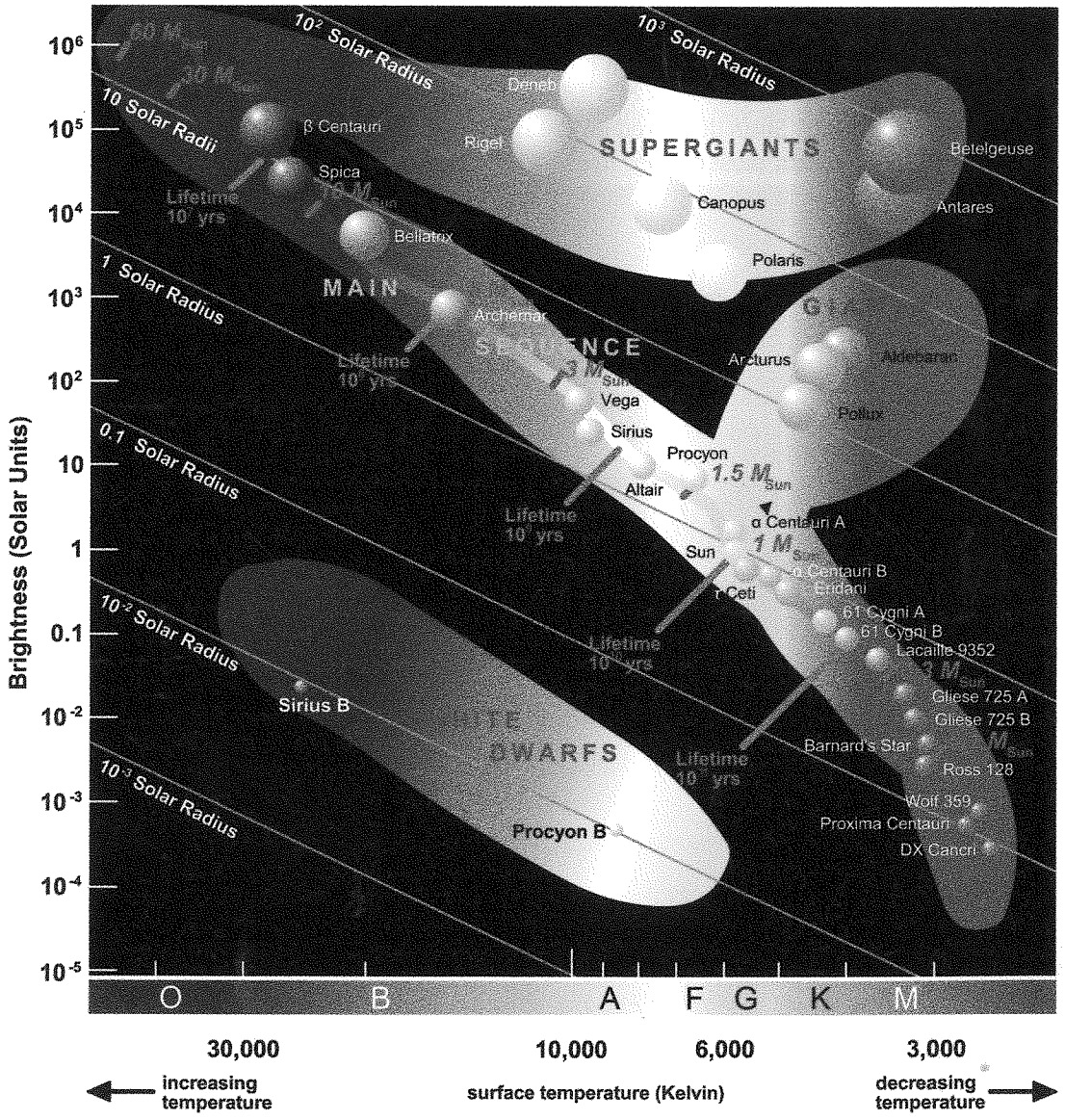

Figure 2-12: The Hertzsprung-Russell diagram, which classifies and categorizes stars

A similar organizational system has been developed to classify stars. In the beginning of the 20th century, Danish astronomer Ejnar Hertzsprung and American astronomer Henry Norris Russell discovered that when they compared the **luminosity** of stars with their temperatures, many patterns emerged. The graph of luminosity vs. the temperature or spectral class of stars is now known as the **Hertzsprung-Russell (H-R) diagram** in honor of the two cofounders. Once a star's position is known on the H-R diagram, the star's temperature, approximate size and mass, color, age, spectral type, and life story can be determined.

Stars fall into four major regions of the H-R diagram. Most stars lie on the **main sequence**, which is a band stretching from the upper left (hot and bright stars) to the lower right (cool and dim stars). There is a smaller number of stars in the other three regions: **white dwarfs** are hot but compact and dim stars in the lower left of the diagram; **supergiants** are large and very bright stars in the upper right; and **giant stars** are large and bright, but not quite as bright as supergiants, so they appear just below the supergiant region on the H-R diagram.

The H-R diagram is also a snapshot of stars at different stages of their lives. A star's position on the graph reveals its relative age. An analogy can be made between the ages of stars on the H-R diagram and the ages of the people in a large urban or suburban neighborhood. If you line up everyone from such a neighborhood, most people will be between the ages of 5 and 75. Very few will be one year old or less, or over 80 years of age. Stars displayed on the H-R diagram have a similar distribution. Most of the stars spend most of their lives on the main sequence (mature adults) and, in general, stars on the upper left of the diagram are young, while stars on the lower right are old.

Checking In

1. How is the H-R diagram useful in understanding the relationship among different types of stars?
2. Why are red dwarfs in one area of the H-R diagram, while red giant stars are in another place on the diagram?

Antares, a supergiant star, is shown on the lower left side of the image. A globular cluster (M4) is to the right.