

CHAPTER 16 Our Solar System

SECTION 2 The Inner Planets



California Science Standards

8.4.c, 8.4.e

BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- Which planets are known as the inner planets?
- What properties do the inner planets share?

STUDY TIP

Organize In your notebook, create a chart showing the similarities and differences among the inner planets.

READING CHECK

1. Explain Why are the inner planets called terrestrial planets?

READING CHECK

2. Explain Why did the atmosphere of Mercury boil away, while the other planets kept at least some of their original atmospheres?

Critical Thinking

3. Infer Which of the facts on the table can scientists use to infer that Mercury has a core made of iron?

Why Group the Inner Planets Together?

The inner solar system includes the only planet known to support life, Earth, and three other planets. These four inner planets are called **terrestrial planets** because they all have a makeup similar to that of Earth. The terrestrial planets are much smaller, denser, and more rocky than the outer planets. ✓

Which Planet Is Closest to the Sun?

Mercury is the planet closest to the sun. After Earth, it is the second densest object in the solar system. This is because, like Earth, Mercury has a large iron core in its center. The surface of Mercury is covered with craters.

The atmosphere of Mercury is very thin. Almost all of the gases that once made up its atmosphere have boiled off into space. This happened because it is so close to the sun. ✓

The amount of time that an object takes to rotate once is called the object's *period of rotation*. It is the length of a day on a planet. Mercury rotates on its axis much more slowly than Earth. Its day is about 59 Earth days long.

On Mercury, a year is not much longer than a day. Each planet revolves around the sun at a particular rate. The amount of time needed to go around the sun once is called the planet's *period of revolution*. It's the length of one year on the planet. A year on Mercury is equal to 88 Earth days. So each Mercurian year is only 1.5 Mercurian days long.

Mercury Statistics

Distance from sun	0.38 AU
Period of rotation	58 days, 19 h
Period of revolution	88 days
Diameter	4,879 km
Density	5.43 g/cm ³
Surface gravity	38% of Earth's

SECTION 2 The Inner Planets *continued***Is Venus Earth's Twin?**

The second planet from the sun is Venus. In some ways, Venus is more like Earth than any of the other planets. Venus is just slightly smaller, less dense, and less massive than Earth. In other ways, the planets are quite different.

If you could observe the sun from the surface of Venus, you would see it rise in the west and set in the east. That is because Venus and Earth rotate on their axes in opposite directions. The rotation of Earth is called **prograde rotation**. This means it spins in a counterclockwise direction if viewed from above its North Pole. When observed the same way, Venus spins clockwise, which is called **retrograde rotation**. ✓

THE ATMOSPHERE OF VENUS

Venus has the densest atmosphere of the terrestrial planets. On its surface, the atmospheric pressure of Venus is 90 times that of Earth's atmosphere. This pressure would instantly crush a human on Venus. The atmosphere is mostly made of carbon dioxide and thick clouds made of sulfuric acid. The thick atmosphere holds heat well, so the surface temperature on Venus averages 464°C, hot enough to melt lead and some other metals.

Venus Statistics

Distance from sun	0.72 AU
Period of rotation	243 days, 16 h
Period of revolution	224 days, 17 h
Diameter	12,104 km
Density	5.24 g/cm ³
Surface gravity	91% of Earth's

MAPPING THE SURFACE OF VENUS

The atmosphere of Venus reflects sunlight so well that Venus is sometimes the brightest object in the sky. Only the sun and moon are brighter.

Because of its thick atmosphere, the surface of Venus cannot be observed from Earth through telescopes. Between 1990 and 1992, the *Magellan* spacecraft made maps of Venus using radar waves. The waves can travel through the atmosphere and bounce off the surface. Maps made from the radar data showed that Venus has craters, mountains, lava plains, and volcanoes.

 **READING CHECK**

4. Compare How do prograde rotation and retrograde rotation differ?

TAKE A LOOK

5. Compare How does the length of a day on Venus compare with the length of its year?

Critical Thinking

6. Analyze Methods Why would scientists use *Magellan's* radar instead of telescopes to map the surface of Venus?

SECTION 2 The Inner Planets *continued***Where Do We Find Life?**

Until the 20th century, no one could know what Earth looked like from space. We can now look at a sparkling blue planet. The blue color comes from light reflected from the water of the oceans that cover much of Earth's surface. ✓

READING CHECK

7. Identify What feature of Earth causes it to appear blue from space?

Math Focus

8. Calculate Use the information on the table to explain why every fourth year is a leap year. Show your work.

A CONSTANTLY CHANGING PLANET

As far as we know, Earth is the only planet in the solar system that has the combination of factors needed to support life. These factors include abundant water and just the right amount of energy from the sun.

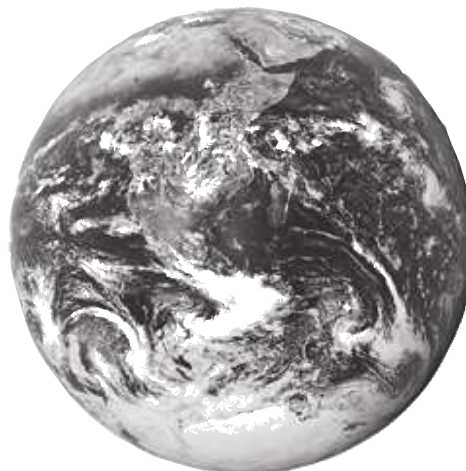
Earth is always changing. Landmasses are in slow, but constant, motion. These motions, along with weathering by wind and water, constantly reshape the surface of Earth.

Earth Statistics

Distance from sun	1.0 AU
Period of rotation	23 h, 56 min
Period of revolution	365 days, 6 h
Diameter	12,756 km
Density	5.52 g/cm ³
Surface gravity	100% of Earth's

STUDYING EARTH FROM SPACE

NASA's Earth Science Enterprise is a program to study Earth from space. Studying Earth from space lets scientists learn about Earth as a whole system. It helps them understand changes in Earth's atmosphere, oceans, ice, landforms, and living things. The study gives clues about how human activities affect everything on Earth.



This image of Earth was taken on December 7, 1972, by members of the crew of *Apollo 17* on their way to the moon.

SECTION 2 The Inner Planets *continued***What Is the Red Planet?**

Besides Earth, the most studied planet in the solar system is Mars. Mars has a red color and is known as the Red Planet. Many people believe that there could be life on Mars.

Scientists have learned much about Mars by observing it from Earth. However, most of our knowledge of the planet has come from unmanned spacecraft. So far, these observations have found no evidence of life.

THE ATMOSPHERE OF MARS

Because it has a thinner atmosphere than Earth and is farther from the sun, Mars is colder than Earth. In the middle of the summer, the spacecraft *Mars Pathfinder* recorded a temperature range from -13°C to -77°C . The Martian atmosphere is carbon dioxide.

The atmospheric pressure on Mars is very low. At the surface, it is about the same as the pressure 30 km above the surface of Earth. Because of low temperature and air pressure, liquid water cannot exist on the surface of Mars.

Mars Statistics

Distance from sun	1.52 AU
Period of rotation	24 h, 37 min
Period of revolution	687 days
Diameter	6,794 km
Density	3.93 g/cm^3
Surface gravity	38% of Earth's

WATER ON MARS

Even though water cannot exist on the surface of Mars today, it may have in the past. Evidence from spacecraft and surface studies of Mars suggests that some of its features were made by liquid water.

There are many places where surface features are similar to those caused by water erosion on Earth. Other features suggest the presence of sediments that may have been deposited by the water from a large lake.

Scientists cannot prove that these features were caused by liquid water. However, they indicate that at some time in the past, Mars may have had liquid water. If this is true, it would show that Mars was once warmer and had a thicker atmosphere than it does today.

**CALIFORNIA STANDARDS CHECK**

8.4.e Students know the appearance, general composition, relative position and size, and motion of objects in the solar system, including planets, planetary satellites, comets, and asteroids.

9. Identify What are two reasons that the surface of Mars is colder than that of Earth?

TAKE A LOOK

10. Compare How does the length of a day on Mars compare with the length of day on Earth?

**READING CHECK**

11. Identify What two Martian features suggest that water once existed on its surface?

SECTION 2 The Inner Planets *continued***THE WATER NOW**

Mars has two polar icecaps that are made of a combination of frozen water and frozen carbon dioxide. Most of the water on Mars is trapped in this ice. There is some evidence from the *Mars Global Surveyor* that water could exist just beneath the surface. If so, it may be there in liquid form. If Mars does have liquid water beneath its surface, there is a possibility that life may exist on Mars. ✓

READING CHECK

12. Identify Where does water exist on Mars today?

VOLCANOES ON MARS

There are the remains of giant volcanoes on the surface of Mars. They show that Mars has had active volcanoes in the past. Unlike Earth, however, the volcanoes are not spread across the whole planet. There are two large volcanic systems on Mars, one of which is about 8,000 km long.

The largest mountain in the solar system, Olympus Mons, is one of the Martian volcanoes. It is a shield volcano that is similar to Muana Kea on the island of Hawaii. However, Olympus Mons is nearly 24 km tall. That is three times as tall as Mount Everest! Its base is 600 km across. It may have grown so tall because the volcano erupted for long periods of time.

MISSIONS TO MARS

Several recent missions to Mars were launched to learn more about the Red Planet. The figure below shows *Mars Express Orbiter*, which reached Mars in December 2003. Since then, it has been investigating Mars from space, including searching for water. In January 2004, the exploration rovers *Spirit* and *Opportunity* landed on Mars. These solar-powered, wheeled robots have found evidence that water once existed on the Martian surface. ✓

READING CHECK

13. Describe What evidence have the rovers *Spirit* and *Opportunity* found?



The *Mars Express Orbiter* helps scientists map Mars and study its atmosphere.

Section 2 Review

SECTION VOCABULARY

<p>prograde rotation the counterclockwise spin of a planet or moon as seen from above the planet's North Pole; rotation in the same direction as the sun's rotation.</p> <p><u>Wordwise</u> The prefix <i>pro-</i> means "forward."</p>	<p>retrograde rotation the clockwise spin of a planet or moon as seen from above the planet's North Pole</p> <p>terrestrial planet one of the highly dense planets nearest to the sun: Mercury, Venus, Earth, and Mars</p>
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1. Compare How does retrograde rotation compare with the rotation of Earth?

2. Classify Fill in the blanks to complete the table.

Planet	Distance from sun	Period of rotation
	0.38 AU	58 days, 19 h
	0.72 AU	243 days, 16 h
	1.00 AU	365 days, 6 h
	1.52 AU	1 year, 322 days

3. Analyze Ideas Why do scientists think that Mars was once warmer and had a thicker atmosphere than it does today?

4. Identify Relationships How is the surface gravity of the terrestrial planets related to the type of atmosphere that they have? (Hint: Examine the statistics tables.)

5. Identify Relationships The diameter of Venus is almost the same as Earth's, and its surface gravity is less. Why is gravity lower on Venus than on Earth? (Hint: Examine the statistics tables for both planets.)
