Chapter Project Worksheet 1

Distance From Sun

1:10,000,000,000 Scale: Sun Center; Mercury 5.8 m; Venus 10.8 m; Earth 15.0 m; Mars 22.8 m; Jupiter 77.9 m; Saturn 143.4 m; Uranus 287.3 m; Neptune 449.5 m; Pluto 587.0 m

1:50,000,000,000 Scale: Sun Center; Mercury 1.2 m; Venus 2.2 m; Earth 3.0 m; Mars 4.6 m; Jupiter 15.6 m; Saturn 28.7 m; Uranus 57.5 m; Neptune 89.9 m; Pluto 117.4 m

Planet Size

1:1,000,000,000 Scale: Sun 1.39 m; Mercury 5 mm; Venus 12 mm; Earth 13 mm; Mars 7 mm; Jupiter 14.3 cm; Saturn 12.1 cm; Uranus 5.1 cm; Neptune 5.0 cm; Pluto 2 mm

1:500,000,000 Scale: Sun 2.78 m; Mercury 10 mm; Venus 24 mm; Earth 26 mm; Mars 14 mm; Jupiter 28.6 cm; Saturn 24.1 cm; Uranus 10.2 cm; Neptune 9.9 cm; Pluto 5 mm

Model Objects: These will vary but should be about the diameters computed for the scales chosen by students.

Chapter Project Worksheet 2

Combination Model

Diameter of Objects: Sun 13.9 cm; Mercury 0.5 mm; Venus 1.2 mm; Earth 1.3 mm; Mars 0.7 mm; Jupiter 14.3 mm; Saturn 12.1 mm; Uranus 5.1 mm; Neptune 5.0 mm; Pluto 0.2 mm

Distance From Sun: Sun Center; Mercury 5.8 m; Venus 10.8 m; Earth 15.0 m; Mars 22.8 m; Jupiter 77.9 m; Saturn 143.4 m; Uranus 287.3 m; Neptune 449.5 m; Pluto 587.0 m

Model Objects: These will vary, but they should be about the size indicated in Diameter of Objects, above.

Analyzing and Presenting

1. Students should describe their experiences, including information on the scales that they used, why they chose those scales, and what problems they encountered.

2. Students should include distances between the planets and the sun, discussing how the solar system is largely empty space. Students should mention that the spacing between the planets is not equal—some planets are much closer together than are others.

3. Students should discuss scaling. One of the advantages of using scale models is that it allows one to work with measurements that are too large to visualize easily. A disadvantage is that it is difficult to choose a scale that is convenient for showing both large distances and relatively small diameters in one model.

Observing the Solar System Guided Reading and Study

Use Target Reading Skills This is one way the graphic organizer can be completed. 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 system?
A. A model that shows Earth and the other planets revolving around the sun

1. Mercury, Venus, Mars, Jupiter, and Saturn

2. Earth is at the center of the revolving planets and stars.

3. Ptolemy thought the planets moved on little circles that moved on bigger circles.

4. heliocentric system

5. Copernicus

6. He saw four moons revolving around Jupiter, and he discovered that Venus goes through phases similar to the moon's phases.

7. a

8. An ellipse is an oval shape, which may be elongated or nearly circular.

9. **a.** Mid-1500s or 1543 **b.** Observed the positions of the planets for more than 20 years **c.** Galileo **d.** Early 1600s **e.** Discovered that the orbit of each planet is an ellipse **f.** 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.

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

Observing the Solar System Review and Reinforce

1. In the geocentric model, the planets and the sun revolve around Earth. In the heliocentric model, Earth and the planets revolve around the sun.

2. In Ptolemy's model, the planets moved on small circles that moved on bigger circles.

3. Galileo observed moons orbiting around Jupiter. This showed that not everything revolves around Earth. He also observed phases of Venus that are similar to those of Earth's moon. The heliocentric model could easily explain these observations.

4. heliocentric

5. ellipse

6. geocentric

Observing the Solar System
Enrich

1. The full moon is on the opposite side of Earth from the sun. The full Venus is in almost the same direction as the sun. The apparent size of the moon does not change with its phases.
2. The new moon is between Earth and the sun. So is the new Venus.
3. Because its size does not appear to change, we know the moon is always about the same distance from Earth. Also, the moon is sometimes between Earth and the sun and sometimes on the opposite side of Earth from the sun.

The Sun
Guided Reading and Study

Use Target Reading Skills
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
  D. Solar Wind
III. Features on the Sun
  A. Sunspots
  B. Prominences
  C. Solar Flares

1. nuclear fusion
2. Hydrogen atoms join together to form helium atoms and produce energy.
3. It occurs in the sun's center, or core.
4. The layers in order are the core, the radiation zone, and the convection zone.
5. The layers in order are the photosphere, the chromosphere, and the corona.
6. You see the photosphere.
7. You can identify it as a reddish glow visible just around the photosphere.
8. The moon blocks light from the photosphere, so the corona becomes visible.
9. solar wind
10. **a.** Sunspots **b.** Prominences **c.** Solar flares
11. a
12. c
13. b
14. Auroras, or magnetic storms

The Sun
Review and Reinforce

1. Chromosphere
2. Photosphere
3. Core
4. Corona
5. Sunspots
6. Prominence
7. f
8. h
9. b
10. d
11. c
12. j
13. a
14. g
15. e
16. k
17. i

The Sun
Enrich

1. Astronomers inferred that the sun rotates because sunspots move in one direction over time.
2. The sun rotates from west to east.
3. Sunspots at points A and B take longer to move around the sun than does a sunspot on the equator.
4. Different parts of the sun's surface rotate at different rates, so scientists must give a range for the time of the sun's rotation.

Stormy Sunspots
Skills Lab

For answers, see the Teacher's Edition.

The Inner Planets
Guided Reading and Study

Use Target Reading Skills This is one way the graphic organizer can be completed. Accept all logical answers.

What You Know

1. Most of Earth is covered with water.
2. Mercury is closest 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.

1. The four inner planets—Mercury, Venus, Earth, and Mars
2. They are small, dense, and have rocky surfaces.
3. Mercury—4, Venus—2, Earth—1, Mars—3
4. Mars
5. (Left to right) Mercury, Venus, Earth, Mars
6. a, d
7. **a.** Crust **b.** Mantle **c.** Core
8. Iron and nickel
9. a, b, d
10. 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.
11. evening star
12. Venus is similar in size and mass to Earth.
13. d
14. Venus rotates from east to west, the opposite of the other planets.
15. True
16. greenhouse effect
17. It has a slightly reddish tinge when you see it in the sky.
18. carbon dioxide
19. True
20. 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. a, b, d
22. **a.** Phobos **b.** Deimos
23. **a.** Mostly carbon dioxide **b.** Two **c.** Yes **d.** Solid and rocky **e.** 70% water, or Mostly water **f.** Possible answer: Humans could not survive without life support in an atmosphere of mostly carbon dioxide. The scarcity of water might also cause problems.

The Inner Planets
Review and Reinforce

1. Mercury
2. Venus
3. Earth
4. Mars
5. Mercury, Venus, Earth, Mars
6. Earth
7. Venus
8. Mars
9. Earth, Mars
10. Venus, Earth
11. Mercury
12. Venus
13. Earth, Mars
14. Mars
15. The first four planets from the sun: Mercury, Venus, Earth, and Mars. They are the Earth-like planets with rocky surfaces.
16. The trapping of heat by the atmosphere

The Inner Planets
Enrich

1. Carbon dioxide is either dissolved in the oceans or absorbed by green plants.
2. On Earth, at any one time, most of the carbon dioxide is locked up in rocks. On Venus, it is in the atmosphere.
3. On Earth, carbon dioxide dissolves in ocean water. While there, it reacts with other chemicals to form rocks. On Venus, there are no oceans in which the carbon dioxide can dissolve.
4. If Earth's temperature increased by 100°C, the amount of carbon dioxide in the atmosphere would increase because the oceans would evaporate and green plants could not live. Without these, the carbon dioxide would have no way out of the atmosphere.
5. The carbon dioxide would increase the greenhouse effect and would further warm Earth's surface.

The Outer Planets
Guided Reading and Study

Use Target Reading Skills This is one way the graphic organizer can be completed. Accept all logical answers.
a. Structure—they do not have a solid surface. **b.** Atmosphere—thick and made up mainly of hydrogen and helium. **c.** Rings—each is surrounded by a set of rings. The gas giants are also alike in that the size and mass of each are much greater than those of Earth.
1. surfaces
2. Jupiter, Saturn, Uranus, and Neptune
3. Their atmospheres are composed mainly of hydrogen and helium.
4. (From left to right) Jupiter, Saturn, Uranus, Neptune, Pluto
5. The rings are made of small particles of ice and rock.

6. True
7. The Great Red Spot is a storm that is larger than Earth and has winds that blow hundreds of kilometers per hour.
8. c, d
9. **a.** Io **b.** Europa **c.** Ganymede **d.** Callisto
10. volcanoes
11. They are made of chunks of ice and rock, each traveling in its own orbit around Saturn.
12. False
13. Titan
14. It looks blue-green because there are traces of methane in its atmosphere.
15. Uranus is about four times the diameter of Earth.
16. He discovered the planet Uranus, the first new planet discovered since ancient times.
17. Uranus rotates from top to bottom instead of from side to side, the way most of the other planets do.
18. They have icy, cratered surfaces. They also have lava flows on their surfaces.
19. Voyager 2
20. False
21. 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. c
23. Triton
24. True
25. It revolves around the sun once every 248 Earth years.
26. a, c, d
27. It is so small that it may be only the largest of thousands of objects revolving around the sun beyond Neptune.

The Outer Planets Review and Reinforce

1. Jupiter, Saturn, Uranus, Neptune, Pluto
2. Jupiter, Saturn, Uranus, Neptune
3. The gas giants are much larger than Pluto. The gas giants are composed mainly of hydrogen and helium, much of it in liquid form, but Pluto is solid.
4. Most of the gas can't escape because the gravity is so great.
5. the sun
6. Jupiter
7. chunks of ice and rock
8. Students' answers should refer to the fact that Neptune's orbit was predicted by mathematicians who calulated its location by its effect on the orbit of Uranus.
9. Charon is more than half the size of Pluto.
10. A planet that is very large and does not have a solid surface
11. A thin disk of small particles of ice and rock that surround a planet

The Outer Planets Enrich

1. 29.7 a.u.
2. 30 a.u.
3. In 2227 (1979 + 248)
4. In 2113 (1989 + 124)
5. Pluto (after February 1999)

Speeding Around the Sun Design Your Own Lab

For answers, see the Teacher's Edition.

Comets, Asteroids, and Meteors Guided Reading and Study

Use Target Reading Skills
a. Leftover pieces of the early solar system, mostly found between the orbits of Mars and Jupiter **b.** Comets or asteroids **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. **e.** Ice, dust, or small rocky particles **f.** Rock or dust

1. Comets are loose collections of ice, dust, and small rocky particles with orbits that are usually very long, narrow ellipses.
2. **a.** Nucleus **b.** Coma **c.** Tail
3. Gas and dust form the comet's tail.
4. True
5. 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 100 times Earth's distance from the sun.
6. asteroids
7. The asteroid belt lies between the orbits of Mars and Jupiter.
8. 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.
9. b
10. c
11. a

12. They usually come from comets or asteroids.
13. meteoroids

Comets, Asteroids, and Meteors Review and Reinforce

Asteroid
Description: Rocky object, revolving around the sun, that is too small to be considered a planet
Location/Movement: Most revolve around the sun between the orbits of Mars and Jupiter.
Comet
Description: Chunk of ice, dust, and small rocky particles with a bright head and tail that grows long as it approaches the sun
Location/Movement: Orbits the sun in a long narrow ellipse
Meteoroid
Description: Chunk of rock or dust, usually from a comet or asteroid
Location/Movement: Moves through the solar system. If formed from comet would have similar elliptical orbit

1. A meteoroid enters Earth's atmosphere and friction causes it to heat up. If the meteoroid is large enough, it does not completely burn up and it hits Earth's surface.
2. The head is made up of the nucleus and coma. The nucleus is the solid inner core. The coma is the fuzzy outer layer formed by clouds of gas and dust. The tail is the gas from the comet that streams outward as the comet approaches the sun.
3. Comets are visible for days or weeks. A meteor is a quick flash of light that moves across the sky.
4. meteor
5. comet
6. meteorite
7. asteroid
8. meteoroid
9. asteroid belt
10. coma
11. Oort cloud
12. Kuiper belt

Comets, Asteroids, and Meteors Enrich

1. Craters on the moon were caused by impacts of large meteoroids. The moon has been revolving around Earth for a long time. Since large meteoroids have hit the moon many times in the past, they have probably hit Earth, too.
2. Many meteoroids never hit Earth's surface because they burn up in Earth's atmosphere. When a meteoroid does hit the surface, wind and rain often erase the crater over time.
3. About 65 million years old
4. Rocks from deep below Earth's surface, rocks from space
5. A large meteoroid might have hit Earth 65 million years ago, causing meteor dust to be spread around Earth. This is one possible explanation of the mass extinction of dinosaurs and other creatures at that time.

Is There Life Beyond Earth? Guided Reading and Study

Use Target Reading Skills This is one way the graphic organizer can be completed. Accept all logical answers.
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.

1. extraterrestrial life
2. **a.** Liquid water **b.** Suitable temperature range **c.** Suitable atmosphere
3. Life has been found deep in the ocean, in caves, inside solid rocks, and in hot springs.
4. Mars is the planet with conditions that are most similar to those on Earth. Mars once had liquid water on its surface.
5. Mars has regions that were almost certainly formed by flowing water. Life as we know it requires water to exist.
6. fossils
7. False
8. Laboratories on two *Viking* lander spacecraft
9. False
10. Close-up views from *Galileo* show that Europa's ice has broken up and re-formed. Similar patterns occur in the ice crust over Earth's Arctic Ocean.
11. True
12. **a.** Mars may once have had the conditions needed for life to exist. **b.** There is a liquid ocean under Europa's ice. **c.** 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.** A hypothesis is a prediction based on observations.

Is There Life Beyond Earth? Review and Reinforce

1. Students should list three of the four conditions given: All living things are made up of one

or more cells, take in energy, and use energy to grow and develop, reproduce, and give off waste.
2. "Goldilocks conditions" are the "just right" conditions on Earth that scientists believe may be necessary for life.
3. The presence of liquid water, a suitable temperature range, and a suitable atmosphere
4. Perhaps the "Goldilocks conditions" aren't necessary for life.
5. The channels were probably formed by flowing water. Since life as we know it requires liquid water, scientists hypothesize that Mars may once have had the conditions needed for life to exist.
6. Europa is covered with an icy crust that has patterns similar to those of the ice crust over Earth's Arctic Ocean. Scientists hypothesize that this may indicate that there is liquid water under the ice. If there is liquid water on Europa, there might also be life.
7. Extraterrestrial life would be life other than that on Earth.

Is There Life Beyond Earth? Enrich

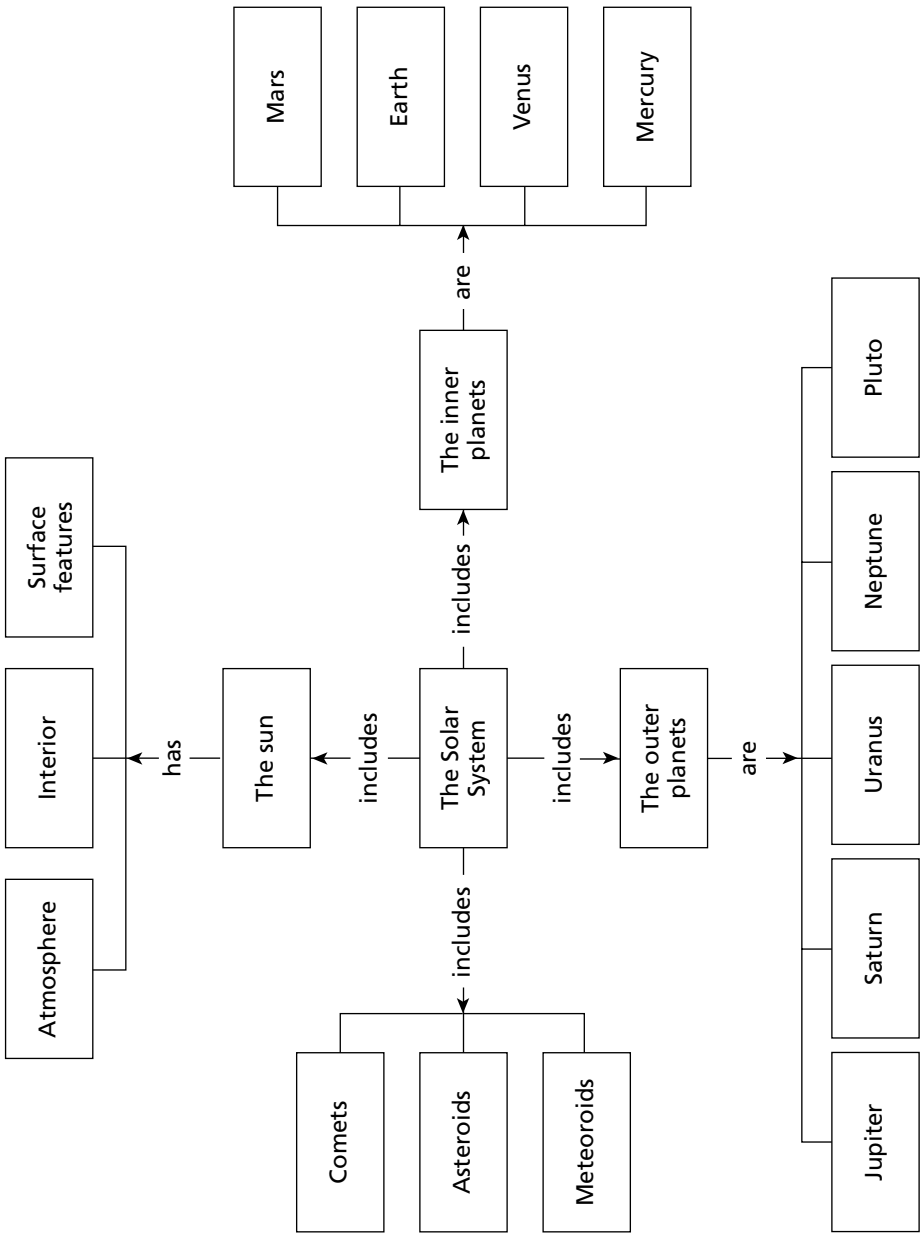
1. Planet A could not support human life for an extended period. Its gravity is too great.
2. Planet B might be able to support human life. Its mass is over 0.4 times that of Earth, so it might have water and an atmosphere. Its length of day is 2.5 times that of Earth. Its gravity is slightly less than Earth's, so humans wouldn't be harmed.
3. Planet C could not support human life for long. Its day is too long.
4. Even though Venus's mass is very similar to that of Earth, Venus could not support human life in Earth's orbit because its day is far too long.
5. Even though its day is only slightly longer than Earth's, Mars could not support human life because it is too small to have a sufficiently thick atmosphere or enough surface water.

Use Key Terms

1. photosphere
2. ellipse
3. asteroids
4. greenhouse effect
5. geocentric
6. meteoroid
7. prominences
8. sunspots
9. solar wind
10. corona
Key Term: heliocentric
Definition: A description of the solar system in which all of the planets revolve around the sun

Connecting Concepts

This concept map is only one way to represent the main ideas and relationships in this chapter. Accept other logical answers from students.



Lab Investigation

Measuring the Diameter of the Sun

Pre-Lab Discussion

1. The photosphere
2. Eyes can be damaged by the intensity of the sun's rays.

Observations

Distance between cards will vary. The sun's image is 8 mm in diameter.

Analyze and Conclude

1. Answers will vary, but should be approximately 1,391,000 km.
2. If students are careful with their observations and calculations, their calculated value should be within 10 percent of the sun's actual diameter.
3. Answers may vary. An average value for the distance between the sun and Earth was used, and measurements on the small card and on the meter stick are not exact.

Critical Thinking and Applications

1. Possible answer: When the moon is full, its diameter could be measured. With a light-gathering instrument such as a telescope, the diameters of some planets could be measured.
2. The 11-mm film must be closer. The greater the distance, the larger the image.
3. If a cloud partly covers the sun, the image might appear smaller that it normally would. Total cloud cover would probably make the image too faint to be seen and measured properly.

More to Explore

Data collected should consist of the distance from the eye to the card and the diameter of the hole. Remind students to do this nighttime activity with adult supervision.

Analyze and Conclude

1. Using the formula

$$\frac{\text{moon's diameter}}{\text{moon's distance}} = \frac{\text{hole's diameter}}{\text{hole's distance}}$$

Student results should be close to a diameter of 3,476 km.
2. To find the moon's distance from Earth, the same formula would be used. Students would find a cross product and divide both sides of the equation by the diameter of the hole to find the moon's distance.

Performance Assessment

Analyze and Conclude
1. Answers will vary. Possible answers:
The sun. Contains over 99 percent of all of the mass of our solar system. The sun's energy comes from nuclear fusion. The sun has an atmosphere with three parts. From inside to outside, these are the photosphere, which is where the sun's light comes from; the chromosphere; and the corona. The chromosphere and corona are normally visible only during eclipses. Features on the sun include these: Sunspots are dark, cooler areas on the sun; prominences are loops connecting parts of sunspot regions; solar flares are huge explosive loops of gas.
Mercury. The smallest of the inner planets and closest to the sun. No moons. Rotates on its axis once each 59 days. Has almost no atmosphere, very hot on the side facing the sun but very cold on the other side.
Jupiter. One of the gas giants. Largest planet. Its day is less than 12 hours long. Its Great Red Spot is a long-lasting storm in its atmosphere. Dozens of known moons, four of which were discovered by Galileo. One of its moons, Europa, may have liquid water beneath an icy crust.
Comets. Most comets have long, elliptical orbits that take them close to the sun and back out far beyond Earth's orbit. When heated by the sun, comets have three parts: the nucleus, or solid inner core; a coma formed when sunlight turns the ice into a cloud of gas and dust; and a long tail that can be over 100 million kilometers long. Most comets have two tails—a gas tail and a dust tail. The tails usually point away from the sun, even when the comet itself is moving away from the sun.
2. Answers may vary. Possible answers: The relative size of the planets is difficult to show so that wasn't included. For example, I wanted to draw each of my objects so that anyone using my cards could compare the sizes, but even if I drew the sun as large as possible on its card, a tiny dot would have been too big to represent an asteroid or Mercury. The relative distances of the objects from the sun are also difficult to show.

Chapter Test

1. a
2. d
3. b
4. d
5. d
6. c
7. b
8. d
9. a
10. b
11. ellipses/elliptical
12. Sunspots
13. Meteorites
14. liquid water/an ocean
15. comets
16. convection
17. heliocentric
18. True
19. True
20. fusion
21. Planet C will take the longest amount of time to revolve around the star because it is the greatest distance from the star.
22. The ancient Greeks developed and generally supported the geocentric model. Most of them would have described Planets A and C as revolving around Earth, Planet B.
23. They noticed that patterns of stars kept the same shapes from night to night and from year to year. However, several objects wandered slowly among the stars. They called these objects planets.
24. Nuclear fusion occurs in the extreme heat and pressure at the sun's core. Hydrogen atoms join to form helium atoms. The helium atoms have a smaller mass than the total mass of the hydrogen from which they are formed. The lost mass is changed into energy.
25. Jupiter, Saturn, Uranus, and Neptune, the gas giants, are all relatively large in size and mass, and they are composed mainly of hydrogen and helium, much of it in liquid form. They do not have solid surfaces and are surrounded by rings. They also have many moons. The inner planets are much smaller, denser, and have solid, rocky surfaces.
26. The farther the distance from Jupiter, the more time it takes a moon to revolve around the planet.
27. About 9.4 times (16.69 ÷ 1.77)
28. The side of Mercury that faces the sun is extremely hot because the planet is so close to the sun. Since Mercury has almost no atmosphere, at night most of the heat escapes into space.
29. Images of Mars from space reveal surface patterns that look as if they were made by ancient streams, lakes, or floods. Close inspection of surface features and rocks by *Spirit* and *Opportunity* rovers provided additional evidence that liquid water once existed on Mars's surface. The presence of liquid water means that life may have once existed there.
30. Venus is closer to the sun than Earth and so receives more solar energy than Earth. Some of this energy reaches Venus's surface and is later given off as heat. The carbon dioxide in Venus's thick atmosphere traps much of this heat. The result is that Venus has the hottest surface of any planet in the solar system.