

## Lesson 2

# The Inner PLANETS

### ESSENTIAL QUESTIONS



How are the inner planets similar?



Why is Venus hotter than Mercury?



What kind of atmospheres do the inner planets have?

### Vocabulary

terrestrial planet p. 59

greenhouse effect p. 61



Florida NGSS



## Launch Lab

20 minutes

### What affects the temperature on the inner planets?

Mercury and Venus are closer to the Sun than Earth. What determines the temperature on these planets? Let's find out.



Florida NGSS

**LA.8.2.2.3** The student will organize information to show understanding or relationships among facts, ideas, and events (e.g., representing key points within text through charting, mapping, paraphrasing, summarizing, or comparing/contrasting);

**MA.6.A.3.6** Construct and analyze tables, graphs, and equations to describe linear functions and other simple relations using both common language and algebraic notation.

**SC.8.E.5.1** Recognize that there are enormous distances between objects in space and apply our knowledge of light and space travel to understand this distance.

**SC.8.E.5.3** Distinguish the hierarchical relationships between planets and other astronomical bodies relative to solar system, galaxy, and universe, including distance, size, and composition.

**SC.8.E.5.7** Compare and contrast the properties of objects in the Solar System including the Sun, planets, and moons to those of Earth, such as gravitational force, distance from the Sun, speed, movement, temperature, and atmospheric conditions.

**SC.8.N.1.1** Define a problem from the eighth grade curriculum using appropriate reference materials to support scientific understanding, plan and carry out scientific investigations of various types, such as systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and

### Procedure

- 1 Read and complete a lab safety form.
- 2 Insert a **thermometer** into a **clear 2-L plastic bottle**. Wrap **modeling clay** around the lid to hold the thermometer in the center of the bottle. Form an airtight seal with the clay.
- 3 Rest the bottle against the side of a **shoe box** in direct sunlight. Lay a second **thermometer** on top of the box next to the bottle so that the bulbs are at about the same height. The thermometer bulb should not touch the box. Secure the thermometer in place using **tape**.
- 4 Read the thermometers and record the temperatures below.
- 5 Wait 15 minutes and then read and record the temperature on each thermometer.

### Data and Observations

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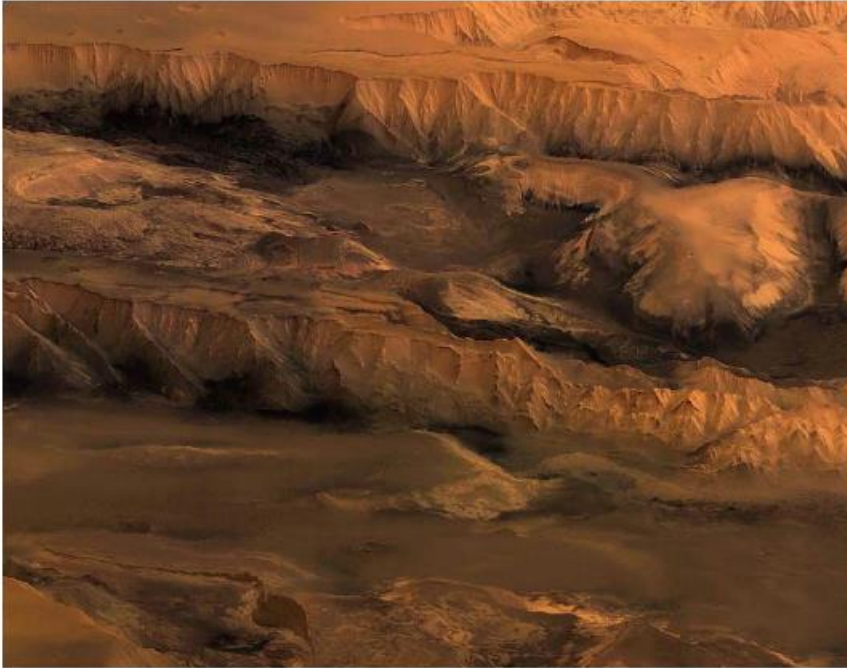
### Think About This

1. How did the temperature of the two thermometers compare?

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2.  **Key Concept** What do you think caused the difference in temperature?



### Inquiry Where is this?

1. This spectacular landscape is the surface of Mars, one of the inner planets. Other inner planets have similar rocky surfaces. Surprisingly, there are planets in the solar system that have no solid surface on which to stand. What can scientists learn by analyzing the appearance of a planet's surface?

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SUBMIT SHOW ANSWERS CLEAR

## Planets Made of Rock

Imagine that you are walking outside. How would you describe the ground? You might say it is dusty or grassy. If you live near a lake or an ocean, you might say sandy or wet. But beneath the ground or lake or ocean is a layer of solid rock.

The inner planets—Mercury, Venus, Earth, and Mars—are the planets closest to the Sun, as shown in **Figure 6**. *Earth and the other inner planets are also called the **terrestrial planets**.* Like Earth, the other inner planets also are made of rock and metallic materials and have a solid outer layer. Inner planets, however, have different sizes, atmospheres, and surfaces.

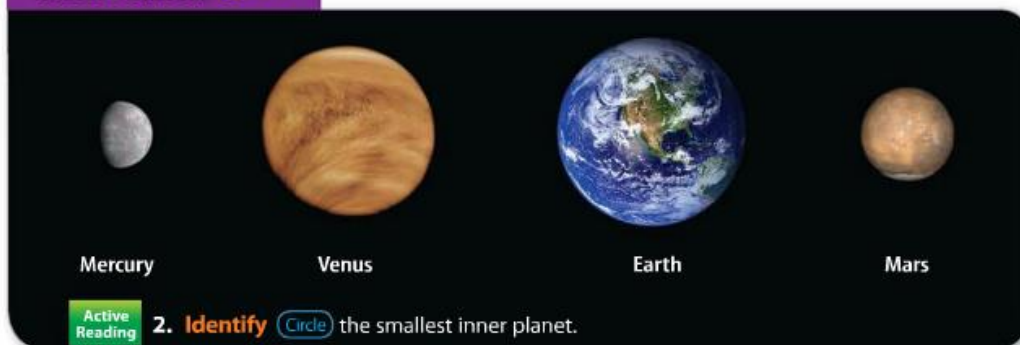
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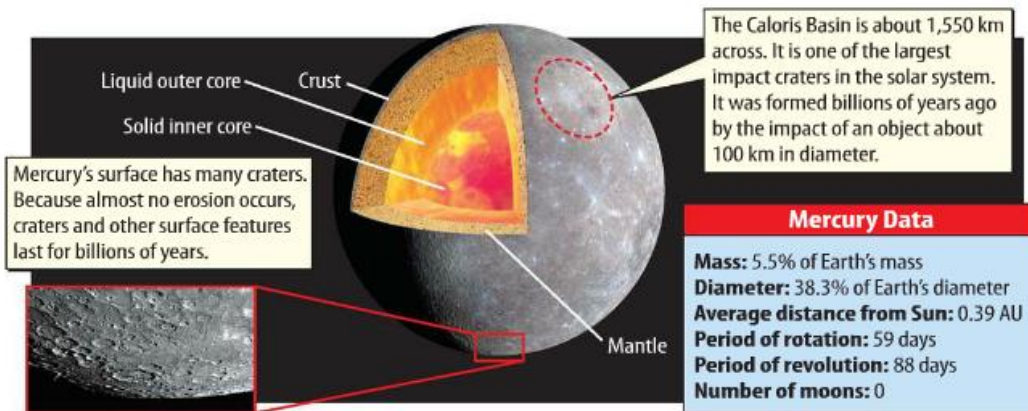
#### terrestrial

from Latin *terrestris*, means "earthly"

**Figure 6** The inner planets are roughly similar in size. Earth is about two and half times larger than Mercury. All inner planets have a solid outer layer.

### Inner Planets





**Figure 7** The *Messenger* space probe flew by Mercury in 2008 and photographed the planet's cratered surface.

**Active Reading** **3. Contrast** What is one difference between Mercury's inner and outer cores?

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## Mercury

The smallest planet and the planet closest to the Sun is Mercury, shown in **Figure 7**. Mercury has no atmosphere. A planet has an atmosphere when its gravity is strong enough to hold gases close to its surface. The strength of a planet's gravity depends on the planet's mass. Because Mercury's mass is so small, its gravity is not strong enough to hold onto an atmosphere. Without an atmosphere there is no wind that moves energy from place to place across the planet's surface. This results in temperatures as high as 450°C on the side of Mercury facing the Sun and as cold as -170°C on the side facing away from the Sun.

### Mercury's Surface

Impact craters cover the surface of Mercury. There are also smooth plains of solidified lava from long-ago eruptions. Long, high cliffs occur also. These might have formed when the planet cooled quickly, causing the surface to wrinkle and crack. Without an atmosphere, almost no erosion occurs on the surface. As a result, features that formed billions of years ago have changed very little.

### Mercury's Structure

The structures of the inner planets are similar. Like all inner planets, Mercury has a core made of iron and nickel. Surrounding the core is a layer called the mantle. It is mainly made of silicon and oxygen. The crust is a thin, rocky layer above the mantle. Mercury's large core might have been formed by a collision with a large object during Mercury's formation.

**4. NGSSS Check Compare** How are the inner planets similar? **SC.8.E.5.7**

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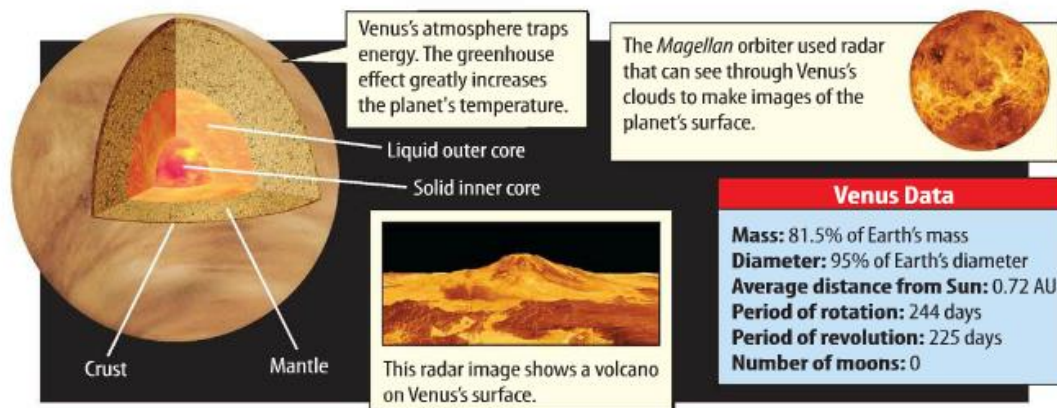


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**Active Reading** **FOLDABLES** LA.8.2.2.3

Make a four-door book. Label each door with the name of an inner planet. Use the book to organize your notes on the inner planets.





## Venus

The second planet from the Sun is Venus, as shown in **Figure 8**. It is about the same size as Earth. Venus spins so slowly that its period of rotation is longer than its period of revolution. This means that a day on Venus is longer than a year. Unlike most planets, Venus rotates from east to west. Several space probes have flown by or landed on Venus.

### Venus's Atmosphere

The atmosphere of Venus is about 97 percent carbon dioxide. It is so dense that the atmospheric pressure on Venus is about 90 times greater than on Earth. Even though Venus has almost no water in its atmosphere or on its surface, a thick layer of clouds covers the planet. Unlike the clouds of water vapor on Earth, the clouds on Venus are made of acid.

### The Greenhouse Effect on Venus

With an average temperature of about 460°C, Venus is the hottest planet in the solar system. The high temperatures are caused by the greenhouse effect. *The greenhouse effect occurs when a planet's atmosphere traps solar energy and causes the surface temperature to increase.* Carbon dioxide in Venus's atmosphere traps some of the solar energy that is absorbed and then emitted by the planet. This heats up the planet. Without the greenhouse effect, Venus would be almost 450°C cooler.

### Venus's Structure and Surface

Venus's internal structure, as shown in **Figure 8**, is similar to Earth's. Radar images show that more than 80 percent of Venus's surface is covered by solidified lava. Much of this lava might have been produced by volcanic eruptions that occurred about half a billion years ago.

**Figure 8** Because a thick layer of clouds covers Venus, its surface has not been seen. Between 1990 and 1994, the *Magellan* space probe mapped the surface using radar.

**Active Reading** **5. Relate** How does Venus's day compare to Venus's year?

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**6. NGSSS Check**  
**Explain** Why is Venus hotter than Mercury? **SC.8.E.5.7**

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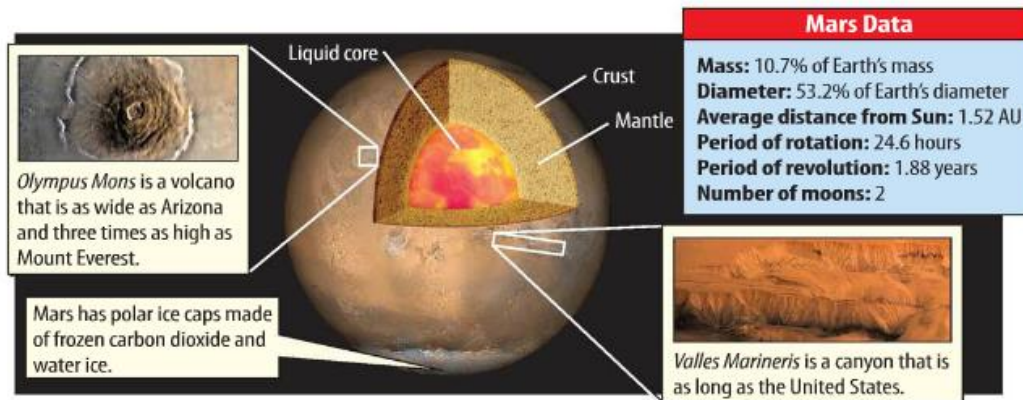


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## Mars

The fourth planet from the Sun is Mars, shown in **Figure 10**. Mars is about half the size of Earth. It has two very small and irregularly shaped moons. These moons might be asteroids that were captured by Mars's gravity.

Many space probes have visited Mars. Most of them have searched for signs of water that might indicate the presence of living organisms. Images of Mars show features that might have been made by water, such as the gullies in **Figure 11**. So far no evidence of liquid water or life has been found.

Click below.

abc

**Active Reading** 8. **Recall** Underline what scientists search for that may indicate life on another planet.

### Mars's Atmosphere

The atmosphere of Mars is about 95 percent carbon dioxide. It is thin and much less dense than Earth's atmosphere. Temperatures range from about  $-125^{\circ}\text{C}$  at the poles to about  $20^{\circ}\text{C}$  at the equator during a martian summer. Winds on Mars sometimes produce great dust storms that last for months.

### Mars's Surface

The reddish color of Mars is because its soil contains iron oxide, a compound in rust. Some of Mars's major surface features are shown in **Figure 10**. The enormous canyon Valles Marineris is about 4,000 km long. The martian volcano Olympus Mons is the largest known mountain in the solar system. Mars also has polar ice caps made of frozen carbon dioxide and ice.

The southern hemisphere of Mars is covered with craters. The northern hemisphere is smoother and appears to be covered by lava flows. Some scientists have proposed that the lava flows were caused by the impact of an object about 2,000 km in diameter.

**Figure 10** Mars is a small, rocky planet with deep canyons and tall mountains.

**9. NGSSS Check Summarize** Describe the atmosphere of each inner planet. **SC.8.E.5.7**

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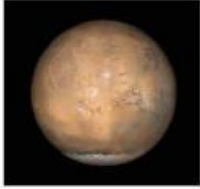
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**Figure 11** Gullies such as these might have been formed by the flow of liquid water.



## Lesson Review 2

### Visual Summary



The terrestrial planets include Mercury, Venus, Earth, and Mars.



The inner planets are made of rocks but have different characteristics. Earth is the only planet with liquid water.



The greenhouse effect increases the surface temperature of Venus.

**Inquiry**  SC.8.N.1.1  
SC.8.E.5.7

**OLAB STATION Try It!**

**Skill Lab** What can we learn about planets by graphing their characteristics? at [connectED.mcgraw-hill.com](http://connectED.mcgraw-hill.com)

### Use Vocabulary

- 1 **Define** *greenhouse effect* in your own words. **SC.8.E.5.7**

### Understand Key Concepts

- 2 **Explain** why Venus is hotter than Mercury, even though Mercury is closer to the Sun. **SC.8.E.5.7**

- 3 **Infer** Why could rovers be used to explore Mars, but not Venus?

- 4 Which of the inner planets has the greatest mass? **SC.8.E.5.7**

(A) Mercury (C) Earth  
(B) Venus (D) Mars

- 5 **Relate** Describe the relationship between an inner planet's distance from the Sun and its period of revolution. **SC.8.E.5.7**

- 6 **Compare and Contrast** Fill in the table below to compare and contrast properties of Venus and Earth. **SC.8.E.5.7**

Planet	Similarities	Differences
Venus		
Earth		

### Critical Thinking

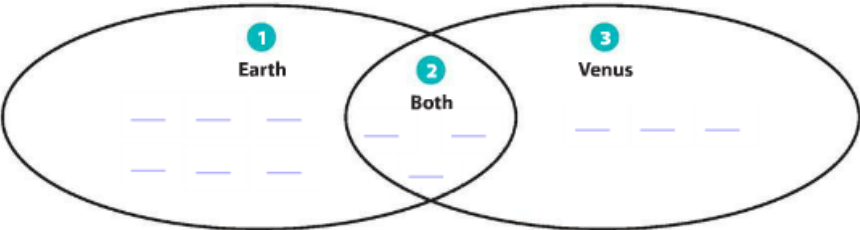
- 7 **Imagine** How might the temperatures on Mercury be different if it had the same mass as Earth? Explain.

- 8 **Judge** Do you think the inner planets should be explored or should the money be spent on other things? Justify your opinion.

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**Sort** facts about Earth and Venus. Place the number of each fact in the Venn diagram.

- 1. has a greenhouse effect
- 2. has extremely high temperatures
- 3. has water in its atmosphere
- 4. year is longer than day
- 5. atmosphere mostly carbon dioxide
- 6. rotates counter-clockwise
- 7. rotates clockwise
- 8. a terrestrial planet
- 9. an inner planet
- 10. has a moon
- 11. has water on its surface
- 12. can support life



**Summarize** information about the inner planets. Place a check mark in each box that applies to each planet.

	Mercury	Venus	Earth	Mars
Atmosphere				
Inner and outer core				
Liquid outer core				
Liquid core, only				
Solid inner core				
Atmosphere 90% CO <sub>2</sub>				
Cratered surface				
Liquid water on surface				
Ice on surface				
A moon or moons				
Mantle and crust				
Signs of volcanic action				

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