Summary

The following statements summarize and describe many of the key terms and concepts presented in the chapter.

- One method for determining the distance to a star is to use a measurement called ***stellar parallax***, the extremely slight back-and-forth shifting in a nearby star's position due to the orbital motion of Earth. ***The farther away a star is, the less its parallax.*** A unit used to express stellar distance is the light-year, which is the distance light travels in a year, about 9.5 trillion kilometers (5.8 trillion miles).

- The intrinsic properties of stars include ***brightness, color, temperature, mass,*** and ***size***. Three factors control the brightness of a star as seen from Earth: how big it is, how hot it is, and how far away it is. ***Magnitude*** is the measure of a star's brightness. ***Apparent magnitude*** is how bright a star appears when viewed from Earth. ***Absolute magnitude*** is the "true" brightness of a star if it were at a standard distance of about 32.6 light-years. The difference between the two magnitudes is directly related to a star's distance. Color is a manifestation of a star's temperature. Very hot stars (surface temperatures above 30,000 K) appear blue; red stars are much cooler (surface temperatures generally less than 3000 K). Stars with surface temperatures between 5000 and 6000 K appear yellow, like our Sun. The center of mass of orbiting ***binary stars*** (two stars revolving around a common center of mass under their mutual gravitational attraction) is used to determine the mass of the individual stars in a binary system.

- A ***Hertzsprung-Russell diagram*** is constructed by plotting the absolute magnitudes and temperatures of stars on a graph. A great deal about the sizes of stars can be learned from H-R diagrams. Stars located in the upper-right position of an H-R diagram are called ***giants***, luminous stars of large radius. ***Supergiants*** are very large. Very small ***white dwarf*** stars are located in the lower-central portion of an H-R diagram. Ninety percent of all stars, called ***main-sequence stars***, are in a band that runs from the upper-left corner to the lower-right corner of an H-R diagram.

- ***Variable stars*** fluctuate in brightness. Some, called ***pulsating variables***, fluctuate regularly in brightness by expanding and contracting in size. When a star explosively brightens, it is called a ***nova***. During the outburst, the outer layer of the star is ejected at high speed. After reaching maximum brightness in a few days, the nova slowly returns in a year or so to its original brightness.

- New stars are born out of enormous accumulations of dust and gases, called a ***nebula***, that are scattered between existing stars. A ***bright nebula*** glows because the matter is close to a very hot (blue) star. The two main types of bright nebulae are ***emission nebulae*** (which derive their visible light from the fluorescence of the ultraviolet light from a star in or near the nebula) and ***reflection nebulae*** (relatively dense dust clouds in interstellar space that are illuminated by reflecting the light of nearby stars). When a nebula is not close enough to a bright star to be illuminated, it is referred to as a ***dark nebula***.

- Stars are born when their nuclear furnaces are ignited by the unimaginable pressures and temperatures in collapsing nebulae. New stars not yet hot enough for nuclear fusion are called ***protostars***. When collapse causes the core of a protostar to reach a temperature of at least 10 million K, the fusion of hydrogen nuclei into helium nuclei begins in a process called ***hydrogen burning***. The opposing forces acting on a star are ***gravity*** trying to contract it and ***gas pressure*** (***thermal nuclear energy***) trying to expand it. When the two forces are balanced, the star becomes a stable ***main-sequence star***. When the hydrogen in a star's core is consumed, its outer envelope expands enormously and a ***red giant star***, hundreds to thousands of times larger than its main-sequence size, forms. When all the usable nuclear fuel in these giants is exhausted and gravity takes over, the stellar remnant collapses into a small dense body.

- The ***final fate of a star is determined by its mass***. Stars with less than one half the mass of the Sun collapse into hot, dense ***white dwarf*** stars. Medium-mass stars (between 0.5 and 3.0 times the mass of the Sun) become red giants, collapse, and end up as white dwarf stars, often surrounded by expanding spherical clouds of glowing gas called ***planetary nebulae***. Stars more than three times the mass of the Sun terminate in a brilliant explosion called a ***supernova***. Supernovae events can produce small, extremely dense ***neutron stars***, composed entirely of subatomic particles called neutrons; or even smaller and more dense ***black holes***, objects that have such immense gravity that light cannot escape their surface.