

Galaxies

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CHAPTER 1

Galaxies

Lesson Objectives

- Identify different types of galaxies.
- Describe our own galaxy, the Milky Way Galaxy.

Vocabulary

- elliptical galaxy
- galaxy
- globular cluster
- irregular galaxy
- Milky Way Galaxy
- open cluster
- spiral arm
- spiral galaxy
- star cluster

Introduction

Compared to Earth, the solar system is a big place. But galaxies are bigger - a lot bigger. A **galaxy** is a very large group of stars held together by gravity. How enormous a galaxy is and how many stars it contains are impossible for us to really understand. A galaxy contains up to a few billion stars! Our solar system is in the Milky Way Galaxy. It is so large that if our solar system were the size of your fist, the galaxy's disk would be wider than the entire United States! There are several different types of galaxies, and there are billions of galaxies in the universe.

Star Clusters

Star clusters are groups of stars smaller than a galaxy. There are two main types, open clusters and globular clusters. **Open clusters** are groups of up to a few thousand stars held together by gravity. The Jewel Box, shown in **Figure 1.1**, is an open cluster. Open clusters tend to be blue in color, and often contain glowing gas and dust. The stars in an open cluster are young stars that all formed from the same nebula.

Globular clusters are groups of tens to hundreds of thousands of stars held tightly together by gravity. Globular clusters have a definite, spherical shape. They contain mostly old, reddish stars. Near the center of a globular cluster, the stars are closer together. **Figure 1.2** shows a globular cluster. The heart of the globular cluster M13 has hundreds of thousands of stars. M13 is 145 light years in diameter. The cluster contains red and blue giant stars.



FIGURE 1.1

These hot blue stars are in an open cluster known as the Jewel Box. The red star is a young red supergiant.



FIGURE 1.2

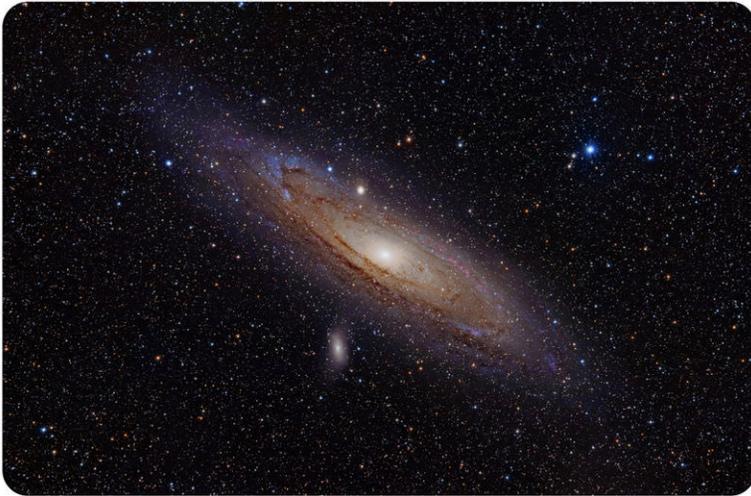
The globular cluster, M13, contains red and blue giant stars.

Types of Galaxies

The biggest groups of stars are called galaxies. A few million to many billions of stars may make up a galaxy. With the unaided eye, every star you can see is part of the Milky Way Galaxy. All the other galaxies are extremely far away. The closest spiral galaxy, the Andromeda Galaxy, shown in **Figure 1.3**, is 2,500,000 light years away and contains one trillion stars!

Spiral Galaxies

Galaxies are divided into three types, according to shape. There are spiral galaxies, elliptical galaxies, and irregular galaxies. **Spiral galaxies** are a rotating disk of stars and dust. In the center is a dense bulge of material. Several

**FIGURE 1.3**

The Andromeda Galaxy is the closest major galaxy to our own.

arms spiral out from the center. Spiral galaxies have lots of gas and dust and many young stars. **Figure 1.4** shows a spiral galaxy from the side. You can see the disk and central bulge.

**FIGURE 1.4**

The Pinwheel Galaxy is a spiral galaxy displaying prominent arms.

Elliptical Galaxies

Figure 1.5 shows a typical elliptical galaxy. **Elliptical galaxies** are oval in shape. The smallest are called dwarf elliptical galaxies. Look back at the image of the Andromeda Galaxy. It has two dwarf elliptical galaxies as its companions. Dwarf galaxies are often found near larger galaxies. They sometimes collide with and merge into their larger neighbors.

Giant elliptical galaxies contain over a trillion stars. Elliptical galaxies are red to yellow in color because they contain mostly old stars. Most contain very little gas and dust because the material has already formed into stars.

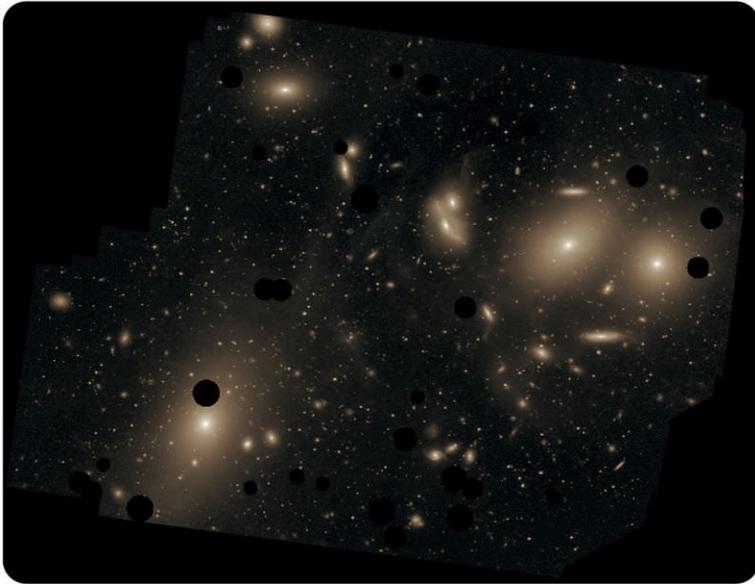


FIGURE 1.5

M87 is an elliptical galaxy in the lower left of this image. How many elliptical galaxies do you see? Are there other types of galaxies displayed?

Irregular Galaxies

Look at the galaxy in **Figure 1.6**. Do you think this is a spiral galaxy or an elliptical galaxy? It doesn't look like either! If a galaxy is not spiral or elliptical, it is an **irregular galaxy**. Most irregular galaxies have been deformed. This can occur either by the pull of a larger galaxy or by a collision with another galaxy.

The Milky Way Galaxy

If you get away from city lights and look up in the sky on a very clear night, you will see something spectacular. A band of milky light stretches across the sky, as in **Figure 1.7**. This band is the disk of the **Milky Way Galaxy**. This is the galaxy where we all live. The Milky Way Galaxy looks different to us than other galaxies because our view is from inside of it!

Shape and Size

The Milky Way Galaxy is a spiral galaxy that contains about 400 billion stars. Like other spiral galaxies, it has a disk, a central bulge, and spiral arms. The disk is about 100,000 light-years across. It is about 3,000 light years thick. Most of the galaxy's gas, dust, young stars, and open clusters are in the disk. Some astronomers think that there is a gigantic black hole at the center of the galaxy. **Figure 1.8** shows what the Milky Way probably looks like from the outside.

Our solar system is within one of the spiral arms. Most of the stars we see in the sky are relatively nearby stars that are also in this spiral arm. We are a little more than halfway out from the center of the Galaxy to the edge, as shown in **Figure 1.8**.

Our solar system orbits the center of the galaxy as the galaxy spins. One orbit of the solar system takes about 225 to 250 million years. The solar system has orbited 20 to 25 times since it formed 4.6 billion years ago.

**FIGURE 1.6**

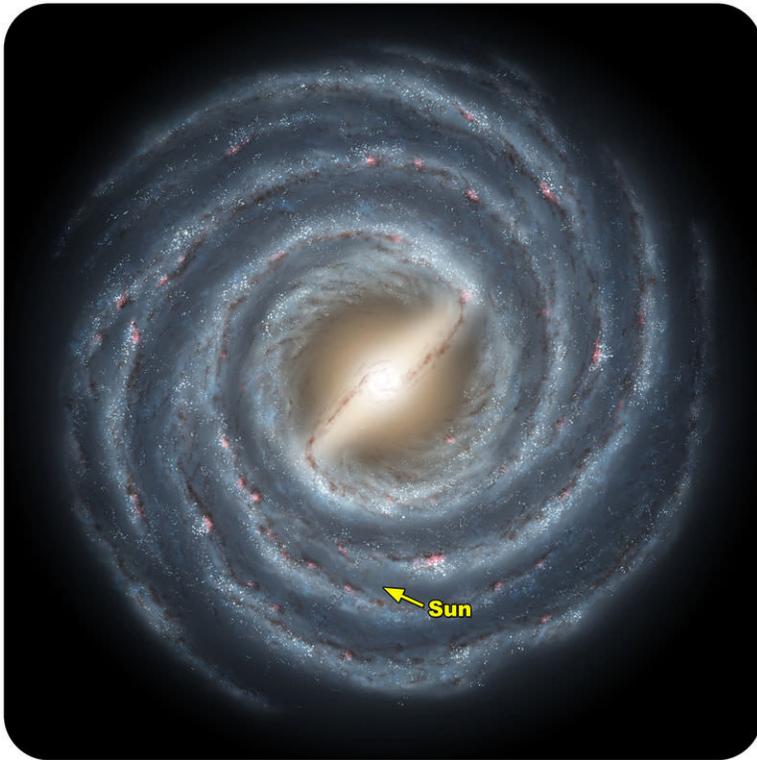
This irregular galaxy, NGC 55, is neither spiral nor elliptical.

**FIGURE 1.7**

The Milky Way Galaxy in the night sky above Death Valley.

Lesson Summary

- Open clusters are groups of young stars loosely held together by gravity.
- Globular clusters are spherical groups of old stars held tightly together by gravity.
- Galaxies are collections of millions to many billions of stars.
- Spiral galaxies have a rotating disk of stars and dust, a bulge in the middle, and several arms spiraling out from the center. The disk and arms contain many young, blue stars.
- Typical elliptical galaxies are oval shaped, red or yellow, and contain mostly old stars.
- A galaxy that is not elliptical or spiral is an irregular galaxy. These galaxies were deformed by other galaxies.
- The band of light called the Milky Way is the disk of our galaxy, the Milky Way Galaxy, which is a typical spiral galaxy.

**FIGURE 1.8**

This is an artist's rendering of the Milky Way Galaxy seen from above. The Sun and solar system (and you!) are a little more than halfway out from the center.

- Our solar system is in a spiral arm of the Milky Way Galaxy, a little more than halfway from the center to the edge of the disk. Most of the stars we see are in our spiral arm.

Lesson Review Questions

Recall

1. What is the difference between a globular cluster and an open cluster?
2. What are the features of a spiral galaxy?
3. What are the features of an elliptical galaxy?

Apply Concepts

4. Where in the Milky Way galaxy is Earth?
5. How do irregular galaxies become irregular? Why do astronomers think that?

Think Critically

6. How do astronomers know that we live in a spiral galaxy if we're inside it?
7. How can astronomers tell the age of a galaxy?

Points to Consider

- Objects in the universe tend to be grouped together. What might cause them to form and stay in groups?
- Can you think of anything that is bigger than a galaxy?

References

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