

Ch. 16

The Solar System ▪ Guided Reading and Study

Observing the Solar System (pp. 554–559)

This section describes the history of ideas about the solar system.

Use Target Reading Skills

Look at Figures 2 and 3 in your textbook, and write two questions about the visuals in the graphic organizer below. The first question is done for you. As you read, write the answers to your questions. Accept all logical answers.

Q. What is a geocentric model?
A. a model that shows Earth at the center of the revolving planets and stars
Q. What is a heliocentric model?
A. a model that shows Earth and the other planets revolving around the sun

Earth at the Center (p. 555)

1. What did the Romans name the points of light that the Greeks called planets?
Mercury, Venus, Mars, Jupiter, and Saturn

2. In a geocentric system, what is at the center of the universe?
Earth is at the center of the revolving planets and stars.

3. How was Ptolemy's model different from the earlier Greek model?
Ptolemy thought the planets moved on little circles that moved on bigger circles.

Observing the Solar System (continued)

Sun at the Center (pp. 556–557)

4. A description of the solar system in which all the planets revolve around the sun is called a(n) heliocentric system.
5. In the 1500s, who further developed the heliocentric explanation for the motion of the planets?
Copernicus
6. What were two observations that Galileo made through his telescope that supported the heliocentric model?
He saw four moons revolving around Jupiter, and he discovered that Venus goes through phases similar to the moon's phases.
7. Circle the letter next to the name of the person or group whose ideas about the solar system are largely accepted today.
a. Copernicus
b. the people of ancient Greece
c. Ptolemy
d. the Romans
8. What is an ellipse?
An ellipse is an oval shape, which may be elongated or nearly circular.

9. Complete the table below, which shows what each scientist contributed to our knowledge of the solar system.

Observer	Time	Accomplishment
Copernicus	a. Mid-1500s or 1543	Further developed heliocentric model; worked out arrangement of known planets
Brahe	Late 1500s	b. Observed the positions of the planets for more than 20 years
c. Galileo	d. Early 1600s	Used a telescope to make discoveries that supported the heliocentric model
Kepler	Early 1600s	e. Discovered that the orbit of each planet is an ellipse

f. Use the table to give examples of how the work of many scientists over time has led to our current understanding of the solar system.

Possible answer: The work of all the scientists supported the heliocentric theory. Kepler built on the work of Copernicus and Brahe to show that orbits are elliptical.

Modern Discoveries (pp. 558–559)

10. What does the solar system consist of?

The solar system consists of the sun, the planets and their moons, and smaller objects, such as comets and asteroids.

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The Sun (pp. 560–565)

This section describes the sun's interior and its atmosphere. It also describes features on and above the sun's surface.

Use Target Reading Skills

As you read about the sun, complete the outline to show the relationships among the headings.

The Sun

- I. The Sun's Interior
 - A. The Core
 - B. The Radiation Zone
 - C. The Convection Zone
- II. The Sun's Atmosphere
 - A. The Photosphere
 - B. The Chromosphere
 - C. The Corona
- III. Features of the Sun
 - A. Sunspots
 - B. Prominences
 - C. Solar Wind
 - D. Solar Flares

The Sun's Interior (p. 561)

- 1. The sun's energy comes from a process called nuclear fusion.

- 2. What occurs in nuclear fusion?
Hydrogen atoms join together to form helium atoms and produce energy.

- 3. Where does nuclear fusion occur in the sun?
It occurs in the sun's center, or core.

- 4. Order the layers of the sun's interior from inner layer to outer layer.
The layers in order are the core, the radiation zone, and the convection zone.

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The Sun's Atmosphere (p. 562)

5. Order the layers of the sun's atmosphere from inner layer to outer layer.
The layers in order are the photosphere, the chromosphere, and the corona.
6. Which layer do you see when you look at a typical image of the sun?
You see the photosphere.
7. How can you identify the chromosphere during a total solar eclipse?
You can identify it as a reddish glow visible just around the photosphere.
8. Why can you see a corona during a total solar eclipse?
The moon blocks light from the photosphere, so the corona becomes visible.
9. The corona sends out a stream of electrically charged particles called the
solar wind.

Features on the Sun (pp. 562–564)

10. Name three features on or above the sun's surface.
- a. _____ sunspots b. _____ prominences
- c. _____ solar flares

Match the feature on the sun with its description.

	Feature	Description
a	11. sunspots	a. Areas of gas on the sun's surface that are cooler than the gases around them
c	12. prominences	b. Large eruptions of gas out into space
b	13. solar flares	c. Reddish loops of gas that link different parts of sunspot regions

14. When solar flares increase solar wind from the corona, what do they cause in Earth's upper atmosphere? auroras, or magnetic storms

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The Inner Planets (pp. 566–573)

This section describes the main characteristics of the four planets closest to the sun.

Use Target Reading Skills

As you come to each major head in the section, stop and write what you know about that topic. As you read the passage, write what you learn. Accept all logical answers.

What You Know

1. Most of Earth is covered with water.
2. Mercury is the closest planet to the sun.
3. Venus is sometimes called the “evening star.”
4. Mars is called the “red planet.”

What You Learned

1. Earth is unique in our solar system in having liquid water at its surface.
2. Mercury has a greater temperature range than any of the other planets.
3. A day on Venus is longer than its year.
4. The reddish tinge on Mars is due to the breakdown of iron-rich rocks.

Introduction (p. 566)

1. Which planets are often called the terrestrial planets?
the four inner planets—Mercury, Venus, Earth, and Mars

2. What are three similarities among the inner planets?
They are small, dense, and have rocky surfaces.

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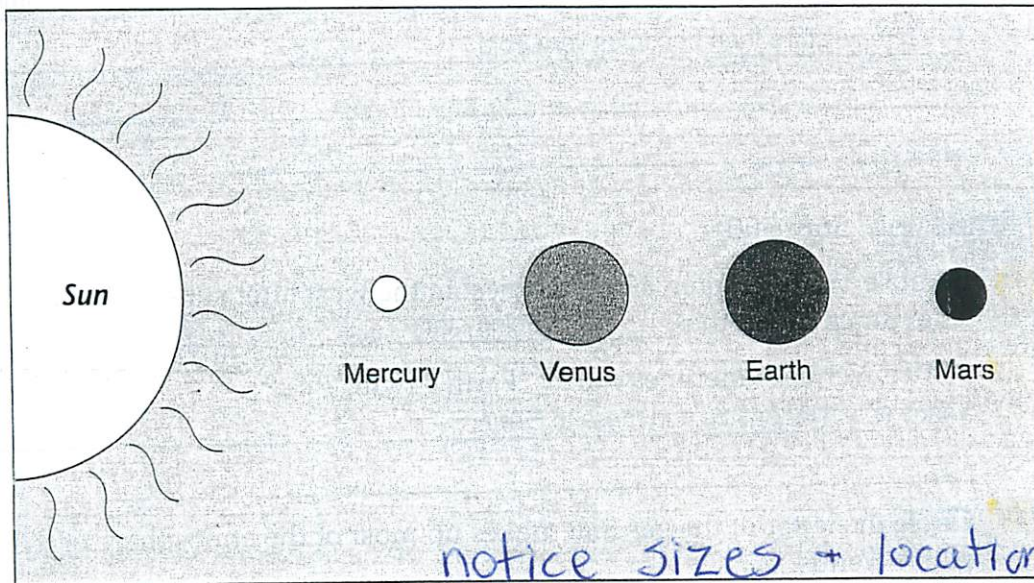
Use the table "The Inner Planets" in your textbook to answer questions 3 and 4.

- 3. Rank the inner planets according to diameter. Rank the planet with the greatest diameter as 1.

4 Mercury 2 Venus 1 Earth 3 Mars

- 4. Which planet rotates on its axis in about the same amount of time that Earth does? Mars

- 5. The drawing below shows the sun and the four inner planets. Label the inner planets according to their place in the solar system.



Earth (pp. 566–567)

- 6. Circle the letter of each sentence that is true about Earth.

- a. About 70 percent of its surface is covered with water.
- b. Its atmosphere extends about 1 kilometer above its surface.
- c. Most of the atmosphere is composed of oxygen gas.
- d. No other planet in the solar system has oceans like Earth's.

- 7. What are the three main layers of Earth?

a. _____ crust b. _____ mantle
 c. _____ core

- 8. What is Earth's dense inner core made of? mostly iron and nickel

The Inner Planets *(continued)*

Mercury (p. 568)

9. Circle the letter of each sentence that is true about Mercury.

a. Mercury's surface has many craters.

b. Mercury has no moons.

c. The interior of Mercury is composed mostly of the element mercury.

d. Mercury is the planet closest to the sun.

Mercury is the smallest inner planet.

10. Why does Mercury have a greater range of temperatures than any other planet?

It is so close to the sun that the side facing the sun gets very hot during the day. However, most of the heat escapes into space at night because Mercury has almost no atmosphere.

The temperature then becomes very cold.

Venus (pp. 568–569)

11. Because Venus is often a bright object in the west after sunset, it is sometimes called the _____ evening star.

12. Why is Venus sometimes called "Earth's twin"?

Venus is similar in size and mass to Earth.

13. Circle the letter of the gas that makes up most of the atmosphere of the planet Venus.

a. oxygen

b. nitrogen

c. sulfuric acid

d. carbon dioxide

14. How is the rotation of Venus different from that of most other planets and moons?

Venus rotates from east to west, the opposite of the other planets.

15. Is the following sentence true or false? The atmosphere of Venus is so thick that there is never a sunny day on its surface.

true

16. The trapping of heat by the atmosphere of Venus is called the _____.

greenhouse effect

Mars (pp. 570–571)

17. Why is Mars called the “red planet”?
It has a slightly reddish tinge.

Mars is smaller than Earth.

18. The atmosphere on Mars is composed mostly of
carbon dioxide.

Mars rotates on its axis every 25 hrs.

19. Is the following sentence true or false? There are no canals on Mars.
true

20. Why do some regions on Mars look darker than others?
Wind storms arise and blow the dust around on the surface of Mars. The darker regions are often where the dust has been blown away.

21. Circle the letter of each sentence that is true about Mars.

- a. The polar ice caps on Mars contain frozen water and carbon dioxide.
- b. Mars has seasons because it is tilted on its axis.
- c. Mars has many large oceans on its surface.
- d. Mars has giant volcanoes on its surface.

22. What are the two moons of Mars?

- a. Phobos
- b. Deimos

23. Complete the table to compare and contrast characteristics of Earth and Mars.

Characteristics of Earth and Mars		
Characteristic	Earth	Mars
Atmosphere	Mostly nitrogen and oxygen	a. Mostly carbon dioxide
Moons	One	b. Two
Seasons	c. Yes	Yes
Surface	Solid and rocky	d. Solid and rocky
Water	e. 70% water, or mostly water	At poles and possibly underground

f. Use the table to identify which characteristics of Mars make it difficult or impossible for humans to live there without life support.

Possible answers: Humans could not survive without life support in an atmosphere of mostly carbon dioxide. The scarcity of water might also cause problems.

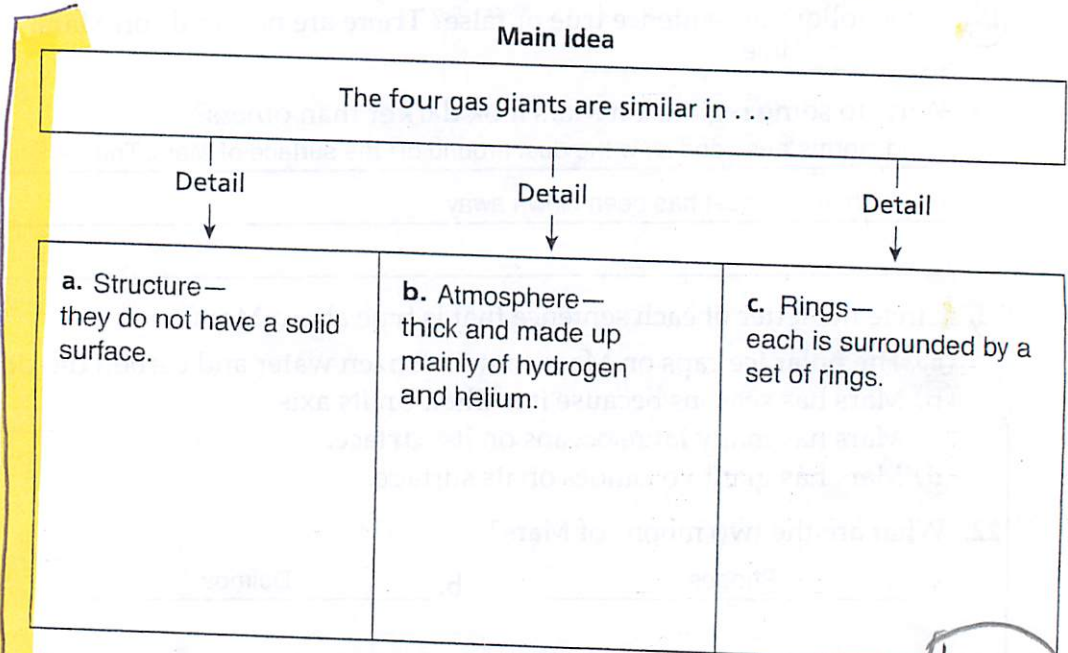
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The Outer Planets (pp. 574–581)

This section describes the main characteristics of the four planets farthest from the sun. It also explains how Pluto is different from planets.

Use Target Reading Skills

As you read about the similarities among the gas giants, fill in the detail boxes that explain the main idea in the graphic organizer below. Accept all logical answers.



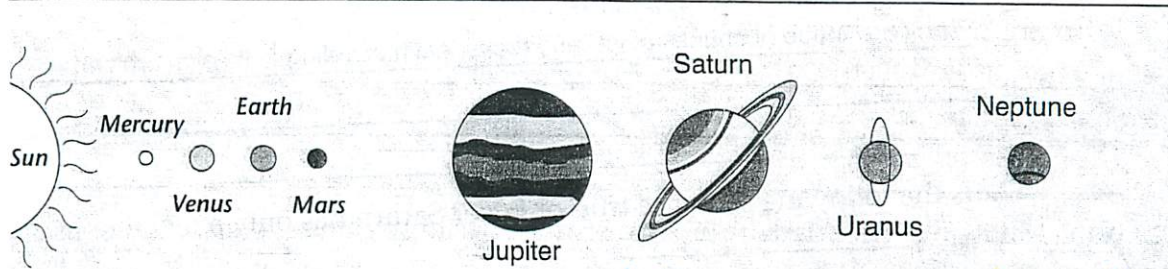
The gas giants are also alike in that they have many moons and the size and mass of each planet are much greater than those of Earth. large

Gas Giants and Pluto (p. 575)

1. The four outer planets do not have solid _____ surfaces.
2. Which four planets are known as the gas giants?
Jupiter, Saturn, Uranus, and Neptune
3. What is the composition of the gas giants?
Their atmospheres are composed mainly of hydrogen and helium.

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4. The drawing below shows the sun, the four inner planets, and the outer planets. Label the outer planets according to their typical place in the solar system.



Notice sizes + locations

5. Describe the composition of the rings that surround the gas giants.
 The rings are made of small particles of ice and rocks.

Jupiter (pp. 576–577)

6. Is the following sentence true or false? Jupiter is the most massive planet in the solar system. true
7. What is the Great Red Spot on Jupiter?
 The Great Red Spot is a storm that is larger than Earth and has winds that blow hundreds of kilometers per hour.
8. Circle the letter of each sentence that is true about Jupiter.
- a. Jupiter has a dense core of hydrogen and helium.
 - b. Jupiter's atmosphere is extremely thin.
 - c. Jupiter has dozens of moons revolving around it.
 - d. Many of Jupiter's moons have been discovered in recent years.
9. What are Jupiter's four largest moons?
- | | |
|--|--|
| a. <u> Io </u> | b. <u> Europa </u> |
| c. <u> Ganymede </u> | d. <u> Callisto </u> |
10. Jupiter's moon Io is covered with active volcanoes .

The Outer Planets *(continued)*

Saturn (p. 578)

11. What are Saturn's rings made of?
They are made of chunks of ice and rocks, each traveling in its own orbit around Saturn.

12. Is the following sentence true or false? Saturn has only a few moons.
false

13. The largest of Saturn's moons is called Titan.

Uranus (p. 579)

14. Why does Uranus look blue-green?
It looks blue-green because there are traces of methane in its atmosphere.

15. How much larger is Uranus than Earth?
Uranus is about four times the diameter of Earth.

16. What discovery made astronomer William Herschel famous?
He discovered the planet Uranus, the first new planet discovered since ancient times.

17. How is the rotation of Uranus unlike that of most of the other planets?
Uranus rotates from top to bottom instead of from side to side, the way most of the other planets do.

18. What are Uranus's five largest moons like?
They have icy, cratered surfaces. They have lava flows on their surfaces.

19. Which spacecraft sent many images of Uranus back to Earth?
Voyager 2

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Neptune (p. 580)

It takes Neptune 165 years to orbit the sun. Neptune has 13 moons.

20. Is the following sentence true or false? Neptune's atmosphere is ~~yellow~~ blue and has ~~no~~ clouds. false true

21. In the 1800s, how did astronomers predict that the planet Neptune would be discovered before anyone had seen it?
Uranus was not quite following the orbit astronomers predicted for it. They hypothesized that
the gravity of another planet was affecting Uranus's orbit.

22. Circle the letter of the sentence that explains how the Great Dark Spot was like the Great Red Spot.

- a. Both formed from volcanoes.
- b. Both formed on rings.
- c. Both were probably storms.
- d. Neither lasted long.

23. Which is the largest of Neptune's moons? Triton

Pluto (p. 581)

24. Is the following sentence true or false? Pluto is smaller than Earth's moon. true

25. How often does Pluto revolve around the sun?
It revolves around the sun once every 248 Earth years.

26. Circle the letter of each sentence that is true about Pluto.

- a. One of its moons is more than half Pluto's size.
- b. Pluto has a gaseous surface.
- c. Pluto is solid and dense.
- d. Pluto is sometimes closer to the sun than Neptune.

27. Why have astronomers decided that Pluto should no longer be called a planet?

It is so small that it is just one of thousands of objects revolving around the sun
beyond Neptune.

Comets, Asteroids, and Meteors (pp. 584–587)

This section describes the other objects in the solar system, including comets, asteroids, and meteors.

Use Target Reading Skills

As you read about comets, asteroids, and meteoroids, fill in the graphic organizer below to compare and contrast their origin, size, and composition.

Feature	Comets	Asteroids	Meteoroids
Origin	Kuiper belt and Oort cloud	a. Leftover pieces of the early solar system mostly found between the orbits of Mars and Jupiter	b. Comets or asteroids
Size	c. About as large as a mountain, excluding the tail	d. Most are less than 1 km in diameter. Three are more than 300 km across.	Smaller than comets or asteroids
Composition	e. Ice, dust, or small rocky particles	Rock	f. Rock or dust

Comets (p. 585)

1. What are comets?
Comets are loose collections of ice, dust, and small rocky particles with orbits that are usually very long, narrow ellipses.
2. What are the three main parts of a comet?
 a. _____ nucleus b. _____ coma
 c. _____ tail
3. What forms a comet's tail?
Gas and dust form the comet's tail. *A comet's tail always points away from the sun.*
4. Is the following sentence true or false? A comet's tail can be more than 100 million kilometers long. _____ true

5. If the orbit of a comet is 500 times the distance between Pluto and the sun, which region is it in? Explain how you know.

The comet is in the region of the Oort cloud. This region extends out to more than 1,000 times the distance between Pluto and the sun. The Kuiper belt extends to only about 100 times Earth's distance from the sun.

Asteroids (p. 586)

6. Rocky objects revolving around the sun that are too small and too numerous to be called planets are called _____ asteroids _____.

7. Where is the asteroid belt?

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

8. What happened when one or more asteroids collided with Earth about 65 million years ago?

The atmosphere was filled with dust and smoke, which blocked out sunlight around the world. Scientists hypothesize that many species of organisms, including the dinosaurs, became extinct.

Meteors (p. 587)

Match the term with its definition.

Term	Definition
b (9) meteoroid	a. A meteoroid that has passed through the atmosphere and hit Earth's surface
c (10) meteor	b. A chunk of rock or dust in space
a (11) meteorite	c. A streak of light caused by the burning up of a meteoroid in the atmosphere

12. Where do meteoroids come from?

They usually come from comets or asteroids.

13. The craters on the moon were caused by the impact of _____ meteoroids _____.

Is There Life Beyond Earth? (pp. 588–591)

This section describes what conditions living things need to exist on Earth and explains why life might exist on Mars and Europa.

Use Target Reading Skills

Complete the first column in the chart by previewing the red headings in your textbook and asking a what, how, or where question for each. As you read the section, complete the second column with the answers. The first question is done for you. Accept all logical answers.

Question	Answer
What are the "Goldilocks" conditions?	a. The conditions that allow life to exist
b. Is there life on Mars?	c. Scientists have not yet found evidence for life on Mars.

Introduction (p. 588)

1. Life other than that on Earth would be called _____
extraterrestrial life

Life on Earth (p. 589)

2. What are the three "Goldilocks conditions" on Earth that life as we know it must have to exist?
 - a. liquid water
 - b. suitable temperature range
 - c. suitable atmosphere

3. Where has life been found on Earth that suggests life forms may not always need the "Goldilocks conditions"?

Life has been found deep in the ocean, in caves, inside solid rocks, and in hot springs.

Life Elsewhere in the Solar System? (pp. 590–591)

4. Why is Mars the most obvious place to look for living things like those on Earth?

Mars is the planet with conditions that are most similar to those on Earth. Mars once had liquid water on its surface.

5. Why do scientists hypothesize that Mars may once have had the conditions needed for life to exist?

Mars has regions that were almost certainly formed by flowing water. Life as we know it requires water to exist.

6. A meteorite from Mars found in Antarctica in 1996 shows tiny shapes that look like _____ fossils.

7. Is the following sentence true or false? All scientists agree that the meteorite from Mars shows that life once existed on Mars.

~~false~~ true

8. Which spacecraft tested the soil of Mars for signs of life?

Laboratories on two *Viking* lander spacecraft

9. Is the following sentence true or false? Life has been discovered in Martian soil.

~~false~~ true

10. What suggests that there might be liquid water on Europa?

Close-up views from *Galileo* show that Europa's ice has broken up and reformed. Similar patterns occur in the ice crust over Earth's Arctic Ocean.

11. Is the following sentence true or false? If there is liquid water on Europa, there might also be life.

true

Is There Life Beyond Earth? (continued)

12 Complete the table that compares and contrasts what scientists know and what they hypothesize about life on Mars and on Europa.

	Mars	Jupiter's moon Europa
What Scientists Know So Far	There are surface features that appear to have been formed by liquid water.	It has a smooth, ice crust with cracks.
What Scientists Hypothesize	a. Mars may once have had the conditions needed for life to exist.	b. There is liquid ocean under Europa's ice.

c. According to these hypotheses, which location is more likely to have life now?

Possible answer: Europa is more likely to have life now because it may have a liquid ocean, which is a favorable environment for life to exist.

d. Based on this table, write a definition of a hypothesis in your own words.
A hypothesis is a prediction based on observations.

Solar System Data

*	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune	*Pluto
Slogan *	My	Very	Excellent	Mother	Just	Served	Us	Nine	Pizzas
Terrestrial Or Gas *	T	T	T	T	G	G	G	G	T
Gravity	.38	.91	1	.38	2.53	1.14	0.9	1.14	0.8
X's Earth's Diameter X's 1,000KM	4.88	12.1	12.76	6.79	143.0	120.5	51.1	49.5	2.39
Color (as seen from Earth)	gray	yellowish white	blue + white	red + orange	stripes orange white	rings yellow	light blue	dark blue	brown
Ability to support life	No	No	* Yes	No maybe...	No	No	No	No	No
Number of moons	0	0	1	2	63	47	27	13	3
Year Length in Earth Years	0.24	0.62	1	1.88	11.9	29.4	84	165	248
Rotates on axis	59 days	243 days	* 24 hr.	* 25 hr.	9.9 hr.	11 hr.	17 hr.	16 hr.	6 days
Distance from Sun x's million km	58	108	150	228	778	1427	2871	4498	5906
Interesting Fact *	extreme temps	Earth's Twin	Life Exists	"Red Planet"	Largest Planet	Rings	abnormal rotation	maybe shrinking	Not a Planet