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231

Astronomy

As a field of study, **astronomy** includes a study of the planets, stars, galaxies, and all other objects in space. One of these objects—the planet Earth— is the planet you call home.

232

Motions of the Earth and Moon

You've noticed at least two objects in space since you were small—the sun and Earth's moon. If you watch the sun or moon for several hours, you will notice that each moves across the sky, which makes it look as if they are moving around Earth. But it is not the sun and moon that are moving in such a short time—it is Earth itself. You may also have noticed that the shape of the moon appears to change, and that the lengths of daylight and darkness change throughout the year. All of these changes are caused by motions of Earth and its moon.

Word Watch!

Do not confuse astronomy with astrology. Astronomy is the scientific investigation of objects in space. Astrology is the attempt to predict human events based on star and planet positions, and it is not considered to be science.

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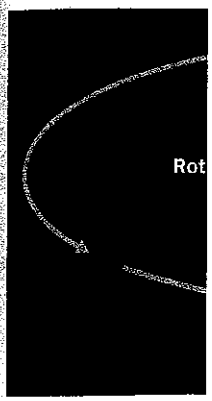

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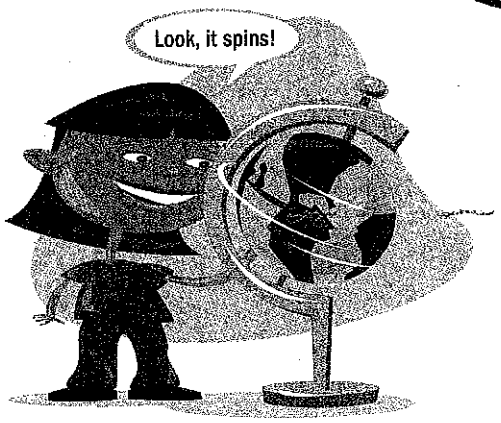
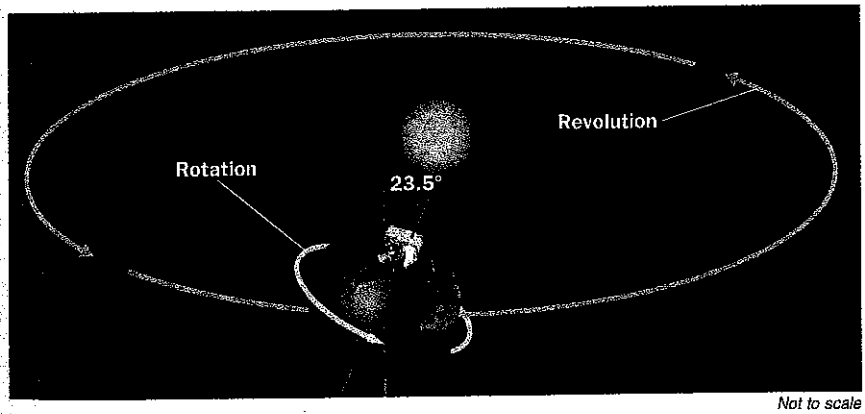
Rotation

A **globe** is a three-dimensional model of Earth. If you look at a globe, you will notice that Earth spins, or rotates, around its axis. Earth spins from west to east. Earth's **axis** is an imaginary line that runs from its North Pole, through its center, to its South Pole. Each complete spin around the axis, or **rotation,** takes about 24 hours, which marks the length of a **day** on Earth. As Earth rotates from west to east, you change position compared to the sun. However, as you stay in place on a moving Earth, it looks as if the sun is moving across the sky.





Not to scale

Another feature of a globe is that it is tilted at an angle of about 23.5°. A globe is tilted this way because the planet Earth is tilted at an angle of 23.5°.

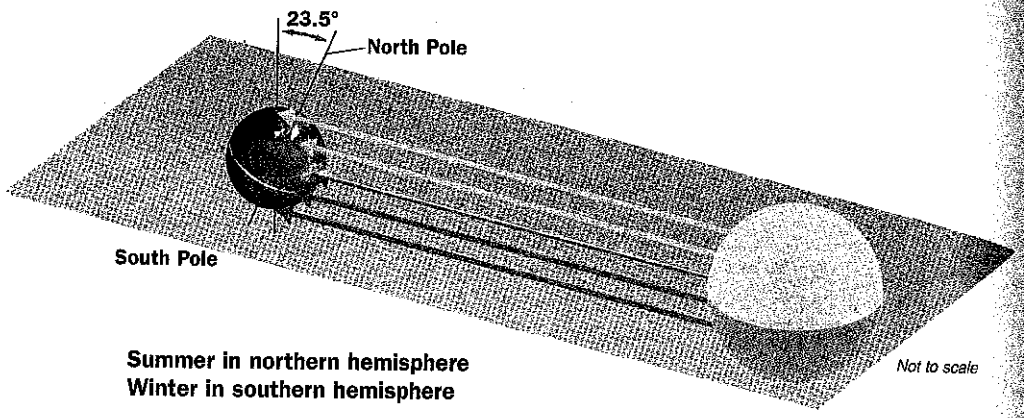
Have you ever noticed that the lengths of day and night change throughout the year? This happens because Earth is tilted on its axis compared to its orbital plane. The **orbital plane** is an imaginary surface that contains Earth's orbit, or its path around the sun. Think of Earth's orbital plane as a flat plate with the sun near the center and Earth revolving around the edge.

Word Watch!

Rotation is Earth's spin, once each day. **Revolution** is Earth moving around the sun, once each year.

MORE ▶

Because Earth is tilted on its axis, its northern hemisphere tilts toward the sun during summer. This results in longer periods of daylight. In winter, the reverse is true. If Earth did not have a tilted axis, night and day would always have equal lengths—about 12 hours each all year long. In areas near the equator, the length of day and night are pretty close all year. Near the poles, the length of day and night changes from 0–24 hours.



Summer in northern hemisphere
Winter in southern hemisphere

Revolution and Seasons

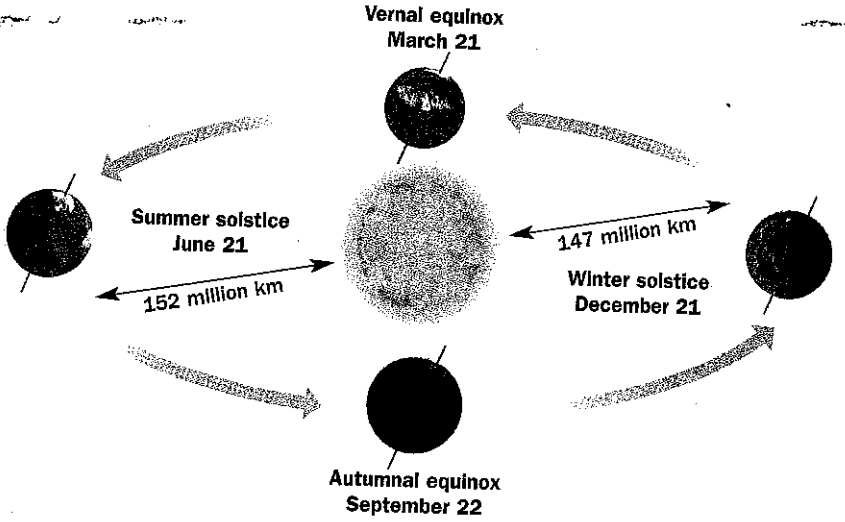
Earth has two major movements. Rotation on its axis is one. Earth revolves, or circles, around the sun. The path a moon or planet follows as it moves around the sun is called its **orbit.** The time it takes Earth to make one revolution around the sun is 365 days, 5 hours, 48 minutes, and 46 seconds. This equals one Earth **year.**

The combination of Earth's tilted axis and its revolution around the sun produces Earth's seasons. At different times of the year, Earth's tilt and revolution cause areas north and south of the equator to be tilted toward the sun, away from the sun, or neither toward nor away from the sun. The days when Earth is most tilted toward the sun, June 21 and December 21, are called **solstices.** The days when Earth is not tilted toward the sun are called **equinoxes.**

Word Watch!
The **equator** is the center (0°) latitude of Earth. The area north of the equator is called the **northern hemisphere.** The area south of the equator is called the **southern hemisphere.**

About June 21, Earth's northern hemisphere is tilted toward the sun. Sunlight strikes this part of Earth at a greater angle. Days become longer and warmer as summer begins. This point in Earth's orbit when summer begins is the **summer solstice** for the northern hemisphere.

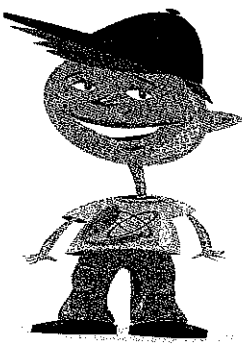
About March 21, Earth reaches a point where the tilt is not toward or away from the sun, and the lengths of day and night are the same all over Earth. The **vernal equinox** marks the beginning of spring in the northern hemisphere.



Earth reaches a point where the tilt is not toward or away from the sun, and the lengths of day and night are the same all over Earth. This occurs about September 22. Autumn begins in the northern hemisphere on this day, which is called the **autumnal equinox**.

About December 21, Earth reaches a point when the northern hemisphere is tilted away from the sun and the hours of daylight are shortest. The **winter solstice** marks the beginning of winter in the northern hemisphere.

Seasons are the opposite in the southern hemisphere. Summer there begins in December, autumn in March, winter in June, and the first day of spring is in September.



Summer does NOT occur because Earth is closest to the sun. In fact, Earth is closest to the sun in January and farthest away in July.

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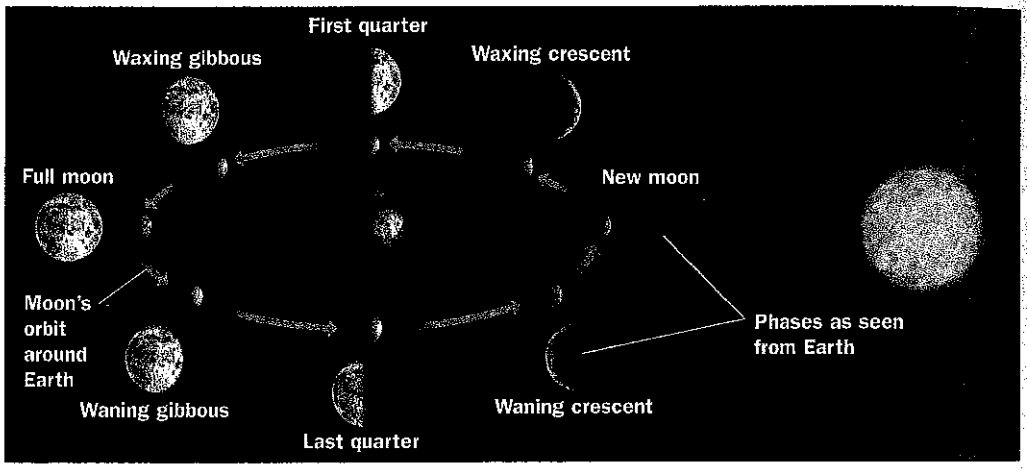
Moon Phases

The moon is lit by sunlight bouncing off it. That light reaches Earth as moonlight. Look for the moon in the sky each day for one month. You will see that the moon's shape appears to change, and that the time of night or day that you can see the moon also changes. The different shapes that the moon appears to have are called the moon's **phases.** The moon goes through eight phases as it revolves around Earth once every 27.3 days. The phase that you see depends on how much of the sunlit part of the moon you can see. The lit part you can see depends on the positions of Earth, moon, and sun.



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Science Alert!

No matter what phase the moon is in, one-half of the moon is always lit by the sun. During a full moon, you see all the sunlit half. During a new moon, you see (or rather don't see) all the dark half. During a quarter moon, you see one-half of the sunlit half.

Eclipses

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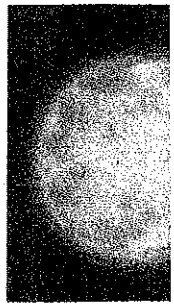

Solar eclipse

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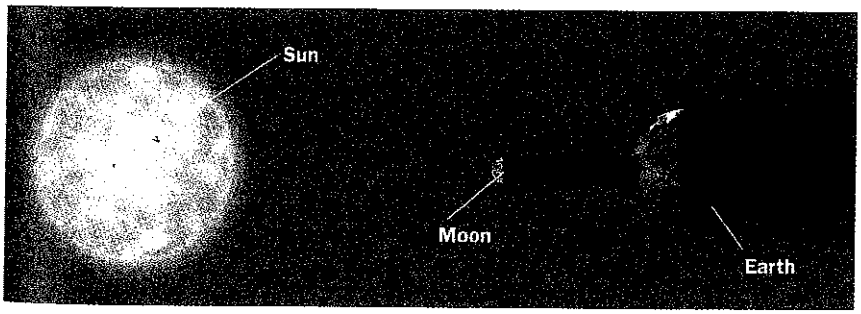
Eclipses

The moon revolves around Earth once every 27.3 days. As it travels in its orbit, it sometimes moves between Earth and the sun, casting a shadow, and it sometimes moves into Earth's shadow, so that no sunlight falls on it. These events are called eclipses. An **eclipse** occurs when one object in space casts a shadow on another.

Place your hand between your eyes and a lighted bulb. Your hand will cast a shadow on your face and block the bulb from your view. This is similar to what happens when the moon moves directly between Earth and the sun. In this case, the moon casts a shadow on Earth, causing a **solar eclipse.** During a solar eclipse, people on Earth who are in the moon's shadow can't see the sun for a few minutes. Solar eclipses are visible only along a short path for a period of minutes.

There are two types of solar eclipses. A total solar eclipse occurs when the moon blocks the whole sun from view. If the moon blocks only part of the sun, the event is called a partial solar eclipse. A solar eclipse can occur only during the new moon phase.



Solar eclipse *Not to scale*

Did You Know?

The moon's orbit is tilted 5° compared to Earth's, so the moon's shadow usually falls in space. If it were not for the tilt, eclipses would happen every month.

MORE ▶

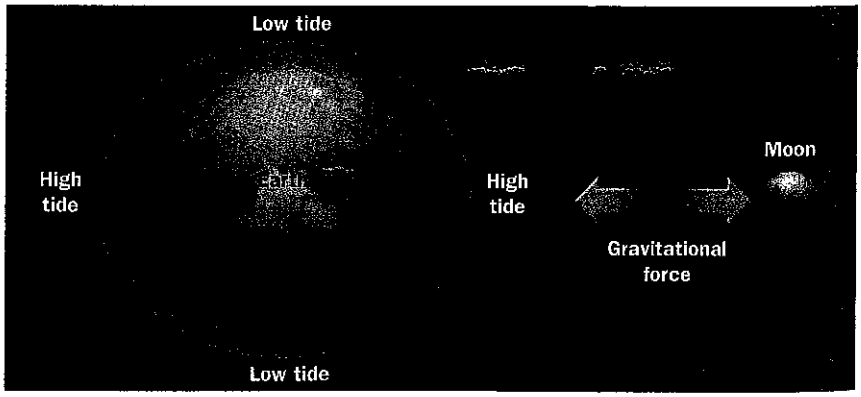
A **lunar eclipse** occurs when Earth casts a shadow on the moon. This happens when the sun, Earth, and moon are exactly lined up with Earth in the middle. Lunar eclipses can occur only when the moon is full. Lunar eclipses are visible over the whole nighttime side of Earth for many hours.

Lunar eclipse *Not to scale*

Tides

Tides are changes in ocean water levels that take place in a regular pattern. Tides are controlled mostly by the pull of gravity between the moon and Earth. The force of gravity due to the moon pulls ocean water away from Earth's surface. As Earth rotates, water is pulled up onto the shore at parts of Earth that face directly toward or away from the moon, causing high tides. At the same time, ocean water is pulled away from the shorelines of points on Earth that are not pulled by the moon at that moment. These areas experience low tides.

Tides usually change four times each day, as Earth rotates beneath the pull of the moon. An area having a high tide has a low tide about 6 hours later. In about another 6 hours, the same area has a second high tide, followed about 6 hours later by yet another low tide.



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SEE ALSO
233 Rotation
208 Ocean Life Zones

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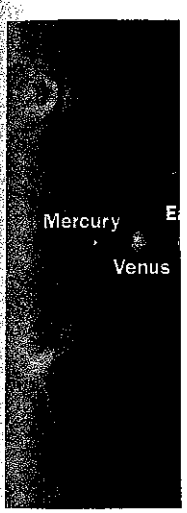

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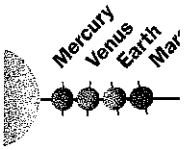

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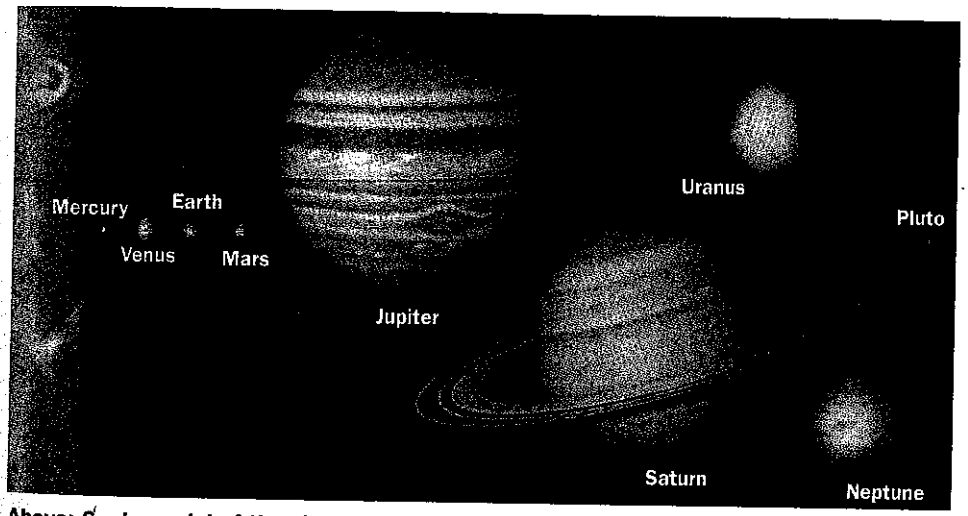
Solar System Objects

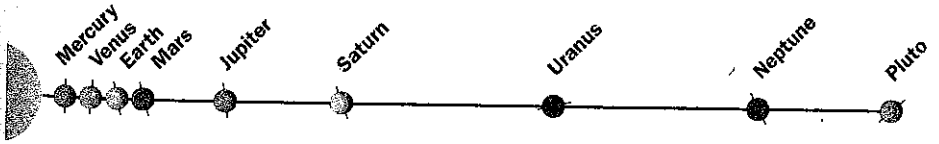
238

Look into the sky on a dark night. Almost everything you can see with your eyes alone is part of our solar system. The **solar system** includes the sun and all objects in space that are affected by the sun's gravity.

The solar system is huge and contains many different objects. These objects range in size from tiny particles of dust to the sun, which is the star at the center of our solar system. The sun, with a diameter of 1,390,180 kilometers, is the largest object in our solar system. The diagram presents scale models of the sizes and distances of objects in the solar system from the sun to Pluto.



Above: Scale model of the sizes of the planets.
Below: Scale model of the distances of the planets.



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Did You Know?

If the sun were the size of a basketball at one end of a school basketball court, Earth would be the size of a sesame seed at the opposite end of the court. Jupiter would be the size of a cherry, outside the gym. Pluto would be a dust speck nearly a kilometer away.

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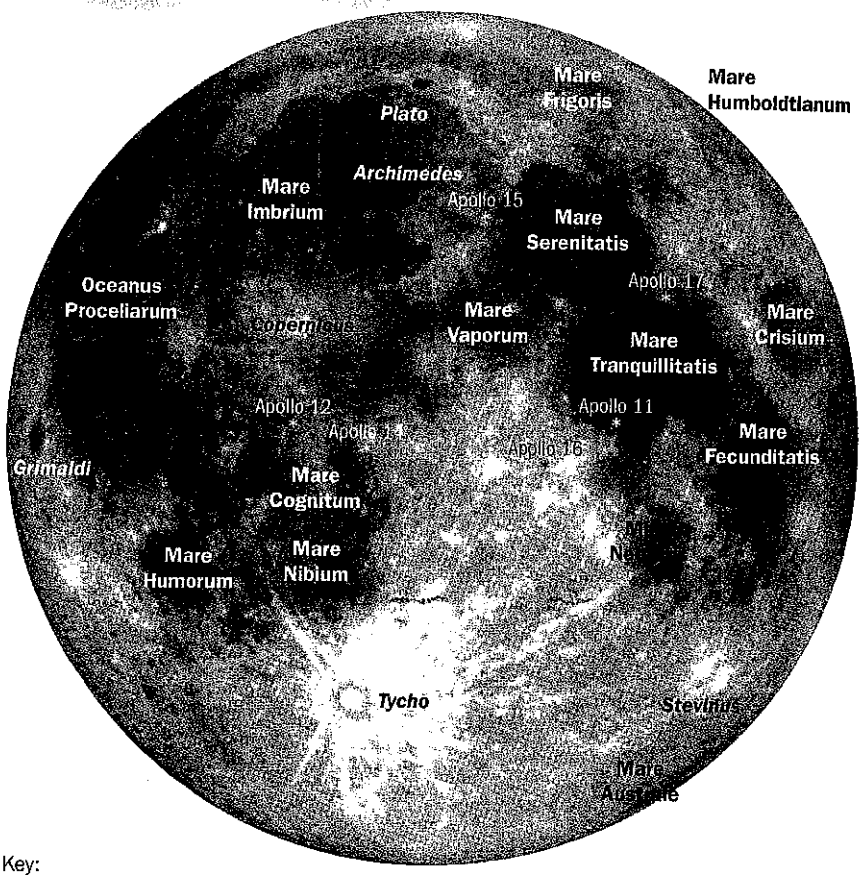
Earth's Moon

One of the most visible objects in space is Earth's moon. A **moon** is a natural satellite of a planet. A **satellite** is an object that stays in an orbit around a planet. The average distance between Earth and its moon is about 384,400 kilometers. The diameter of Earth's moon is 3,476 kilometers, slightly more than one-quarter the diameter of Earth. The moon revolves around Earth every 27.3 days.

Did You Know?

The same side of the moon always faces Earth, no matter what phase the moon is in. There are photos of the side that faces away from Earth, taken by probes, but only the *Apollo* astronauts have seen the far side. The *Apollo* missions took place between 1969 and 1972.



Key:

Mare Crisium	Lunar "sea"
Tycho	Major crater
*Apollo 11	Apollo landing site

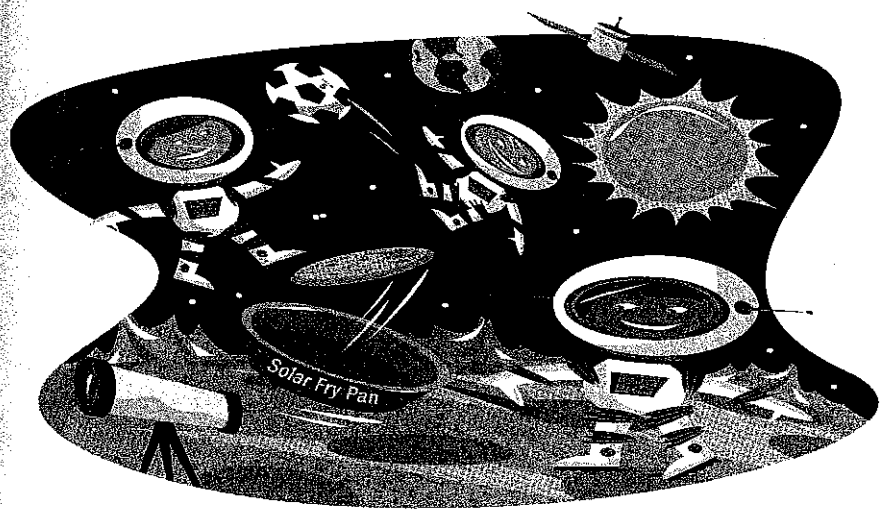
SEE ALSO

235 Moon Phases
236 Eclipses
237 Tides

The moon's surface is thick with dust and dotted with rocks of various sizes. Astronauts brought samples of moon rocks back to Earth for study. The side of the moon that faces Earth is covered by vast, dark plains. Galileo, the first person known to look at the moon with a telescope, thought he was looking at oceans. He named these plains **maria** (MAHR-ee-uh), Latin for seas. The singular of maria is **mare** (MAHR-ay). Actually, maria are made of basalt, a volcanic rock. The basalt is evidence that the moon once had magma near the surface. Other surface features include lunar mountains and **craters,** which are dish-shaped pits formed when objects from space struck the surface. Large craters, such as Tycho, have rays of dust around them that splashed out when the crater was formed. You can tell which craters are youngest by looking for the ones that have the most complete dust rays around them.

Closeup of the lunar surface

There is no water on the moon's surface. There is also no atmosphere. Because there is no air or water, temperatures vary from −172°C to 114°C, which is 14°C greater than the boiling point of water. The moon's smaller size and lower mass gives it lower gravity—one-sixth of Earth's gravity. For this reason, your weight on the moon would be one-sixth your weight on Earth.



SEE ALSO
276 Gravity

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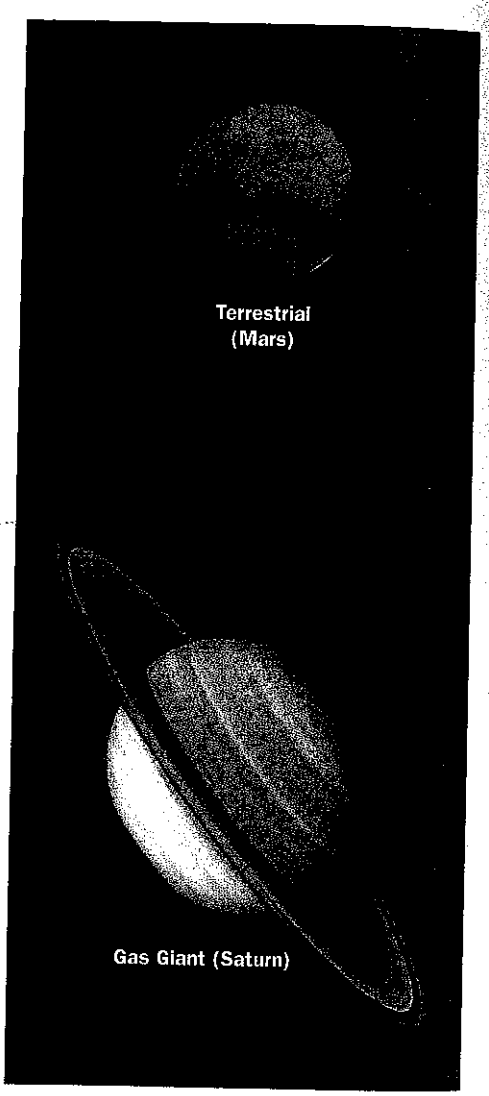
Planets

Nine planets—Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto—revolve around the sun. These planets stay in orbit because of the gravitational force between each planet and the sun.

The planets are generally classified as terrestrial planets (or inner planets) and gas giants (or outer planets). Terrestrial means Earth-like. **Terrestrial planets** are those having rocky surfaces and cores (centers) made of iron, as Earth does. The terrestrial, or inner, planets include the four planets nearest the sun: Mercury, Venus, Earth, and Mars. Craters are common on the surfaces of most of the terrestrial planets. The craters formed when rocky objects from space crashed into the surfaces of these planets. Evidence suggests that Earth has been hit by objects too, but weathering, erosion, and uplift have erased most craters from Earth's surface. Also, most objects burn in Earth's atmosphere before reaching the ground.

Jupiter, Saturn, Uranus, and Neptune are the gas giants, sometimes called the outer planets. The **gas giants** are planets that have surfaces made of a kind of slush that forms from their gaseous atmospheres. Although their surfaces are not solid, there is evidence that the gas giants have solid cores made up at least partly of iron. The gas giants earned the name "giants" because of their large sizes compared to the terrestrial planets.



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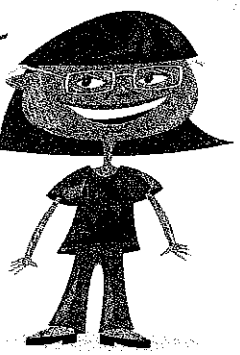
Pluto, the outermost planet, is not classified as a terrestrial planet or a gas giant. Unlike the gas giants and terrestrial planets, the surface of Pluto appears to be made of gases frozen into ice. Some astronomers think Pluto may be an escaped moon of Neptune. Pluto has a very large moon, named Charon. Pluto and its moon are so close in size that they act more like two planets revolving around each other, rather than a planet and a moon. Very little else is known about Pluto because no probes have visited it.

To remember the names of the planets in order, try inventing a sentence whose words begin with the same letters as the planets. Here's an example: My Very Eager Monkey Just Swallowed Uncle Ned's Plum.



Planetary Data

Planet	Diameter at Equator (km)	Distance from the Sun (million km)	Period of Rotation (Earth time)	Period of Revolution (Earth time)	Number of Known Moons
Mercury	4,878	57.9	58.64 days	88 days	0
Venus	12,104	108.1	243.0 days	224.7 days	0
Earth	12,756	149.6	23.9 hours	365.25 days (1 year)	1
Mars	6,786	227.9	24.6 hours	687 days (1.88 yrs)	2
Jupiter	142,984	778.3	9.84 hours	4,333 days (11.86 yrs)	28
Saturn	120,536	1427.0	10.2 hours	10,759 days (29.46 yrs)	25
Uranus	51,108	2869.6	17.9 hours	30,688 days (84.02 yrs)	21
Neptune	49,538	4496.6	19.1 hours	60,181 days (164.8 yrs)	8
Pluto	2,300	5900.0	6 days, 9 hours	90,470 days (247.7 yrs)	1

Sources: New York Public Library Science Desk Reference, Encyclopedia of the Solar System; The Cambridge Atlas of Astronomy; Science News; NASA/ JPL Solar System Dynamics web site

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Asteroids

The sun, the nine planets, and their moons are not the only objects in our solar system. After moons, the next largest objects in the solar system are large rocks called **asteroids.** A few asteroids are larger than the smallest moons of the solar system, but they are too small to be planets. Large asteroids are sometimes called "minor planets." Asteroids exist in all parts of the solar system, but most are concentrated in a belt that lies between the orbits of Mars and Jupiter. One explanation for these millions of stony and metallic bodies is that they are bits and pieces of a planet that never formed when the solar system took shape between 4 and 5 billion years ago.

Asteroids occur in many sizes and shapes, although none is larger than 940 kilometers across. Asteroids are irregularly shaped. Some resemble lumpy potatoes, while others are shaped like the rocks you might find in any field. No asteroids appear to have a round shape like the planets.

Did You Know?

Most scientists now accept the theory that an asteroid hitting Earth 65 million years ago caused a dust cloud that blocked the light of the sun, causing the death of many plants and possibly the extinction of the dinosaurs and other animal species.

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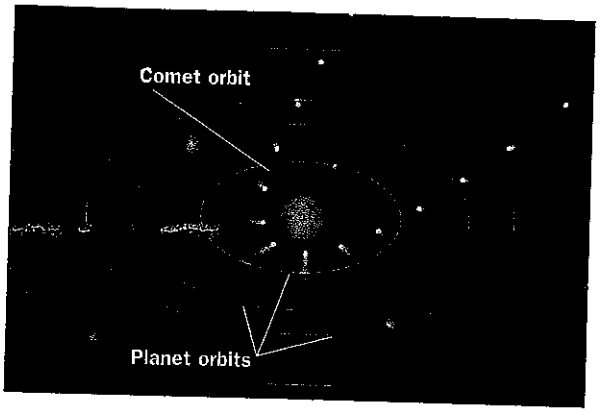
Comets

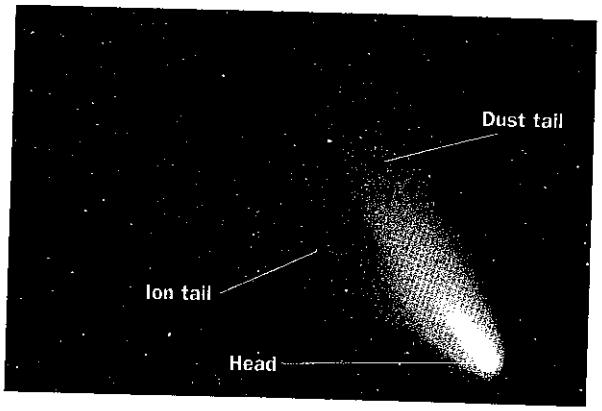
A **comet** is a mixture of frozen gases (including water) and tiny particles of dust. Sometimes called a "dirty snowball," the core of a comet is usually no more than a few kilometers across, although its mass may be more than 1000 billion metric tons. A cloud of dust and gases called a **coma** surrounds the core. Together, the core and the coma form the comet's head. The heads of most comets are generally smaller than asteroids; however the tail of a comet (gases and dust given off by a moving comet) may extend millions of kilometers into space.

Like other objects in the solar system, comets follow an orbit around the sun. Some comets make many revolutions of the sun. The most famous returning comet is Halley's comet, which revolves

around the sun once every 76 years. Halley's comet last visited the neighborhood of Earth in 1986 and will return again in 2061. Other comets make a single orbit before vanishing forever into outer space.

As a comet approaches the sun, particles from the sun—called the **solar wind**—rub away the head of the comet, to produce a long, glowing tail. Because the tail of a comet is blown outward by the solar wind, the tail always points away from the sun. As the comet moves away from the sun, its tail grows smaller again.





Meteors

Have you ever seen a "shooting star" flash across the sky? If so, you have observed a meteor. A **meteor** is a streak of light formed by a space rock burning up as it plunges into Earth's atmosphere. Most meteors are no larger than a grain of sand, but some can be many meters in diameter. If the rock strikes Earth's surface, it is called a **meteorite.** Meteorites can leave behind large craters. For example, a 45-meter-wide meteorite produced the 1.2-kilometer, 170-meter deep crater known as Meteor Crater in Arizona.

On any clear, dark night, you can see about six meteors per hour. During **meteor showers** as many as 60 meteors might be seen each hour. A meteor shower occurs when Earth passes through the tail of a comet or a cloud of dust left behind by a broken-up asteroid. Some meteor showers occur on a regular schedule each year as Earth's orbit takes it through these dust clouds. Listen for announcements of meteor showers on weather forecasts.

CHAPTER 8

ASTRONOMY

- *THE PHYSICAL SETTING: KEY IDEA 1*
  Earth and celestial phenomena can be described using principles of relative motion and perspective.

The Universe

The universe is composed of empty space, energy, and matter. Most of the universe is empty space. Matter in the universe includes gas molecules, mainly hydrogen, and dust particles. Some of this matter has come together to form stars, planets, moons, meteors, asteroids, and comets. The unaided eye can see a few of these objects. Others can only be seen with scientific instruments such as telescopes.

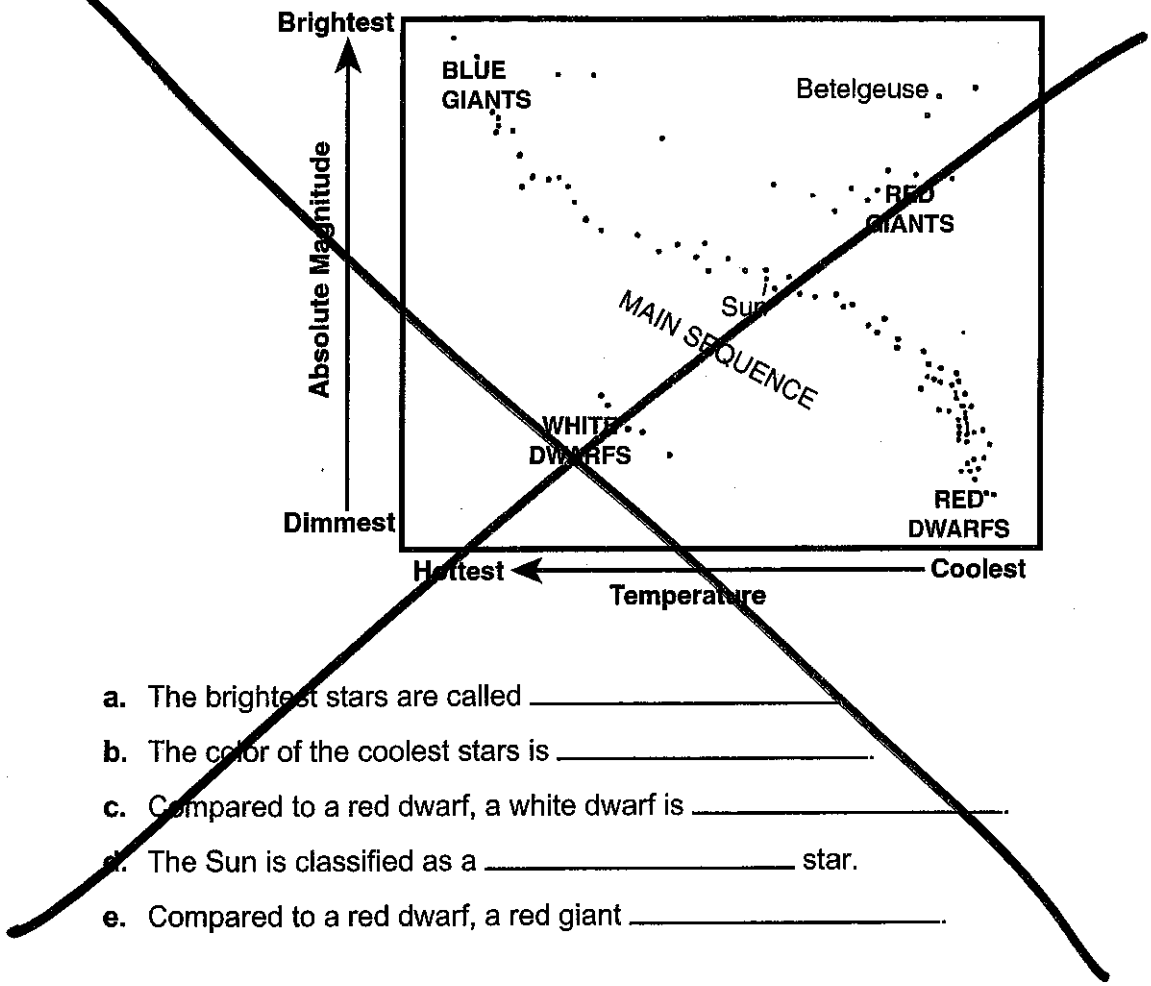
Stars are spherical masses of hot gases that produce energy. These luminous bodies look small because they are so far away. The distances between stars is vast and can not be measured in ordinary distance units such as kilometers. Astronomers use the unit "light year" to measure distances in space. A light year is the distance light travels in a year.

The objects in the universe are in motion relative to Earth and to each other. Astronomers have evidence that our universe is expanding. Most stars and galaxies of stars are moving away from each other.

Review Questions

1. The universe is mostly _____.
2. Light, heat, and ultraviolet radiation are types of _____ produced by stars.
3. The most common gaseous element found in stars is _____.
4. Large distances in space make stars appear very _____.
5. In the universe all objects are in motion and moving _____ each other.

6. The graph below shows the temperature and brightness of some types of stars.



a. The brightest stars are called _____

b. The color of the coolest stars is _____.

c. Compared to a red dwarf, a white dwarf is _____.

d. The Sun is classified as a _____ star.

e. Compared to a red dwarf, a red giant _____.

The Solar System

Our Sun is about 4.6 billion years old. It is the central and largest body of our solar system. The Sun is the nearest star to Earth. It is an average sized, yellow star which produces energy by the fusion of hydrogen gas. Some of the features on the Sun's surface are eruptions called solar flares and dark, cool areas known as sunspots.

Planets are solid bodies which move in definite paths around a central star. Gravity keeps the planets in orbit around the star. There are two types of planets in our solar system. Terrestrial planets are the inner planets closest to the Sun. They are small, dense, and rocky. The Jovian or outer planets are large, gaseous, and have low densities. All planets have nearly spherical shapes. Each planet revolves around the Sun in an almost circular path called an ellipse. Each planet also rotates or spins on an axis.

Our solar system includes other solid objects. **Moons** orbit the planets. The Jovian planets have more moons than the terrestrial planets. **Asteroids** are large, irregular shaped rocks that orbit the Sun. Most asteroids are found between Mars and Jupiter. **Comets** are masses of ice and embedded rock debris. This ice is made of water, ammonia, methane, and carbon dioxide. As a comet orbits the Sun,

it will begin to warm and vaporize as it gets closer to the Sun. The comet's vapor and debris trail becomes visible when it reflects sunlight. As the comet melts it leaves behind a trail of rock debris. This rock debris becomes meteoroids. **Meteoroids** are rock fragments in space that can be as big as a boulder or as small as dust. When a meteoroid enters our atmosphere, the heat from friction causes it to disintegrate in a visible streak across our sky. Many meteoroids and asteroids have hit planets and moons forming craters.

Most objects in the solar system have regular and predictable motions. Most of these objects rotate and revolve in a known pattern. These motions helps us to explain the occurrences of a day, a year, phases of the moon, eclipses, tides, and meteor showers.

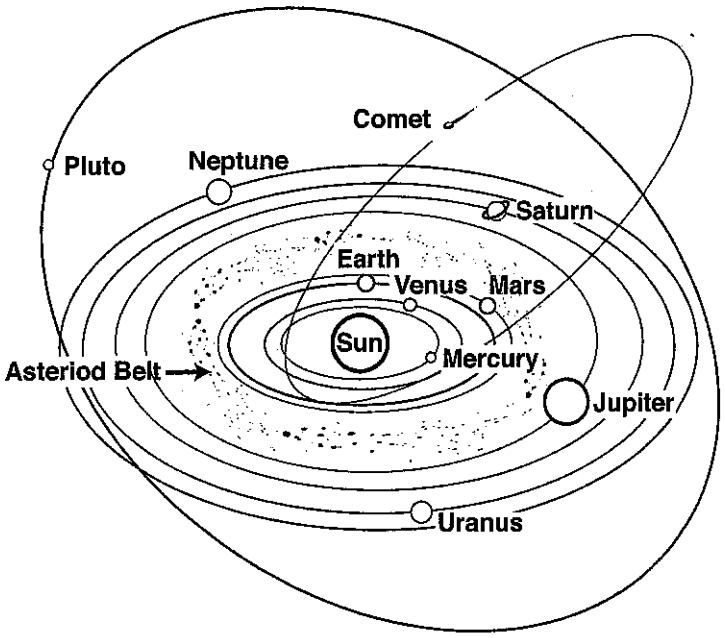


FIGURE 1. SOLAR SYSTEM (not to scale)

Review Questions

7. Compared to other stars, our Sun is an _____ sized star.
8. The planets stay in orbit around the Sun because of _____.
9. Jupiter is a large planet of low density; it is classified as a _____ planet.
10. Solid objects which orbit planets are called _____.
11. The phrase "dirty snowball" could best describe a _____.
12. Smaller rock particles in the solar system are _____.
13. Impacts of asteroids and meteors on a planet's surface will form a _____.
14. All objects in the solar system _____; they rotate and revolve.

The Moon

The Moon is a natural satellite of Earth. It revolves around Earth in a nearly circular, or elliptical path. Its period of revolution is $27^1/_3$ days, and its period of rotation is also $27^1/_3$ days. The same side of the Moon always faces Earth because the rate of rotation is equal to the rate of revolution.

We see the Moon because it reflects light from the Sun. The amount of reflected sunlight that we see from the Moon varies during the month as the Moon revolves around Earth. This monthly cycle is observed as the **Moon phases**. The phases include: *new moon*, when the Moon is between the Sun and Earth and is not visible from Earth, *first quarter* when half the Moon appears to be lit, *full moon* when the Moon appears fully illuminated , and *last quarter* when the Moon appears again as half lit.

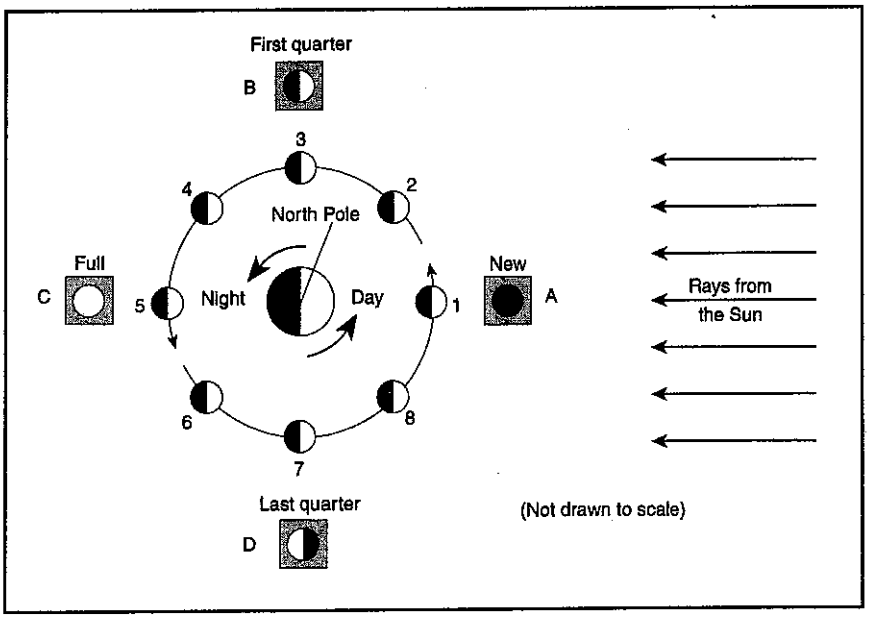


FIGURE 2. MOON PHASES

The interactive movements of the Moon and Earth relative to the Sun cause **eclipses**. Eclipses only occur when the Moon, Earth, and Sun are exactly lined up in space. During a solar eclipse the Moon is between Earth and the Sun. In this position the Moon's shadow falls on Earth so that the Sun is not visible. During a lunar eclipse, Earth is between the Moon and the Sun so that Earth's shadow darkens the full moon.

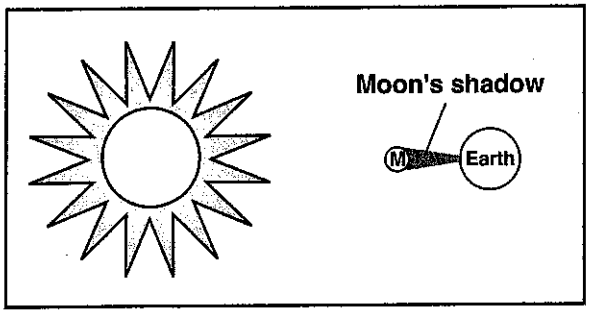


FIGURE 3. SOLAR ECLIPSE

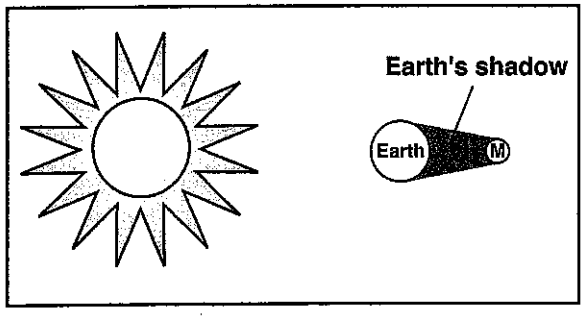


FIGURE 4. LUNAR ECLIPSE

Tides are the cyclic pattern of water rising and falling along the ocean shoreline. They are caused by the gravitational pull of the Moon and Sun on Earth's oceans. Since the Moon is closer to Earth, the Moon has more effect on the tides.

Review Questions

16. The Moon revolves around Earth once every _____ days.

17. We see the Moon because it reflects light from the _____.

18. Moon phases describe the part of the Moon that is _____ to us on Earth.

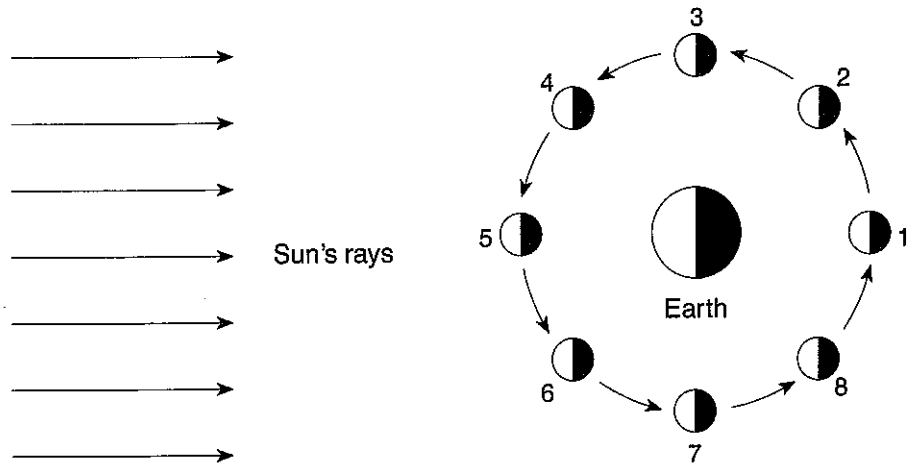
19. Phases of the Moon occur because the Moon _____ around Earth.

20. The cycle of Moon phases repeats about once every _____.

21. During a lunar eclipse, the _____ is not visible to observers on Earth.

22. Tides are caused by the gravitational pull of the _____ on the oceans.

23. Refer to the diagram which shows eight positions of the Moon relative to Earth and the Sun.



(Not drawn to scale)

a. Full moon phase is at position. _____

b. A lunar eclipse could occur at _____

c. More of the Moon becomes visible as it goes from position _____ to _____.

d. The arrows indicate the motion called _____.

e. The Moon at position **8** is visible during the (daytime) (nighttime) on Earth.

Earth's Motions

Earth is in motion. Earth's motions include rotation (spinning on its axis) and revolution (orbiting around the Sun).

Earth **rotates** or spins on an imaginary axis about once every 24 hours (one day). The axis is tilted at an angle of 23½°. Earth rotates from west to east, or counterclockwise. Earth's rotation causes the Sun, Moon, and most stars to appear to rise toward the east and set toward the west. Celestial objects, such as the Sun, Moon, planets and stars, appear to move across our sky due to the rotation of Earth.

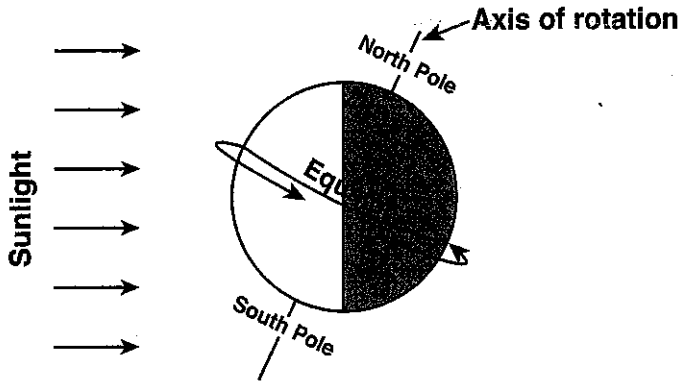


FIGURE 5. EARTH'S ROTATION

Earth **revolves** or orbits around the Sun every 365¼ days (one year). The path of revolution is nearly circular (elliptical) in a counterclockwise direction. Earth's revolution around the Sun causes apparent yearly changes in the celestial objects that are seen from Earth.

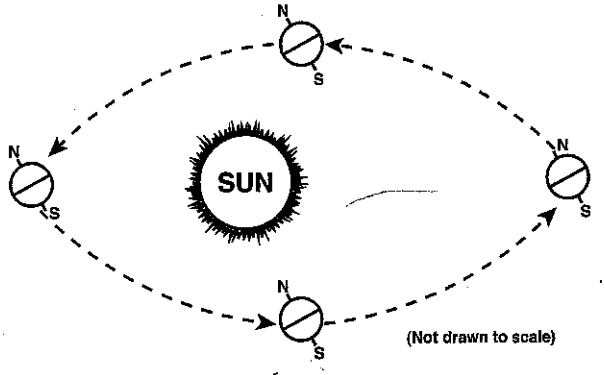


FIGURE 6. EARTH'S REVOLUTION

Review Questions

24. A planet is _____ when it spins on its axis.

25. Planets are _____ when they orbit the Sun.

26. Most stars appear to rise towards the _____ and set towards the _____.

27. Earth rotates once every _____.

28. One Earth revolution around the Sun takes _____ days.

Seasons

Seasons are caused by the tilt of Earth's axis relative to the Sun as Earth revolves. **Summer solstice** usually occurs on June 21st when the Northern Hemisphere is tilted toward the Sun. The Northern Hemisphere then receives the most direct Sun rays and the longest hours of daylight. The summer Sun is highest in the sky and casts the shortest shadows. The North Pole has 24 hours of daylight, while the South Pole is in darkness .

Winter solstice usually occurs on December 21st. The Southern Hemisphere is tilted toward the Sun while the Northern Hemisphere leans away from the Sun. As a result, the Northern Hemisphere receives the least direct sunlight and daylight hours are the shortest. The winter sun is lowest in the sky casting very long shadows. Those that live south of the Equator have direct Sun rays, long daylight hours, and high Sun. In winter the North Pole is in darkness, while the South Pole has 24 hours of daylight.

March 21st is usually the spring equinox, and September 21st is usually the fall equinox. On an **equinox** the Sun is most direct at the Equator. There are 12 hours of daylight and 12 hours of night worldwide.

If Earth were not tilted the seasonal change in the Sun's position and resulting weather changes would not occur. All planets in the solar system are tilted.

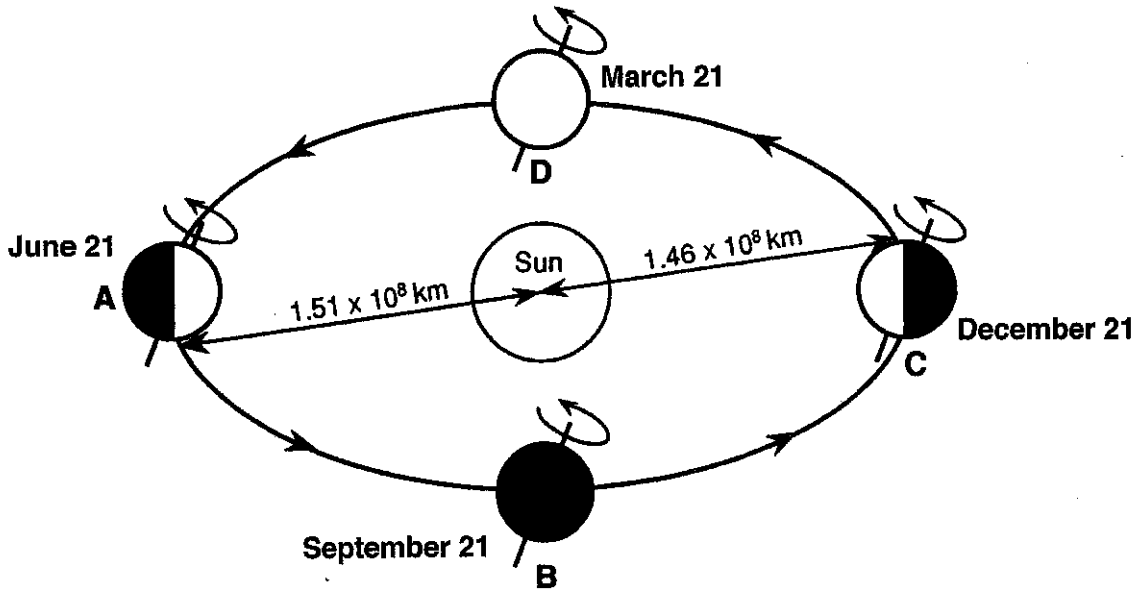


FIGURE 9. EARTH REVOLUTION AND TILT FOR SEASONAL DATES.

Review Questions

34. Seasonal changes on Earth are caused by the _____.

35. The Sun is most direct in New York when the axis leans _____ the Sun.

36. When the Sun is highest in the sky, shadows are _____.

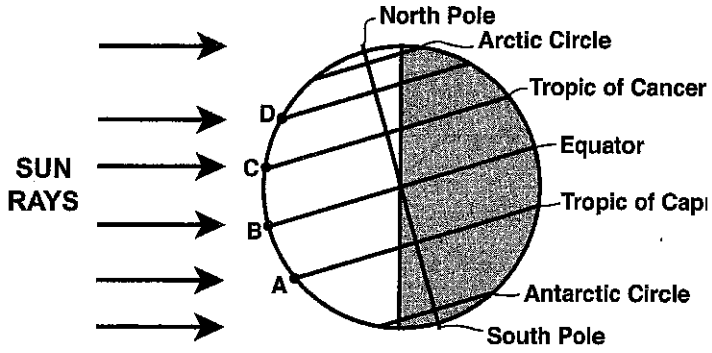
37. When it is summer in the United States, South America has _____.

38. A planet that has no axis tilt would not experience _____ change.

39. In the chart, place an "**X**" in the column(s) for which the statement is correct.

	Statement	Winter	Summer	Fall/Spring
a.	Equinox season			
b.	Sun is lowest in the sky in NY			
c.	In New York, the Sun is most direct			
d.	Longest shadows cast by the Sun in New York			
e.	12 hours of daylight worldwide			
f.	Longest daylight hours in New York			
g.	Occurs on December 21			
h.	Earth's axis tilts towards the Sun			
i.	North Pole has 24 hours of daylight			

40. The diagram shows the tilt of Earth relative to the Sun for one season.



a. The season in the Northern Hemisphere would be _____.

b. The North Pole would have _____ hours of daylight.

c. The Sun is highest in the sky for the _____ Hemisphere.

d. Longest daylight hours will occur in the _____ Hemisphere.

e. Position **A** will have _____ season.

f. The South Pole will have _____ hours of daylight.

g. The latitude of position **B** is _____.

CHAPTER REVIEW

1. The area between stars is mainly

(1) hydrogen gas
(2) empty space
(3) dust particles
(4) planets and their moons

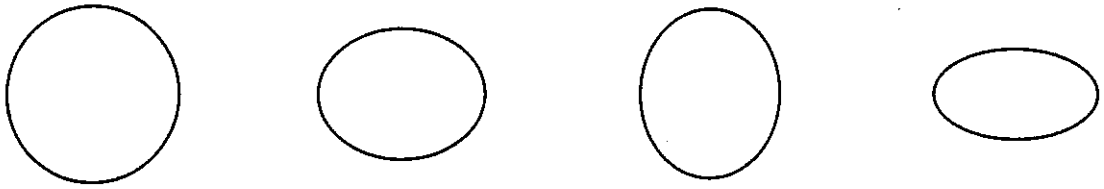
2. Compared to distances between planets in our solar system, the distance between stars is

(1) much less (2) much greater (3) about the same

3. The Sun's position in space is best described as the approximate center of

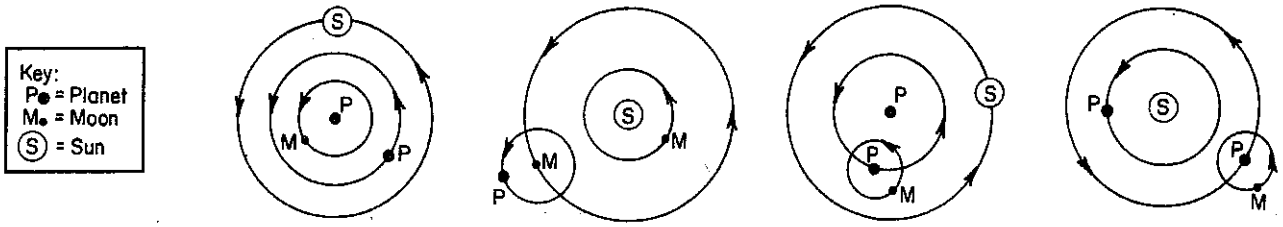
(1) a constellation
(2) the universe
(3) the Milky Way galaxy
(4) our solar system

4. Which diagram most accurately shows the shape of Earth?



(1) (2) (3) (4)

5. Which diagram best represents the motions of objects in the solar system?



(1) (2) (3) (4)

6. A planet is viewed from Earth for several hours. The diagrams show the planet at four different times.

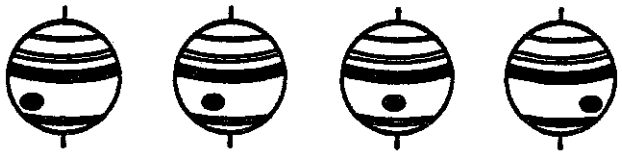
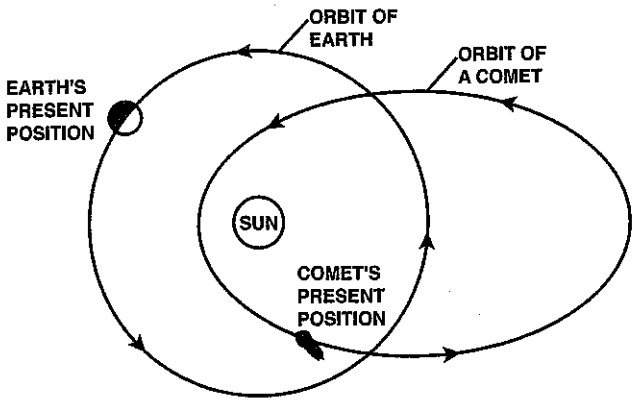


DIAGRAM A DIAGRAM B DIAGRAM C DIAGRAM D

The best explanation for these observations is that the planet is

(1) tilted on its axis
(2) changing seasons
(3) revolving
(4) rotating

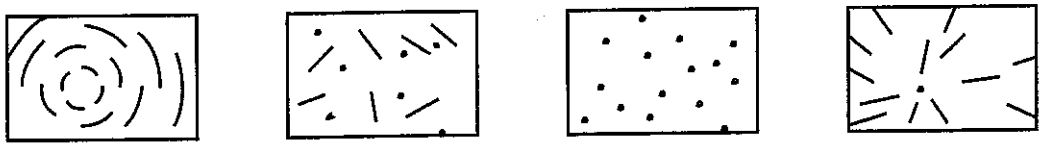
7. The diagram below shows Earth's orbit and the orbit of a comet around the Sun.



A comet is similar to Earth in that they both

(1) have liquid water
(2) are the same size
(3) orbit the Sun
(4) are frozen

8. How would the stars appear through the night if Earth did ***not*** rotate?



(1) (2) (3) (4)

9. Which group is outside the solar system?

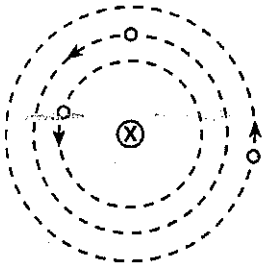
(1) planets (2) asteroids (3) moons (4) Andromeda galaxy

10. Which force keeps the planets in orbit around the Sun?

(1) friction (2) electrical (3) magnetism (4) gravity

11. The diagram below shows three planets in orbit. What object is represented by the letter **X**?

(1) comet
(2) moon
(3) star
(4) asteroid



(Not drawn to scale)

12. Which motion causes the apparent rising and setting of Sun each day?

(1) Earth revolving around the Sun
(2) Earth rotating on an axis
(3) Moon rotating on an axis
(4) Moon revolving around Earth

13. The phases of the Moon are caused by the

(1) Earth's revolution around the Sun
(2) Moon's revolution around Earth
(3) Moon's rotation on its axis
(4) Earth's rotation on its axis

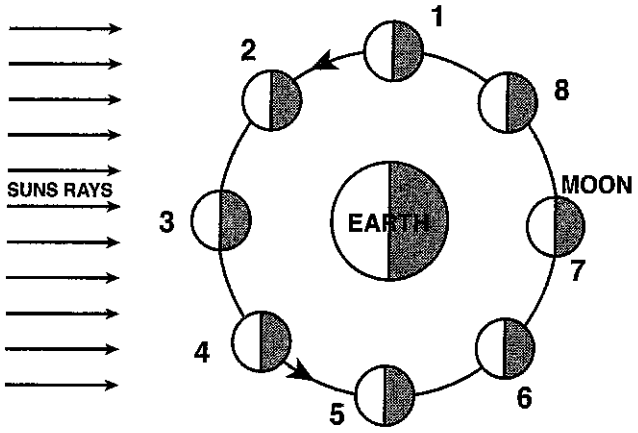
14. Which object would orbit a planet?

(1) an asteroid (2) a comet (3) a star (4) a moon

15. The Moon's gravitational force has a greater effect on the ocean tides of Earth than the Sun's gravitational force. What is the reason for this?

(1) The Moon has a greater mass than the Sun.
(2) The Moon is closer to Earth than the Sun.
(3) The Moon's mass is less than the Sun.
(4) The Moon is a solid.

Base your answers to **questions 16-18** on the diagram below which shows eight positions of the Moon as it revolves around Earth.



16. The time it takes for the Moon to completely orbit Earth is approximately a

(1) day (2) week (3) month (4) year

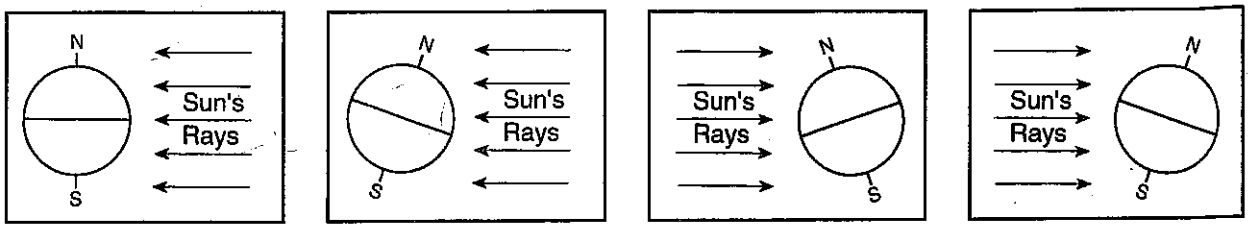
17. At which position would the Sun be eclipsed if Earth, Moon, and Sun were exactly lined up?

(1) 1 (2) 3 (3) 5 (4) 7

18. As viewed from Earth when the Moon is at position **7** it would appear as

(1) (2) (3) (4)

19. Which diagram would represent the first day of winter in the Northern Hemisphere?



(1) (2) (3) (4)

20. The apparent daily motion of the Sun across the sky is caused by

(1) Earth's rotation on its axis
(2) Earth's revolution around the Sun
(3) Sun's revolution around earth
(4) Sun's rotation on its axis

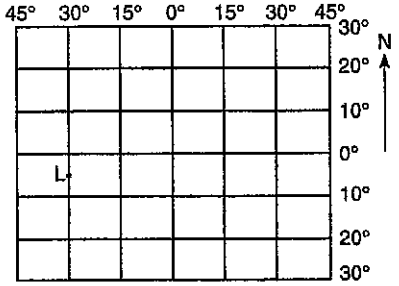
21. The length of an Earth day is equal to one:

(1) Earth rotation
(2) Earth revolution
(3) Moon rotation
(4) Moon revolution

22. Which change would occur if Earth rotated faster?

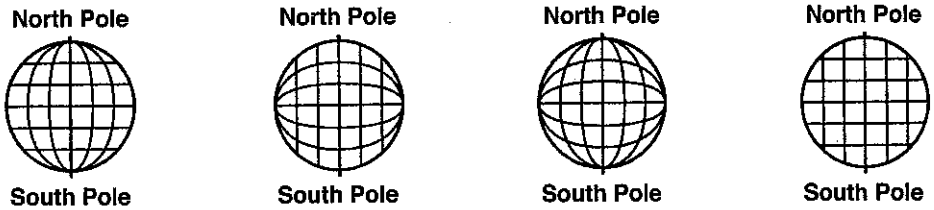
(1) The year would be shorter
(2) The day would be shorter
(3) The day would be longer
(4) The year would be longer

23. The diagram represents part of Earth's latitude-longitude system. What is the latitude and longitude of point **L** ?



(1) 5°E, 30°N (2) 5°W, 30°S (3) 5°N, 30°E (4) 5°S, 30°W

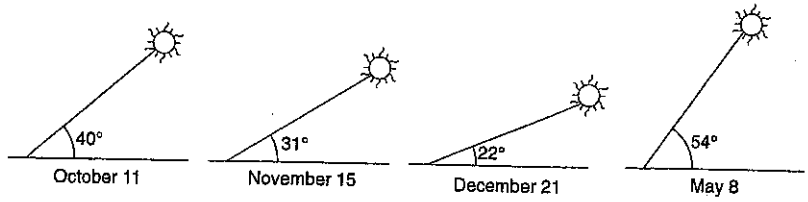
24. Which diagram is most similar to Earth's latitude-longitude system?



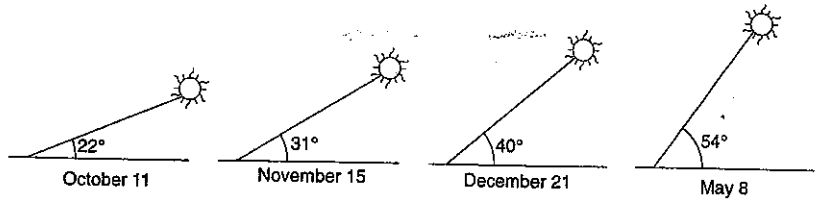
(1) (2) (3) (4)

25. A student accurately measures the altitude of the noon Sun from the same location on four days during the school year. Which is the correct sequence?

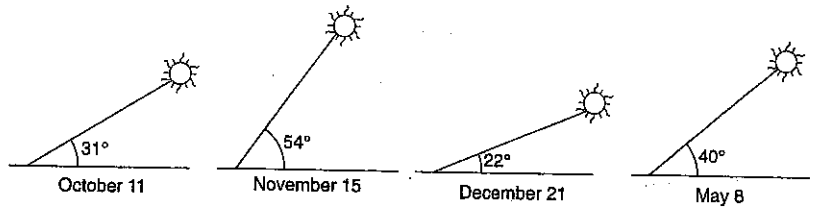
(1)



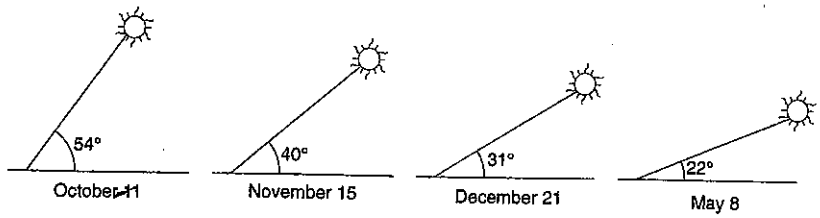
(2)



(3)



(4)



26. Summer days are hotter than winter days because in the summer

(1) Earth is closer to the Sun

(2) the number of sunspots increases

(3) the Sun's rays are more direct

(4) the Sun gives off more energy

27. Which is true of winter in New York?

(1) The Sun is higher in the sky, daylight is shorter

(2) The Sun is higher in the sky, daylight is longer

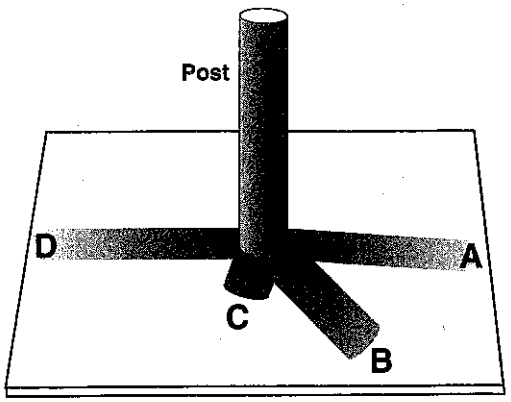
(3) The Sun is lower in the sky, daylight is longer

(4) The Sun is lower in the sky, daylight is shorter

28. In what general direction does an observer look to see the sunset each day?

(1) north (2) south (3) east (4) west

29. The diagram shows a vertical post which casts shadows A, B, C, and D at four different times during the day. Which shadow was cast when the Sun was highest in the sky?



(1) A (2) B (3) C (4) D

30. Seasonal changes on Earth are caused by the revolution of Earth and

(1) its rotation on its axis
(2) the tilt of its axis
(3) the Moon's revolution
(4) the distance to the Sun