Name _____ Class _____ Date _____

CHAPTER 21 A Family of Planets

SECTION 1

Our Solar System

BEFORE YOU READ

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

- What are the parts of our solar system?
- When were the planets discovered?
- How do astronomers measure large distances?

National Science Education Standards

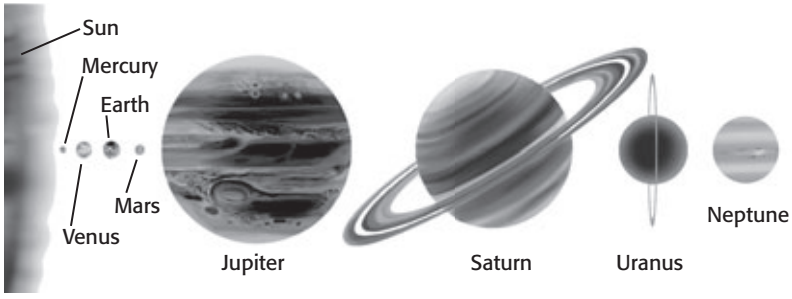
ES 1c, 3a, 3b, 3c

What Is Our Solar System?

Our *solar system* includes our sun, the planets, their moons, and many other objects. At the center of our solar system is a star that we call the sun. Planets and other smaller objects move around the sun. Most planets have one or more moons that move around them. In this way, our solar system is a combination of many smaller systems.

STUDY TIP

Describe As you read, make a chart showing the parts of our solar system that were discovered in the following time periods: before the 1600s; the 1700s; the 1800s; and the 1900s.



The planets and the sun are some of the objects in our solar system.

STANDARDS CHECK

ES 3a The earth is the third planet from the sun in a system that includes the moon, the sun, eight other planets and their moons, and smaller objects, such as asteroids and comets. The sun, an average star, is the central and largest body in the solar system. **Note:** In 2006, the International Astronomical Union ruled that Pluto is no longer considered to be a planet.

1. Identify List three kinds of objects that make up our solar system.

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How Was Our Solar System Discovered?

Until the 1600s, people thought that there were only eight bodies in our solar system. These were the sun, Earth's moon, and the planets Earth, Mercury, Venus, Mars, Jupiter, and Saturn. These are the only objects in the solar system that we can see from Earth without a telescope.

Once the telescope was invented, however, scientists were able to see many more bodies in our solar system. In the 17th century, scientists discovered some of the moons of Jupiter and Saturn. Uranus and several other moons were discovered in the 1700s. Neptune was discovered in the 1800s. Pluto was not discovered until the 1900s.

How Do Scientists Measure Long Distances?

Remember that astronomers use light-years to measure long distances in space. To measure distances within our solar system, astronomers use two other units: the astronomical unit and the light-minute.

One **astronomical unit** (AU) is the average distance between the sun and Earth. This distance is about 150,000,000 km. Earth is 1 AU from the sun. Neptune is about 30.1 AU from the sun. Therefore, Neptune is about $30.1 \times 150{,}000{,}000 \text{ km} = 4{,}500{,}000{,}000 \text{ km}$ from the sun.

Another way to measure distances in space is by using the speed of light. Light travels at about 300,000 km/s in space. In one minute, light travels about 18,000,000 km. Therefore, one *light-minute* is equal to about 18,000,000 km. Light from the sun takes 8.3 minutes to reach Earth. Therefore, Earth is 8.3 light-minutes from the sun.

Math Focus

2. Convert Scientists discover an asteroid that is 3 AU from the sun. How far, in kilometers, is the asteroid from the sun?

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Math Focus

3. Convert About how many light-minutes from the sun is Neptune?

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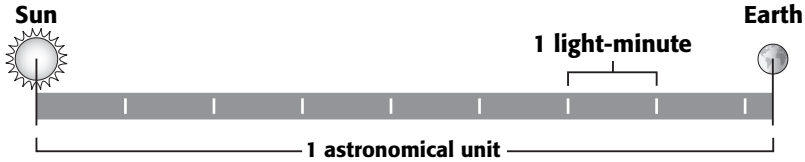


One astronomical unit equals about 8.3 light-minutes.

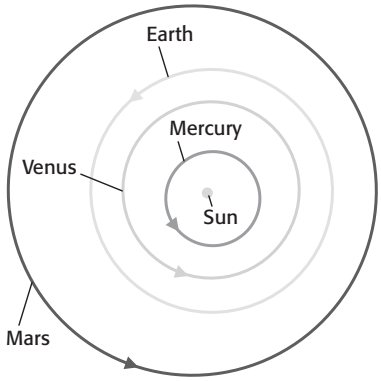
How Is Our Solar System Divided?

Astronomers divide our solar system into two main parts. These parts are called the *inner solar system* and the *outer solar system*.

THE INNER PLANETS

The inner solar system contains the four planets that are closest to the sun: Mercury, Venus, Earth, and Mars. The inner planets are also sometimes called the *terrestrial planets*. *Terrestrial* means "like Earth." Mercury, Venus, and Mars are like Earth because they have dense, rocky surfaces, as Earth does. The figure on the top of the next page shows the orbits of the inner planets.

The Inner Planets



TAKE A LOOK

4. Identify Which of the inner planets is closest to the sun?

_____

5. Identify Which of the inner planets is furthest from the sun?

_____

THE OUTER PLANETS

The outer solar system contains four planets: Jupiter, Saturn, Uranus, and Neptune. The outer planets are very different from the inner planets.

The outer planets are very large and are made mostly of gases. Therefore, Jupiter, Saturn, Uranus, and Neptune are sometimes called the *gas giant* planets, or simply the "gas giants."

The distances between the outer planets are much larger than the distances between the inner planets. For example, the distance between Jupiter and Saturn is much larger than the distance between Mars and Earth. The figure below shows the orbits of the outer planets.

Critical Thinking

6. Compare Give two differences between the inner solar system and the outer solar system.

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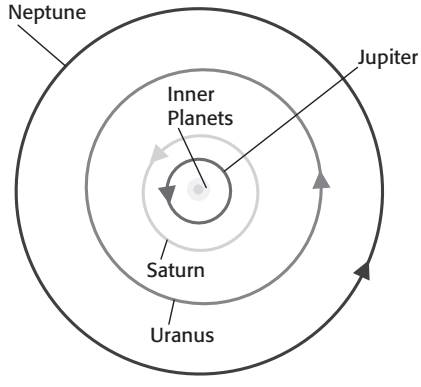
The Outer Planets



TAKE A LOOK

7. Identify What planet is farthest from the sun?

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Section 1 Review

NSES ES 1c, 3a, 3b, 3c

SECTION VOCABULARY

astronomical unit the average distance between the Earth and the sun; approximately 150 million kilometers (symbol, AU)	

1. **Calculate** Mercury is about 0.39 AU from the sun. About how many kilometers from the sun is Mercury? Show your work.

2. **Identify** Name the four planets in the inner solar system.

3. **Identify** Name the four gas giant planets.

4. **Infer** Scientists sometimes use light-hours to measure distances in our solar system. What is a light-hour? About how many kilometers make up one light-hour?

5. **Explain** Why do scientists use light-minutes and light-hours instead of light-years to measure distances within our solar system?

3. He made and analyzed observations of planetary motions.
4. The point closest to the sun should be labeled.
5. The farther a planet is from the sun, the longer its period of revolution.
6. Gravity pulls it toward the Earth.

Review

1. Rotation describes the motion of a body spinning on an axis. Revolution describes the motion of a body orbiting another body.
2. The speed at which a planet is moving in its orbit is different at different places in the orbit.
3. Mass of the objects: As mass increases, the force of gravity increases.

   Distance between the objects: As the separation increases, the force of gravity decreases.
4. inertia and gravity
5. The object would crash into the planet.
6. According to Kepler's third law, moon A will take longest to orbit because it is farthest away.

Chapter 21 A Family of Planets

SECTION 1 OUR SOLAR SYSTEM

1. planets, sun, moons
2. about 450 million km
3. about 250 light-minutes
4. Mercury
5. Mars
6. The planets in the outer solar system are, in general, larger and farther apart than those in the inner solar system.
7. Neptune

Review

1. about 58 million km
2. Mercury, Venus, Earth, Mars
3. Jupiter, Saturn, Uranus, Neptune
4. A light-hour is the distance light travels in an hour—about 1,080 million km.
5. Light-years are much longer than light-minutes or light-hours. Our solar system is too small to measure accurately in light-years.

SECTION 2 THE INNER PLANETS

1. They have a makeup similar to that of Earth.
2. density
3. The rotations are in opposite directions when viewed from above the North Pole.
4. 1 day
5. The thick atmosphere prevents visual observations, even from space probes.
6. its oceans
7. Period of revolution is 6 h longer than 365 days.

   4×6 h $= 24$ h, or 1 day
8. Mars has a thinner atmosphere, and it is farther from the sun.
9. A Martian day is longer than an Earth day.
10. erosion and sediments
11. at the poles and possibly below the surface
12. It may have erupted over long periods of time.
13. evidence that water once existed on the Martian surface

Review

1. prograde
2.

Planet	Distance from sun (AU)	Period of revolution
Mercury	0.38	58 Earth days, 19 h
Venus	0.72	243 Earth days, 16 h
Earth	1.00	365 Earth days, 6 h
Mars	1.52	687 Earth days

3. Features on the surface show that there may have been erosion or sedimentation like that caused by water on Earth. For liquid water to exist, there would have to be a warmer surface and a thicker atmosphere than there are now.
4. Planets that are farther from the sun take longer to orbit the sun.
5. Venus has a thicker atmosphere and a stronger greenhouse effect, making it hotter than the other inner planets.
6. If the Earth were too close to the sun, liquid water would boil away.

SECTION 3 THE OUTER PLANETS

1. Four of the following: hydrogen, helium, ammonia, methane, water
2. its period of rotation
3. about 29 times
4. ice, dust
5. It does not reflect enough light.