Chapter 1
Earth's Place in the Universe

Standards Covered: 6-MS-ESS1-1, 6-MS-ESS1-2, 6-MS-ESS1-3

Essential Questions:

- What is the Sun's role in the solar system?
- What is the difference between planets and plutoids?
- How do stars and planets differ in motion?
- What is a constellation?

Key Term Activity at the end of the chapter

Our Solar System

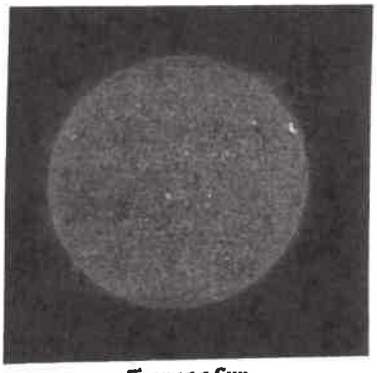

Figure 1.1 Sun

The **Sun** is at the center of our solar system. Despite its massive size, the Sun is a star, not a planet. It looks different than the stars you see in the night sky. The tiny lights twinkling in the sky are a contrast to the bright, yellow Sun. The reason is not that the Sun is genuinely different, but because of the Sun's distance from Earth.

The distance from the Earth to the Sun is 92.96 million miles. That's a long way for something that seems so close. If you flew to the Sun in a regular airplane, it would take 19 years to reach it. The Sun feels closer because of the warmth we can feel on Earth. Most of the stars, like the Sun, are millions of miles away. The light of many stars, including the Sun, takes a long time to reach the Earth. The time is based on their distance from the Earth. The farthest star you can see in the night sky is V762 in the constellation Cassiopeia at 16,308 light-years away (or 9.58686 x 1016 miles). The Sun you see now is about eight minutes old because that is how long it takes for the Sun's light to reach the Earth. The closest stars to Earth are Alpha Centauri A and B, which are 4.22 light-years away (2.4808 x 1013 miles).

The Solar System

Our **solar system** is the part of our galaxy which revolves around the Sun. The Sun is the center of our solar system. The objects in our solar system **revolve** (move) around the Sun. The Sun's gravitational force keeps the planets revolving in a regular pattern. This **gravitational force** is the attraction that any object of mass has for other objects. The Sun's huge mass gives it a tremendous gravitational force. The force of gravity has a significant impact on many aspects of the solar system.

Each object in the solar system uniquely revolves around the Sun. Their paths are called **orbits**. The shape of an orbit depends on the size of the object. The orbit of a planet is slightly oval (almost circular). Other objects in the solar system have elliptical orbits.

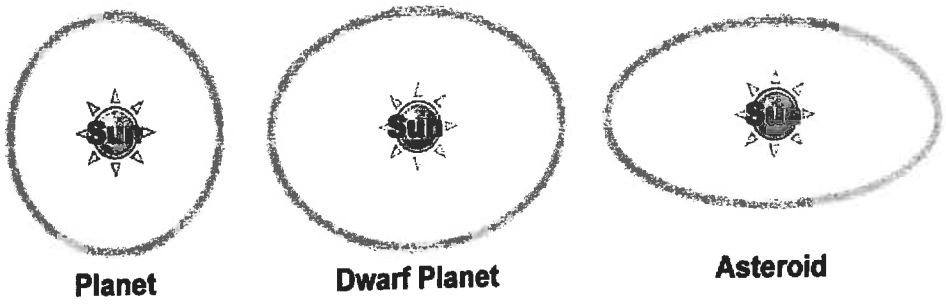

Figure 1.2 The Orbit of Objects around the Sun

Planets and Other Objects

The largest objects in the solar system are **planets**. Objects are called planets when they have enough mass to have gravity. The force of gravity makes a planet rounder over many millions of years. **Dwarf planets** are much smaller than other planets in the solar system. Their gravitational force is also lower. This means they are less round than familiar planets like Earth and Mars. In 2008, scientists developed a new category for objects in the solar system, **plutoids**. This category is based on planetary shape and orbit. Plutoids must be round. They must also revolve around the Sun in orbit beyond Neptune. Pluto and Eris are now considered plutoids.

The planets in our solar system are shown in Figure 1.3.

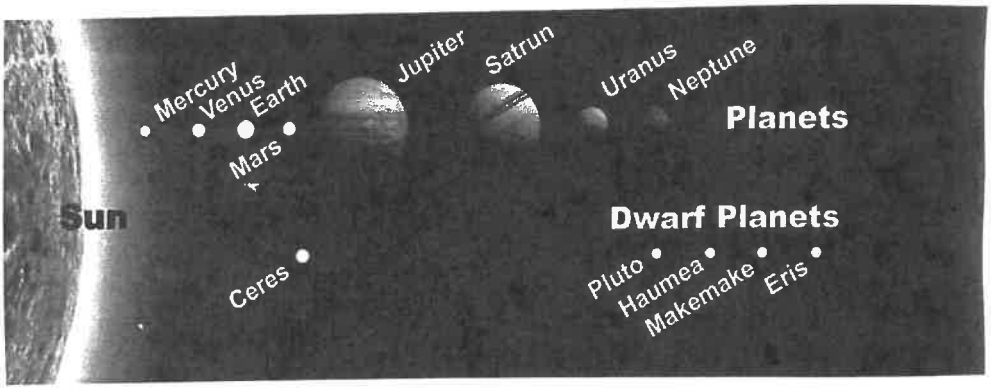

Figure 1.3 The Solar System

Looking at this figure, you should notice three important things:

1. **The Sun is much larger than anything else in our solar system**. It has the most mass. This mass means it has the largest amount of gravitational pull in the solar system. The result is that everything in our solar system revolves around it.
2. **Our solar system has eight planets**. Pluto and Eris are plutoids. Ceres is a unique object and may be the only one of its kind.
3. **The first four planets are much smaller than the last four planets**. The first four planets called **terrestrial planets** (Mercury, Venus, Earth, and Mars) make up the inner planets. The outer planets are called **Jovian planets** or **Gas Giants** (Jupiter, Saturn, Uranus, and Neptune).

Class Discussion

Science changes a lot. There are many times when scientists do not agree. This is part of the nature of science. Many scientists disagree over what to call Pluto. When Pluto was discovered in the 1930s, it was called a planet. Then it was called a dwarf planet. Now, it is called a plutoid.

In small groups, discuss what you think Pluto should be called. Why do you think scientists need to change the classification of objects in the solar system? What factors might scientists use to classify objects? What role do scientific instruments (like telescopes and probes) play in the classification of objects in our solar system?

Science Journal

Objective: Use Figure 1.3 to make a model of the solar system. Be sure your model correctly shows the size and location of the twelve recognized objects in our solar system. You can use objects like marbles, Ping-Pong balls, tennis balls, pasta, foam, or wads of paper for your model.

The Motion of Stars vs. Planets

Because stars are very far from Earth, their movements are not noticeable to us on Earth. The stars appear to remain in the same positions relative to each other. You can think of the stars as a background of lights in the night sky. The planets can be seen moving against the backdrop of stars. The stars will also "move" in constellations, but more slowly.

Planets cannot be seen at the same time each night or even all the time. Each planet moves at a different speed. Whether they can be seen depends on where they and the Earth are in their orbits. If you look at the night sky for several nights, you should be able to spot a planet by its movement. Because the planet is close to Earth, it appears to move very fast. It changes its position in the sky each night.

Look at Figure 1.4. This picture shows the motion of Mars from 6/15/05 to 3/15/06. You can see how it moves while the constellations (Pisces, Cetus, Taurus, and Perseus) remain in place for that short period.

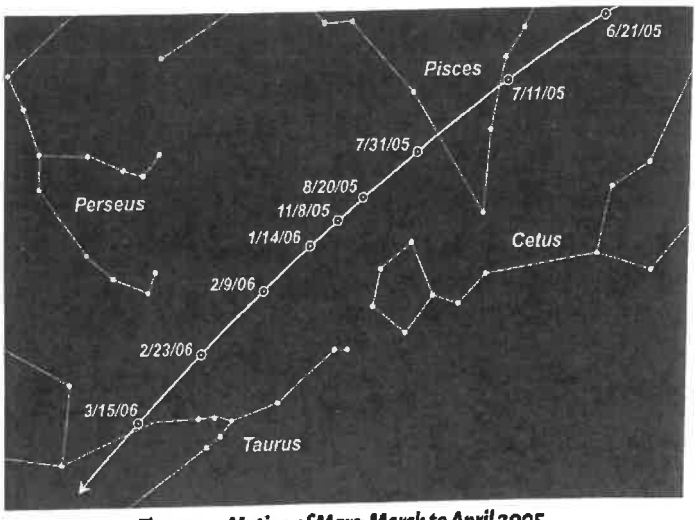

Figure 1.4 Motion of Mars, March to April 2005

The **North Star** marks true north in the Northern Hemisphere (the northern half of the planet). Each night, the entire sky can be seen rotating around the North Star. The North Star, also called **Polaris**, is almost directly overhead if you are standing anywhere in the Northern Hemisphere. People in the Southern Hemisphere cannot see the North Star.

Galaxies and Constellations

A **galaxy** is a vast system of stars. The shape of a galaxy results from the location of the stars. Stars are not spaced evenly, so the shape of a galaxy can be a little strange. Most of the stars visible in the night sky are located in other galaxies.

Our galaxy is the **Milky Way Galaxy**. It is a flattened disk of billions of stars. Our Sun is just one of those stars. It is located on an outer arm of the galaxy.

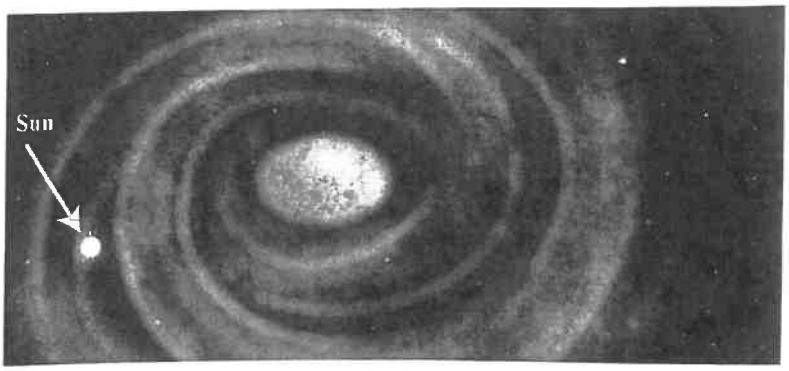

Figure 1.5 Milky Way Galaxy

We can see our galaxy from Earth. It looks like a milky band of stars in the night sky. This band divides the night sky in half. All the other stars that we see are from different galaxies very far away.

We built our first map of the stars using just our eyes. These maps were of the constellations. A constellation is a group of stars that form an imaginary shape. For example, the constellation Leo is named for the shape of a lion. The North Star is part of the constellation is called "the Little Dipper."

As the entire sky appears to move each night, constellations appear to move with it. That means the night sky looks different from month to month. The constellations can be seen for a few months at a time. They move in a predictable pattern across the sky. The position of stars relative to each other stays the same, so when it is visible, a constellation can always be recognized. In other words, the shapes of the constellations never change. Ancient people used the constellations to measure time, so they knew when to plant crops and when to harvest. For example, when the constellation Orion became visible in northern regions, they knew winter was coming. Early sailors used constellations for navigation. Because they sailed close to shore, they measured the height of constellations from the horizon (where the land or sea meets the sky). Out on the ocean, Christopher Columbus experimented with using constellations to navigate.

Science Journal

Objective: Observe the difference between planets and constellations in the night sky.

Notes: Summarize what you know about planets and constellations.

Data: With an adult, find a constellation in the sky in the early evening. Try to find a planet. Then look for them again a few hours later. Write the time of each observation and its location in your journal. Draw your own "map" of the night sky.

Summary: Describe how the constellation and the planet moved.

Practice 1: Our Solar System

1. What is the distance between the Sun and the Earth?
   - **A** 88 million miles
   - **B** 92.96 million miles
   - **C** 100.98 million miles
   - **D** 72.87 million miles

2. What keeps the planets revolving around the Sun?
   - **A** magnetic fields
   - **B** the Sun's polarity
   - **C** gravitational force
   - **D** the moons of each planet

3. Explain why the Sun feels closer to Earth even when it's millions of miles away.

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4. Which phrase best describes the Milky Way?
   - **A** a round disk of stars
   - **B** a vortex of stars
   - **C** a black hole of stars
   - **D** a flattened disk of stars

5. Describe the difference between a plutoid and a dwarf planet.

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6. Which of the following is not a terrestrial planet?
   - **A** Mars
   - **B** Neptune
   - **C** Venus
   - **D** Mercury

Essential Questions:

- What are the moon's phases?
- What causes day and night?
- What happens during a lunar eclipse?

The Moon's and Earth's Rotation

Phases of the moon

Most of the planets in our solar system have moons. **Moons** are smaller objects that revolve around a planet. Moons revolve around the planet to which they are closest. They are smaller than their planet.