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

• Why do we use space probes to visit other planets?
• What kinds of information can space probes gather?

What Are Space Probes?

What does the surface of Mars look like? Does life exist anywhere else in the solar system? To answer questions like these, scientists send space probes through the solar system. A space probe is a vehicle that carries scientific instruments into outer space, but has no people on board. Space probes visit planets or other bodies in space. They can complete missions that would be too dangerous or expensive for humans to carry out.

LUNA AND CLEMENTINE

*Luna 1*, the first space probe, was launched by the Soviet Union in 1959. It flew past the moon. In 1966, *Luna 9* made the first soft landing on the moon’s surface. In all, space probes from the United States and the Soviet Union have completed more than 30 lunar missions.

In 1994, the United States probe *Clementine* discovered that craters on the moon may contain water. The water may have been left from comet impacts. In 1998, the *Lunar Prospector* confirmed that frozen water exists on the moon. This ice would be valuable to a human colony on the moon.

**Critical Thinking**

1. Infer Why would frozen water on the moon be useful for a human colony there?

**TAKE A LOOK**

2. Identify What was the first spacecraft to land softly on the moon?
**VENERA 9: THE FIRST PROBE TO LAND ON VENUS**

The Soviet probe *Venera 9* was the first probe to land on Venus. It parachuted into Venus’s atmosphere and transmitted images of the surface to Earth. *Venera 9* found that the surface temperature and atmospheric pressure on Venus are much higher than on Earth.  

*Venera 9* and earlier missions to Venus showed that Venus has a severe greenhouse effect. Today, scientists study Venus’s atmosphere to learn about the effects of increased greenhouse gases in Earth’s atmosphere.

**THE MAGELLAN MISSION: MAPPING VENUS**

The United States launched the *Magellan* probe in 1989. This probe mapped 98% of the surface of Venus. The data were transmitted back to Earth. Computers used the data to produce three-dimensional images of the surface of Venus. The Magellan mission showed that Venus has surface features that are similar to Earth’s. Some of these features suggest that plate tectonics occurs there. Venus also has volcanoes.

**THE VIKING MISSIONS: EXPLORING MARS**

The United States sent a pair of probes called *Viking 1* and *Viking 2* to Mars in 1975. The surface of Mars is similar to the Earth’s surface. Therefore, one of the main goals of the Viking mission was to look for signs of life on Mars. The probes gathered soil and tested it for evidence of life. They did not find signs of life. However, they did discover that Mars was once much warmer and wetter than it is now.
THE MARS PATHFINDER MISSION: VISITING MARS

A NASA space probe, the *Mars Pathfinder*, visited the surface of Mars again in 1997. The goal of the Mars Pathfinder mission was to explore Mars more cheaply than the Viking missions. The probe sent back images of channels on the planet’s surface. The channels look like dry river valleys on Earth. These images suggest that running water may once have flowed on Mars.

The *Mars Pathfinder* probe took many photographs of the surface of Mars. These photographs showed many features on the surface of Mars. Some of the features, like those shown here, indicate that liquid water may once have flowed over Mars’ surface.

The *Mars Pathfinder* probe landed on Mars and sent out the *Sojourner* rover. The *Sojourner* traveled across the surface of Mars for almost three months, collecting data and recording images. The European Space Agency and NASA have more Mars missions planned in the near future.

**TAKE A LOOK**

6. **Explain** How do scientists know that liquid water may once have flowed on the surface of Mars?

7. **Identify** What did the *Sojourner* rover do?

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**Viking 2 (U.S.)**

*Launched:* September 1975  
*Purpose:* to search for life on the surface of Mars

**Mars Pathfinder (U.S.)**

*Launched:* December 1996  
*Purpose:* to use inexpensive technology to study the surface of Mars
How Can Space Probes Help Us Learn About the Outer Solar System?

Jupiter, Saturn, Uranus, and Neptune make up the outer solar system. These planets are very far away. Probes to these planets may take 10 years or more to complete their missions.

PIONEER AND VOYAGER: TO JUPITER AND BEYOND

The Pioneer 10 and Pioneer 11 space probes were the first to visit the outer planets. These probes sampled the solar wind— the flow of particles coming from the sun. The Pioneer probes also gathered a lot of data about the composition of Jupiter’s atmosphere. In 1983, Pioneer 10 became the first probe to travel past the orbit of Pluto.

The Voyager space probes were the first to detect Jupiter’s faint rings. Voyager 2 was the first probe to fly by the gas giants—Jupiter, Saturn, Uranus, and Neptune. Today, the Pioneer and Voyager probes are near the edge of the solar system. Some of them are still sending back data!

THE GALILEO MISSION

The Galileo probe arrived at Jupiter in 1995. It sent a smaller probe to measure the composition, density, temperature, and cloud structure in Jupiter’s atmosphere. Galileo gathered data about Jupiter’s magnetic properties and the geology of some of Jupiter’s moons. Galileo discovered that some of the moons have magnetic fields. It also found that one of the moons, Europa, may have an ocean of liquid water under its icy surface.

TAKE A LOOK

10. Infer How long did it take Pioneer 10 to travel from Earth to Pluto?

Pioneer 10 (U.S.)
Launched: March 1972
Purpose: to study Jupiter and the outer solar system

Galileo (U.S.)
Launched: October 1989
Purpose: to study Jupiter and its moons
THE CASSINI MISSION: EXPLORING SATURN’S MOONS
The Cassini space probe was launched in 1997 on a seven-year journey to Saturn. In 2005, it launched a small probe to examine the atmosphere of Titan, one of Saturn’s moons. Scientists think that Titan’s atmosphere is similar to the Earth’s early atmosphere. Therefore, studying Titan’s atmosphere may help scientists learn how Earth’s atmosphere formed and changed.

What Are Some More Recent Space Probes?
The early space probe missions were large and expensive. Probes such as Voyager 2 and Galileo took many years to develop. Today, NASA is trying to develop missions that are “faster, cheaper, and better.”

STARDUST: COMET DETECTIVE
The Stardust space probe was the first probe to focus only on a comet. The probe was launched in 1999 and arrived at the comet in 2004. It gathered samples of the comet’s dust tail and returned the samples to Earth in 2006.

DEEP SPACE 1: TESTING ION PROPULSION
Another new space probe project is the New Millennium program. The purpose of this program is to test new technologies that can be used in the future. Deep Space 1, launched in 1998, is the first mission of this program. The purpose of the Deep Space 1 mission is to test a new type of propulsion system. Deep Space 1 uses an ion-propulsion system. Ion-propulsion systems may help future space probes travel more quickly with less fuel.

Critical Thinking
11. Explain Why are scientists interested in the atmosphere of Titan?

Critical Thinking
12. Infer What was the purpose of the Stardust probe?

READING CHECK
13. Describe What is the purpose of the New Millennium program?
Section 3 Review

SECTION VOCABULARY

**space probe** an uncrewed vehicle that carries scientific instruments into space to collect scientific data

1. **Identify** What was the first space probe to fly past the moon?

2. **Describe** Complete the table below.

<table>
<thead>
<tr>
<th>Probe</th>
<th>Year of launch</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Venera 9</td>
<td></td>
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</tr>
<tr>
<td>Viking 2</td>
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<tr>
<td>Clementine</td>
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<tr>
<td>Deep Space 1</td>
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</tr>
</tbody>
</table>

3. **Describe** What did the Magellan probe discover?

4. **Explain** What was unique about the mission of the *Stardust* probe?

5. **Identify Relationships** How can missions to Venus and Titan help scientists learn about the Earth?
6. gathering images and data about an object from far away

SECTION 3 SPACE PROBES
1. If the colonists could use the ice for drinking water, they wouldn’t have to bring as much water with them.
2. Luna 9
3. Venera 9
4. 49/50
5. to record surface conditions on Venus
6. Images of the surface show features that look like those produced by running water on Earth.
7. traveled over the surface of Mars, collecting data and images
8. The outer solar system is very far away.
9. Voyager 2
10. 11 years
11. It may be similar to Earth’s early atmosphere, so it could give clues about how Earth’s atmosphere formed.
12. to study a comet and bring back samples of its dust tail
13. to test new technologies for future use

Review
1. Luna 1
2. | Probe     | Year of launch | Purpose                                           |
<table>
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<tr>
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<td>1994</td>
<td>to map the composition of the moon’s surface</td>
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<td>1972</td>
<td>to study Jupiter and the outer solar system</td>
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<td>1989</td>
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<td>to study the atmosphere of Titan</td>
</tr>
<tr>
<td>Deep Space 1</td>
<td>1998</td>
<td>to test ion propulsion</td>
</tr>
</tbody>
</table>
3. The geology on Venus is similar to geology on Earth.
4. It was the first probe to focus only on a comet.
5. Venus has an extreme greenhouse effect, so studying Venus may help scientists learn the effect of greenhouse gases on Earth. Titan’s atmosphere may be like Earth’s early atmosphere, so studying Titan may help scientists learn how Earth’s atmosphere has changed with time.

SECTION 4 PEOPLE IN SPACE
1. Yuri Gagarin
2. Yuri Gagarin: first person to orbit the Earth
   John Glenn: first American to orbit the Earth
   Neil Armstrong: first person to stand on a world other than the Earth
3. The orbiter’s inertia keeps it in orbit around the Earth.
4. orbiter
5. about 62 mi
6. U.S.S.R.
7. No. The ISS is being built in LEO, so it moves relative to the Earth’s surface.

Review
1. Space shuttles are reusable.
2. Neil Armstrong
3. orbiter, liquid-fuel tank, solid-fuel rocket boosters
4. orbiter, rocket boosters
5. smoke detectors, pacemakers, firefighting equipment, video game joysticks, cordless power tools
6. the first privately owned, reusable vehicle to carry a crew to an altitude of 100 km
7. Resources from space can be used on Earth. Space offers low gravity and vacuum environments for manufacturing.