

Inside Galaxies

Except for galaxies, everything that we see in the night sky is part of *our* Milky Way galaxy.

Galaxies are groupings of billions of stars. They are the largest structures in the universe. Our Sun resides in one of over 100 billion galaxies in the universe.

What's inside a galaxy?

Galaxies are dynamic places where stars are born and die. Inside are nebulae, clusters, black holes, and more.

What is a nebula?

A nebula is a gigantic cloud of hydrogen gas that is often a hundred light years across. In spiral galaxies, nebulae (plural of nebula) are concentrated in the arms. They glow from the light of nearby stars. Nebulae are cauldrons where stars are born. The best example is the Orion Nebula pictured on the next page.

How are stars born?

Stars are born inside nebulae. Nebulae are so large that many stars form within at the same time. The stars condense, by gravity, from pockets of hydrogen gas. A good example of a group or cluster of young stars is the Pleiades or Seven Sisters pictured to the right.

What is the energy source of stars?

Stars create energy by a special process called nuclear fusion (this is different from nuclear fission, which is the principal behind nuclear weapons). Since stars are very large, the pressure at their centers is so great that hydrogen atoms are forced together to become helium atoms. During this



Heart of the Milky Way



Pleiades Cluster



Omega Nebula

“fusing” process, a very small amount of matter, less than 1%, gets converted into an enormous amount of energy. We see this energy as starlight and sunlight.

What kinds of stars are there?

Stars come in different colors and sizes. Our Sun is a very average star.

The colors of stars indicate their surface temperature. They vary from red and orange, the coolest, to white and blue, the hottest. Surface temperatures range from 4,500° F to 72,000° F. Our Sun is yellowish and has a surface temperature of 10,000° F.

Very large stars have diameters over 500 times that of our Sun while the smaller ones are about one-third the Sun's diameter.

How long do stars last?

The life of a star depends on how massive it is. The most massive burn faster and last about 10 million years. On the other hand, the smaller stars are very efficient and will last for a trillion years.

CAPTIONS

The **Heart of the Milky Way**. A view of the Milky Way band as it appears above the southern horizon in the summer evening sky. This area points to the center of our Milky Way galaxy. **Pleiades Cluster**. Also known as the Seven Sisters. This naked-eye grouping of stars typifies a star cluster. Stars are born in groups or clusters. The **Omega Nebula** is another example of a nebula where stars are being born. This one is in the constellation Sagittarius.

How do stars die?

Average-size stars will eventually burn up their fuel supply and collapse to a special type of star called a white dwarf. Prior to this happening, the star will shed its outer gas layers in one final heave to create what is called a **planetary nebula**. This type of nebula is not the type from which stars are born. Planetary nebulae are circular or ball shaped. Good examples are the Ring nebula and Owl nebula pictured on this page.

What are supernovae explosions?

The most massive stars explode as supernovae. This explosion is so powerful that the light emitted outshines the galaxy the star is in. The last supernova to occur in our Milky Way galaxy was in the year 1572. Remnants from this and other supernovae are visible to this day. The Veil Nebula below is one such example.

What are globular clusters?

These are clusters of stars comprised of hundreds of thousands to a million or more stars. These clusters are roundish and resemble cottonballs. They are not galaxies! There are about 200 globular clusters that surround our Milky Way galaxy. A good example is M13 (a catalog designation) pictured in the center of this page.

What is the difference between the Milky Way band and the Milky Way galaxy?

We call the galaxy that our Sun resides in the Milky Way galaxy. The Sun is placed about two-thirds of the way out from the center. Since our Sun and Earth are in the Milky Way galaxy, we cannot directly observe it, however, we do see it from the



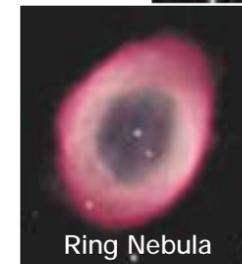
Orion Nebula



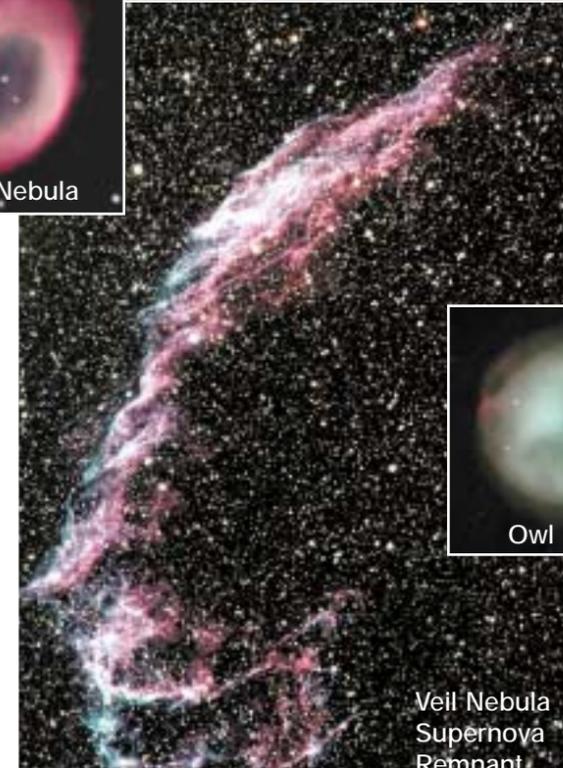
Horsehead Nebula



“M13” Globular Cluster



Ring Nebula



Veil Nebula Supernova Remnant



Owl Nebula

“inside” as the faint milky band that stretches across the night sky. The Milky Way band represents the distant glow from the bulk of the stars in our galaxy.

Here are brief descriptions of other types of stars in galaxies.

About half of all stars are part of a **Binary or Multiple Star System** where two or more stars revolve around one another. The other half are loners stars like our Sun. **Brown Dwarfs** are failed stars, that is, they are stars that did not have enough matter to start nuclear fusion. They smolder and are visible in the infrared. **Red Supergiants** are the largest stars with diameters over 1,000 times that of the Sun. They are stars near the end of their lives. **White Dwarfs** are collapsed stars at the very end of their lives and are physically about the size of Earth. **Neutron Stars**, created from supernovae explosions are about 10 miles in diameter and are so dense that a sugar cube of their material weighs 100 million tons. Finally, there are **Black Holes**, which are the densest of all collapsed stars — so dense, not even light can escape from them. They are created by the final collapse of a star which has a remaining mass of three or more of our Suns. Astronomer speculate that there may be “giant” black holes at the center of every galaxy.

CAPTIONS

Stars form in hydrogen gas clouds called nebulae, like the **Orion Nebula**, located below the easily recognized three belt stars. The **M13 Globular Cluster** in Hercules is visible with binoculars. The **Veil Nebula**, near Cygnus, is a beautiful

display of the aftermath from a supernova explosion. The **Ring and Owl Nebula** are planetary nebulae. The **Horsehead Nebula** represent a dark, unlighted nebula in front of a lighted one.