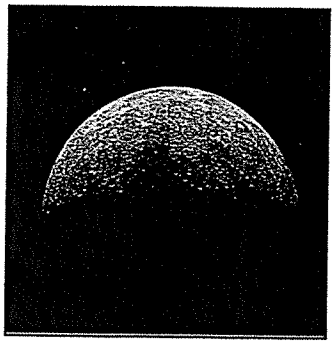
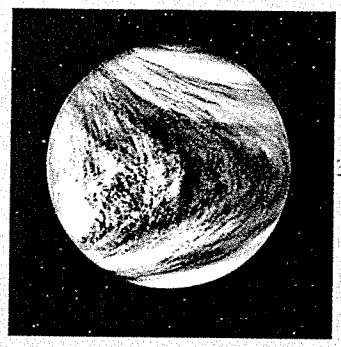
Table 3 Planets

Mercury



- closest to the Sun
- second-smallest planet
- surface has many craters and high cliffs
- no atmosphere
- temperatures range from 425°C during the day to −170°C at night
- has no moons

Venus

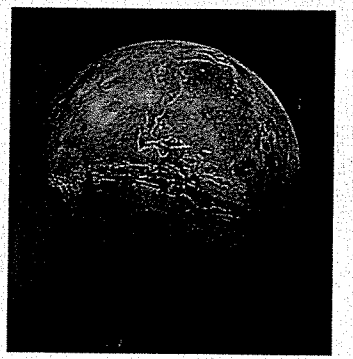


- similar to Earth in size and mass
- thick atmosphere made mostly of carbon dioxide
- droplets of sulfuric acid in atmosphere give clouds a yellowish color
- surface has craters, faultlike cracks, and volcanoes
- greenhouse effect causes surface temperatures of 450°C to 475°C
- has no moons

Earth

- atmosphere protects life
- surface temperatures allow water to exist as solid, liquid, and gas
- only planet where life is known to exist
- has one large moon

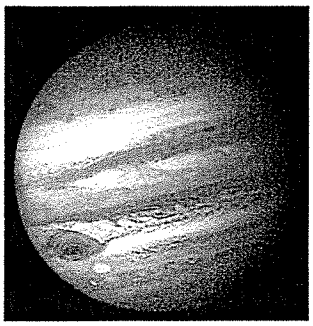
Mars



- surface appears reddish-yellow because of iron oxide in soil
- ice caps are made of frozen carbon dioxide and water
- channels indicate that water had flowed on the surface; has large volcanoes and valleys
- has a thin atmosphere composed mostly of carbon dioxide
- surface temperatures range from −125°C to 35°C
- huge dust storms often blanket the planet
- has two small moons

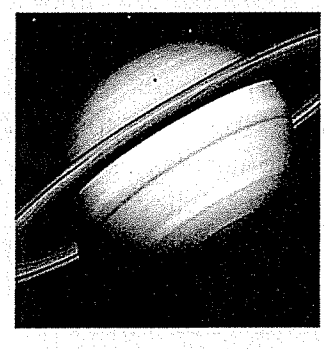
Table 3 Planets

Jupiter



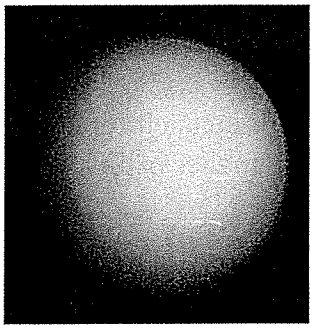
- largest planet
- has faint rings
- atmosphere is mostly hydrogen and helium; continuous storms swirl on the planet—the largest is the Great Red Spot
- has four large moons and at least 59 smaller moons; one of its moons, Io, has active volcanoes

Saturn



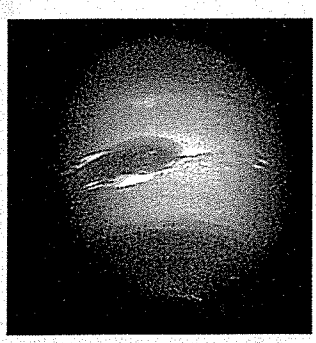
- second-largest planet
- thick atmosphere is mostly hydrogen and helium
- has a complex ring system
- has at least 47 moons—the largest, Titan, is larger than Mercury

Uranus



- large, gaseous planet with thin, dark rings
- atmosphere is hydrogen, helium, and methane
- axis of rotation is nearly parallel to plane of orbit
- has at least 27 moons

Neptune



- large, gaseous planet with rings that vary in thickness
- is sometimes farther from the Sun than Pluto is
- methane atmosphere causes its bluish-green color
- has dark-colored storms in atmosphere
- has at least 13 moons

section 4

Other Objects in the Solar System

as you read

What You'll Learn

- **Describe** how comets change when they approach the Sun.
- **Distinguish** among comets, meteoroids, and asteroids.
- **Explain** that objects from space sometimes impact Earth.

Why It's Important

Comets, asteroids, and most meteorites are very old. Scientists can learn about the early solar system by studying them.

Review Vocabulary

crater: a nearly circular depression in a planet, moon, or asteroid that formed when an object from space hit its surface

New Vocabulary

- comet
- meteor
- meteorite
- asteroid

Comets

The planets and their moons are the most noticeable members of the Sun's family, but many other objects also orbit the Sun. Comets, meteoroids, and asteroids are other important objects in the solar system.

You might have heard of Halley's comet. A **comet** is composed of dust and rock particles mixed with frozen water, methane, and ammonia. Halley's comet was last seen from Earth in 1986. English astronomer Edmund Halley realized that comet sightings that had taken place about every 76 years were really sightings of the same comet. This comet, which takes about 76 years to orbit the Sun, was named after him.

Oort Cloud Astronomer Jan Oort proposed the idea that billions of comets surround the solar system. This cloud of comets, called the Oort Cloud, is located beyond the orbit of Pluto. Oort suggested that the gravities of the Sun and nearby stars interact with comets in the Oort Cloud. Comets either escape from the solar system or get captured into smaller orbits.

Comet Hale-Bopp On July 23, 1995, two amateur astronomers made an exciting discovery. A new comet, Comet Hale-Bopp, was headed toward the Sun. Larger than most that approach the Sun, it was the brightest comet visible from Earth in 20 years. Shown in **Figure 17,** Comet Hale-Bopp was at its brightest in March and April 1997.

Figure 17 Comet Hale-Bopp was most visible in March and April 1997.

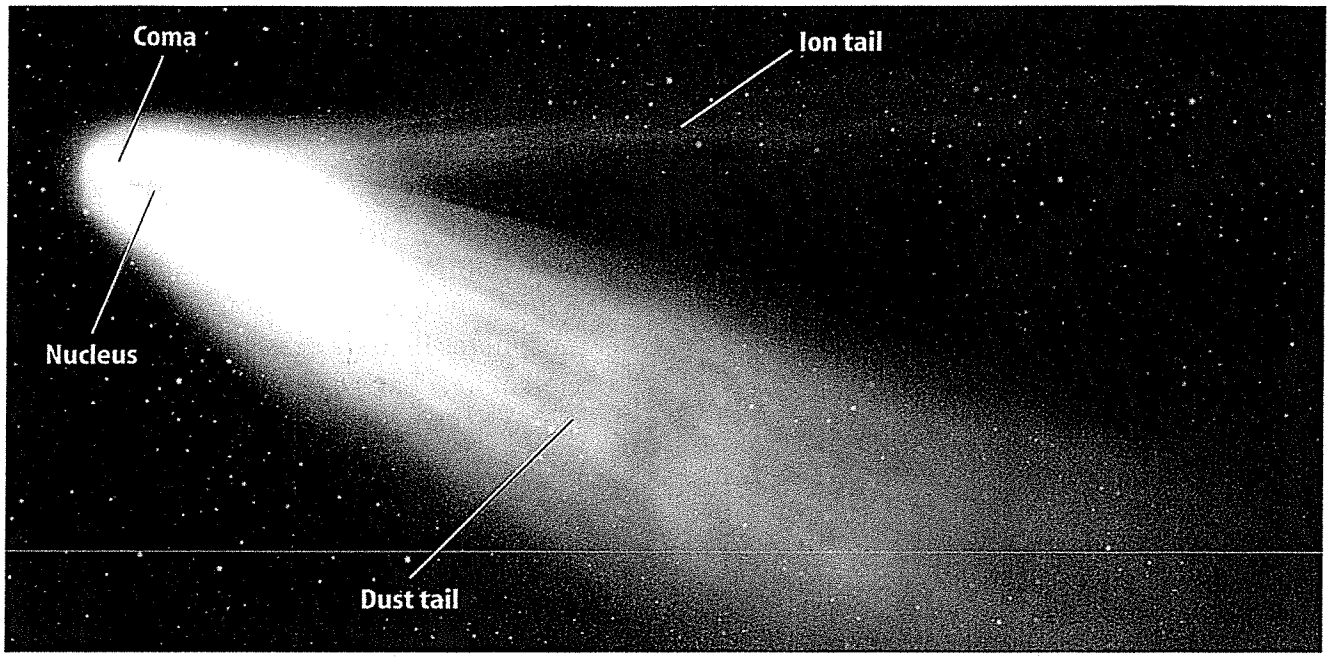


Figure 18 A comet consists of a nucleus, a coma, a dust tail, and an ion tail. Pictures of the comet Wild 2 from *Stardust* show that the comet has a rocky, cratered surface.

Structure of Comets The *Hubble Space Telescope* and spacecrafts such as the *International Cometary Explorer* have gathered information about comets. In 2006, a spacecraft called *Stardust* will return a capsule to Earth containing samples of dust from a comet's tail. Notice the structure of a comet shown in **Figure 18.** It is a mass of frozen ice and rock.

As a comet approaches the Sun, it changes. Ices of water, methane, and ammonia vaporize because of the heat from the Sun. This releases dust and jets of gas. The gases and released dust form a bright cloud called a coma around the nucleus, or solid part, of the comet. The solar wind pushes on the gases and dust in the coma, causing the particles to form separate tails that point away from the Sun.

After many trips around the Sun, most of the ice in a comet's nucleus has vaporized. All that's left are dust and rock, which are spread throughout the orbit of the original comet.

Meteoroids, Meteors, and Meteorites

You learned that comets vaporize and break up after they have passed close to the Sun many times. The small pieces from the comet's nucleus spread out into a loose group within the original orbit of the comet. These pieces of dust and rock, along with those derived from other sources, are called meteoroids.

Sometimes the path of a meteoroid crosses the position of Earth, and it enters Earth's atmosphere at speeds of 15 km/s to 70 km/s. Most meteoroids are so small that they completely burn up in Earth's atmosphere. A meteoroid that burns up in Earth's atmosphere is called a **meteor,** shown in **Figure 19.**

Figure 19 A meteoroid that burns up in Earth's atmosphere is called a meteor.

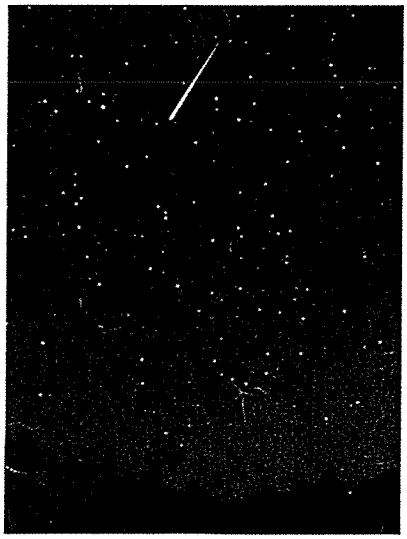


Figure 20 Meteorites occasionally strike Earth's surface. A large meteorite struck Arizona, forming a crater about 1.2 km in diameter and about 200 m deep.

Meteor Showers Each time Earth passes through the loose group of particles within the old orbit of a comet, many small particles of rock and dust enter the atmosphere. Because more meteors than usual are seen, the event is called a meteor shower.

When a meteoroid is large enough, it might not burn up completely in the atmosphere. If it strikes Earth, it is called a **meteorite.** Barringer Crater in Arizona, shown in **Figure 20,** was formed when a large meteorite struck Earth about 50,000 years ago. Most meteorites are probably debris from asteroid collisions or broken-up comets, but some originate from the Moon and Mars.

Reading Check *What is a meteorite?*

Asteroids

An **asteroid** is a piece of rock similar to the material that formed into the planets. Most asteroids are located in an area between the orbits of Mars and Jupiter called the asteroid belt. Find the asteroid belt in **Figure 21.** Why are they located there? The gravity of Jupiter might have kept a planet from forming in the area where the asteroid belt is located now.

Other asteroids are scattered throughout the solar system. They might have been thrown out of the belt by Jupiter's gravity. Some of these asteroids have orbits that cross Earth's orbit. Scientists monitor the positions of these asteroids. However, it is unlikely that an asteroid will hit Earth in the near future.

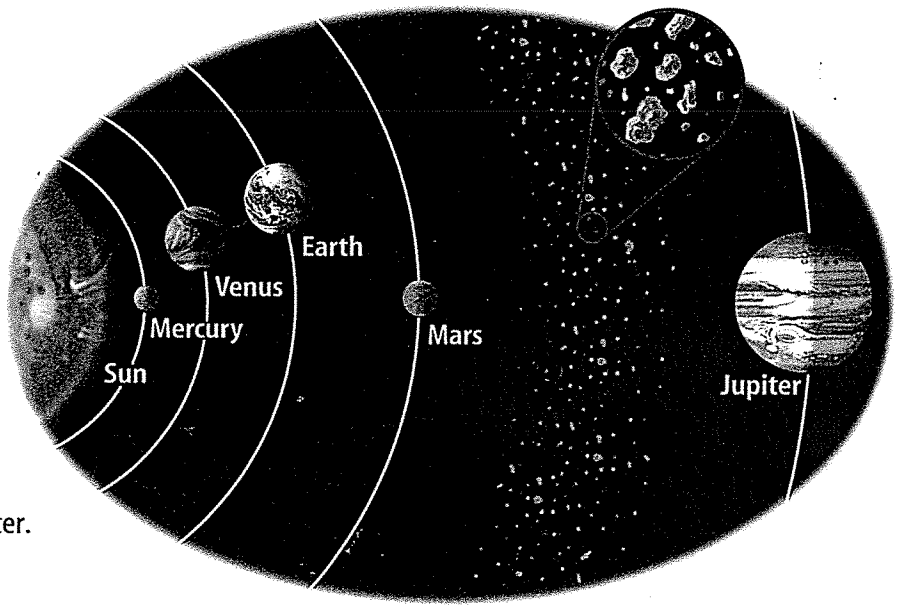


Figure 21 The asteroid belt lies between the orbits of Mars and Jupiter.

Asteroid Sizes The sizes of the asteroids in the asteroid belt range from tiny particles to objects 940 km in diameter. Ceres is the largest and the first one discovered. The next three in order of size are Vesta (530 km), Pallas (522 km), and 10 Hygiea (430 km). The asteroid Gaspra, shown in **Figure 22,** was photographed by *Galileo* on its way to Jupiter.

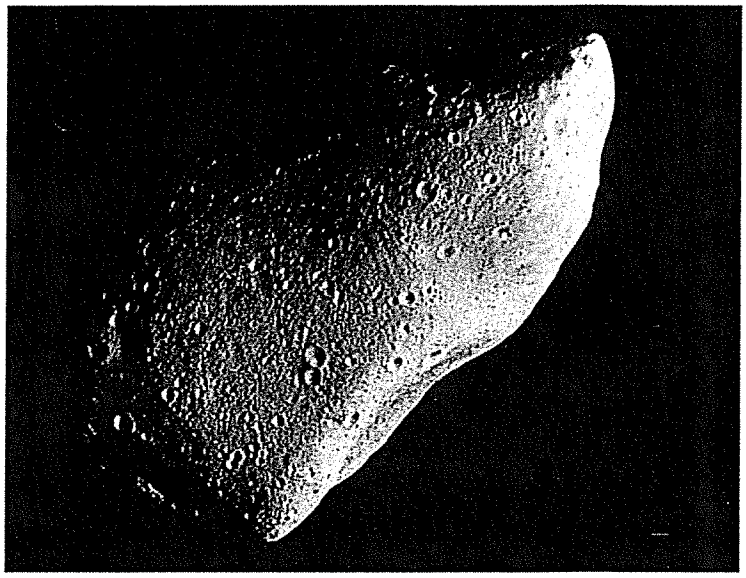


Figure 22 The asteroid Gaspra is about 20 km long.

Exploring Asteroids On February 14, 2000, the *Near Earth Asteroid Rendezvous (NEAR)* spacecraft went into orbit around the asteroid 433 Eros and later completed its one-year mission of gathering data. Data from the probe show that Eros has many craters and is similar to meteorites on Earth. The Japanese space probe *Hayabusa* arrived at the asteroid Itokawa in November 2005. Its mission is to collect samples and return them to Earth in a capsule in June 2010.

Comets, asteroids, and most meteorites formed early in the history of the solar system. Scientists study these space objects to learn what the solar system might have been like long ago. Understanding this could help scientists better understand how Earth formed.

section 4 review

Summary

Comets

- Comets consist of dust, rock, and different types of ice.
- The Oort Cloud was proposed as a source of comets in the solar system.

Meteoroids, Meteors, Meteorites

- When meteoroids burn up in the atmosphere, they are called meteors.
- Meteor showers occur when Earth crosses the orbital path of a comet.

Asteroids

- Many asteroids occur between the orbits of Mars and Jupiter. This region is called the asteroid belt.

Self Check

1. **Describe** how a comet changes when it comes close to the Sun.
2. **Explain** how craters form.
3. **Summarize** the differences between comets and asteroids.
4. **Describe** the mission of the *NEAR* space probe.
5. **Think Critically** A meteorite found in Antarctica is thought to have come from Mars. How could a rock from Mars get to Earth?

Applying Math

6. **Use Proportions** During the 2001 Leonid Meteor Shower, some people saw 20 meteors each minute. Assuming a constant rate, how many meteors did these people see in one hour?