



*The "Pillars of Creation"*



*Spiral Galaxy M51*

## V. Galaxies

The Milky Way is an island in a sea of galaxies. Two small galaxies and many very small galaxies orbit our Milky Way. Galaxies range from very small, not many times larger than the largest globular clusters, to having over a trillion stars in them. They can be as small as a few thousand light years across or as large as over 200,000 light years across.

The nearest large galaxy to our own, the Andromeda Galaxy (M31) is the best galaxy to view in a small telescope (besides our own!), and its visibility is at its best during the fall and winter. M31 is located in the constellation of Andromeda. In larger telescopes, Andromeda's own companion galaxies can be seen.

### Information on the S\*T\*A\*R Astronomy Club

S\*T\*A\*R is a registered non-profit educational amateur astronomy society. Meetings are the first Thursday of each month, except July and August, at 8:00 PM at the King of Kings Lutheran Church, 250 Harmony Rd. in Middletown (intersection of Harmony and Cherry Tree Farm Rd.). Membership is open to anyone interested in any area of astronomy. Newcomers are always welcome, and you don't need a telescope! Meeting content is balanced so that both novices and more experienced members can benefit. In addition to its regular meetings, the club conducts regular observation nights during which members and visitors can enjoy an evening of stargazing. The club also has groups for telescope making and astrophotography. More details of the club can be found at [www.starastronomy.org](http://www.starastronomy.org) or by emailing [gwarnes1@comcast.net](mailto:gwarnes1@comcast.net).



## Our Place In Space

We inhabit a speck of dust in a huge cosmos. To get a sense of scale for our universe, imagine that the Sun is the size of a beach ball. On this scale, the entire Earth would be about the size of a pea. If you placed the beach ball on one goal line of a football field, the Earth would be at about the fifty-yard line. Pluto would be about 20 football fields away from the Sun. How far away are the closest stars? Imagine now that the Sun is shrunk even further, to the size of an orange. The nearest star to the Sun, Alpha Centauri (actually a three star system), would be another orange about a thousand miles away – the distance from New York to St. Louis. We live in a collection of about 200 billion stars called the Milky Way Galaxy. So if you can picture 200 billion oranges, each about a thousand miles away from another orange, you can get a sense of the size of our galaxy.

Well, that's pretty big! But we're not finished yet. The Milky Way Galaxy is not the only galaxy in the Universe. How many are there? Astronomers think that the Universe contains about 100 billion galaxies, each of which contains as many stars as our own Milky Way. The Universe is truly an unimaginably vast place.

How many galaxies are there in the Universe? The Hubble Space Telescope focused on a tiny patch of sky, smaller than the angle covered by holding a dime at arm's length. The image was full of galaxies, leading to our current estimate that there are at least 125 billion galaxies in the Universe.

Astronomers measure distance in units called light years. A light year is the distance that light travels in a year. This is about six trillion miles. The nearest star is 4.3 light years away, the galaxy is about 100,000 light years across, and the farthest parts of the Universe that we can see are about 13 billion light years away. So, what can we see in our galaxy, and what can we see beyond?

## I. Globular Clusters

Globular clusters are huge clusters of stars shaped like a globe; hence their name. Globular clusters can contain as many as a million stars packed into a sphere about 100 light years across. Globular clusters are the oldest population of stars in our galaxy, dating almost to the formation of the universe 13.7 billion years

ago. Since these stars are so old, astronomers think that it is unlikely that the stars in these clusters could have formed planets on which life could have developed.

One globular cluster that you can see tonight is called M13. The “M” is for the Messier catalog, a famous list of 110 objects that lie beyond the solar system; M13 is the thirteenth object in this list. This is the biggest and brightest globular cluster visible from the northern hemisphere. M13 has about 100,000 stars and lies 20,000 light years away.

## II. Open Clusters

Open clusters are also clusters of stars, but they are much smaller and younger than globular clusters. A typical open cluster might contain anywhere from less than 10 to more than 10,000 stars in an area about 50-100 light years across. When comparing these to globular clusters, which can have over a million stars in this same area, it is easy to see how much more densely packed a globular cluster is as compared to an open cluster.

One of the most spectacular open clusters in the sky is actually two clusters; this grouping is called the Double Cluster. The Double Cluster, made of open clusters NGC 869 and NGC 884, is about 7,000 light years from us and is an excellent target for binoculars or a small telescope.



*Globular Cluster NGC 6093*



*The “Double Cluster”*

## III. Planetary Nebulae

When a star such as our sun dies, it first swells to become a huge, bloated red star called a red giant (such as the bright star Arcturus). Then it puffs off its outer layers, leaving a glowing remnant called a white dwarf, which is only the size of the Earth but can contain more mass than the Sun. Because of this, white dwarves are very dense; a basketball made of white dwarf material would weigh about as

much as an aircraft carrier. The layers that are blown off leave beautiful nebulae known as planetary nebulae (even though these have nothing to do with planets); the white dwarf is visible at the center of some planetary nebulae.

One of the best known planetary nebulae is the Ring Nebula in the constellation Lyra. The Ring Nebula is 57 light years from the Earth and is similar to what our Sun will look like when it dies about 5 billion years from now. The Ring Nebula is an excellent target for small telescopes, and it is M57 in the Messier catalog.



*Planetary Nebula Menzel 3*



*The Rosette Nebula*

## IV. Emission Nebulae

Among the most spectacular objects in the sky are emission nebulae. A nebula is a region of gas and dust that is held together by its own gravity. Stars form in nebulae when pockets of gas in these nebulae collapse and heat up enough to ignite nuclear fires in their cores. Our own Sun formed in such a nebula five billion years ago. When a nebula is forming hot, young stars, the light from the stars excites the gas in the nebula and causes it to glow; hence the name “emission nebula”. Emission nebulae are mostly red due to the fact that their major component is hydrogen, which glows reddish-pink when excited. Other types of nebulae are “dark” nebulae, made of dust that obscures the light behind it, and reflection nebulae, which reflect starlight and consequently glow blue (for the same reason that the sky is blue; blue light is scattered more easily than red light because its wavelength is shorter).

One of the nebulae visible in the fall is the Eagle Nebula, M16, in the constellation Serpens. M16 is 7,000 light years away and has 3 huge “pillars” of dark dust that are silhouetted against the nebula in the background. One of the most famous Hubble images depicts these “Pillars of Creation” and shows the young stars forming within them.