The Solar System

The Sun and everything that orbits it make up the solar system. The solar system formed 4.6 billion years ago from a cloud of gas and dust. As gravity pulled the cloud together, the cloud became smaller and hotter and began to spin. In the center of the cloud, where the gas was hottest and densest, a star formed—the Sun.

At first, the solar system was shaped like a ball. As it rotated, gravity caused it to flatten into a disk. Gravity also caused leftover gas and dust from the solar system’s formation to clump together and form small, rocky or icy bodies. These bodies merged and formed planets and other objects.

Except for the Sun, planets are the largest objects in the solar system. A planet orbits the Sun, is massive enough to be nearly spherical in shape, and has no other large object in its orbital path. All eight planets revolve in the same direction. The closer a planet is to the Sun, the faster it revolves. Mercury orbits the Sun once every 88 Earth days. The planet farthest from the Sun, Neptune, orbits the Sun once every 165 Earth years.

Recall that Earth orbits the Sun at a distance of 1 AU. Neptune is 30 times farther from the Sun. But the Sun’s gravitational pull extends far beyond Neptune. Billions of small, icy objects orbit the Sun at a distance of 50,000 AU.
Objects in the Solar System

The solar system contains many different objects. These objects include planets as well as other objects that are too small to be classified as planets.

Planets and Dwarf Planets Recall that planets are massive objects that do not have other objects of similar size in their orbital paths around the Sun. Some spherical objects that orbit the Sun are similar to planets but are not massive enough to be planets. Some of these are dwarf planets. Dwarf planets orbit the Sun and are nearly spherical in shape, but they share their orbital paths with other objects of similar size. Pluto was once considered a planet but is now classified as a dwarf planet.

Other Solar System Bodies Not all spherical bodies in the solar system are planets. Many moons are massive enough to be spherical. A moon is a natural satellite that orbits an object other than a star. Some asteroids also are spherical. Asteroids are small, rocky objects that orbit the Sun. Most known asteroids are in the asteroid belt located between the orbits of Mars and Jupiter. Comets are small, rocky, icy objects that orbit the Sun. As comets move nearer to the Sun, the ice melts and the water forms a “tail” behind the comet. The orbital paths of comets extend to the outer solar system, beyond Neptune. Meteoroids are small, rocky particles that move through space. When a meteoroid enters Earth’s atmosphere, it produces a streak of light and is called a meteor. A meteoroid becomes a meteorite only if it impacts Earth. Objects in the solar system are shown in the art of the solar system on the next two pages.

Inner Planets

The center of the solar system was very hot when it formed. Gases and materials with low boiling points escaped from the area closest to the Sun. The four inner planets, also called the rocky planets, formed from the rocks and the heavy elements, including metals, left behind. The cores of the inner planets are mostly iron. The inner planets are the smallest planets. They have few or no moons, no rings, and they rotate more slowly than the outer planets. Refer to the art of the solar system as you read about the inner planets.

Mercury At 0.39 AU from the Sun, Mercury is the planet closest to the Sun. It is also the smallest planet. It is only about one-third the diameter of Earth. Mercury rotates slowly. As its surface heats and cools during its long day, temperatures can vary by as much as 500°C. Mercury has almost no atmosphere. Its gray surface has many impact craters and resembles Earth’s moon.
Venus

Venus is 0.72 AU from the Sun. As you can see in the figure above, it is almost the same size as Earth. It also has nearly the same makeup as Earth. Venus has the slowest rotation of any planet. One day on Venus is equal to 244 Earth days. Its heavy layer of clouds and thick carbon-dioxide atmosphere trap energy from the Sun. This makes Venus the hottest planet. Scientists hypothesize that some volcanoes on its surface might be active.
Earth is 1 AU from the Sun. Earth is the largest and densest of the inner planets. It is the only planet where life is known to exist. Earth is also the only planet with large amounts of liquid water on its surface. Earth's water and water vapor appear blue and white when viewed from space. Earth's atmosphere is 78 percent nitrogen and 21 percent oxygen.

Key Concept Check
5. Contrast How does Earth differ from other inner planets?
Mars  Half the size of Earth, Mars orbits at 1.5 AU from the Sun. Mars is too cold for liquid water to exist on the surface, although ice has been detected at the poles. Ice might exist below the surface of Mars. Liquid water probably flowed on Mars in the past. Rocks on Mars’s surface contain iron oxides, which give Mars a reddish color. High mountains on Mars are extinct volcanoes.

Outer Planets

The four outermost planets formed farther from the Sun than the inner planets did. As a result, they have more gases and other materials with low boiling points. They are often called the gas giants. They are larger than the inner planets, they rotate more quickly, and they each have rings. Except for Saturn’s rings, the rings are barely visible. Each outer planet also has many moons. Scientists suspect that each outer planet has a small, rocky core. These planets do not have solid surfaces. They have thick atmospheres of hydrogen and helium.

Jupiter
Though it is made mostly of hydrogen and helium, Jupiter contains more mass than the rest of the planets combined. Jupiter revolves around the Sun at a distance of 5 AU. It has the fastest rotation of any planet—a day lasts just 10 Earth hours. Jupiter’s clouds swirl with various colors because they contain small amounts of sulfur and phosphorus. Jupiter has strong weather systems.

Saturn
At 9.5 AU from the Sun, Saturn is nearly twice as far from the Sun as Jupiter, but its makeup is similar. Saturn is the second-largest planet. It has thousands of thin rings made of billions of pieces of ice ranging in size from pebbles to boulders. Saturn’s clouds form bands and spots, but they are hard to see. Saturn’s hazy upper atmosphere hides its colorful lower layers.

Uranus
This planet orbits the Sun at a distance of nearly 20 AU. Uranus is tilted so much that its axis sometimes points directly toward the Sun. It is a bluish-green color because of the small amount of methane in its atmosphere. Scientists think that a layer of icy liquid water, ammonia, and other compounds lies deep below Uranus’s thick atmosphere.

Neptune
At 30 AU, Neptune is so far away that it cannot be seen from Earth without a telescope. Neptune’s makeup is similar to that of Uranus, although it has more methane in its atmosphere and is deeper blue. Neptune has the fastest winds of any planet, recorded at over 1,100 km/h. The spots on its surface are hurricane-like storms, which do not last long.
**Mini Glossary**

- **asteroid:** a small, rocky object that orbits the Sun
- **comet:** a small, rocky, icy object that orbits the Sun
- **dwarf planet:** an object that orbits the Sun and is nearly spherical in shape but shares its orbital path with other objects of similar size
- **meteor:** a meteoroid that enters Earth’s atmosphere, producing a streak of light
- **meteoroid:** a small, rocky particle that moves through space
- **moon:** a natural satellite that orbits an object other than a star
- **planet:** an object that orbits the Sun, is massive enough to be nearly spherical in shape, and has no other large object in its orbital path

1. Review the terms and their definitions in the Mini Glossary. Write a sentence explaining why the outer planets do not have solid surfaces.

2. Write the name of each inner planet in the space provided based on its size and distance from the Sun. Also, record the distance of each planet from the Sun in astronomical units (AU).

[Diagram showing the relative sizes and distances of inner planets from the Sun]

**What do you think NOW?**

Reread the statements at the beginning of the lesson. Fill in the After column with an A if you agree with the statement or a D if you disagree. Did you change your mind?

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