



1

The Universe

THE UNIVERSE

The heavenly bodies such as the sun, moon, planets and stars have been known to mankind since the existence of life on the earth. In ancient times, people were of the opinion that these heavenly bodies were Gods and spirits. They also believed that the universe consists only of the limited area where they live or consists of the places which were known to them.

However, with the passage of time, man gained knowledge about the universe. The branch of science which deals with the study of heavenly bodies is called **astronomy**. Astronomers (scientists who study about the heavenly bodies) explored lots of theories about



Fig. 1.1 The universe

the universe and they are still in the process of this study. The universe is thus defined as **the vast surrounding space which includes everything that exists from the earth to the most distant parts of space that one can possibly see**. The earth, stars, planets, satellites and all the objects in it are parts of the universe. It is not known till date how big the universe is and whether it has any limit or not. We can imagine the vastness of the universe from the fact that the planet earth on which we live is only a tiny part of this big universe.

THE STARS

We know that during daytime, the sun is the only object visible in the sky. However, as soon as it becomes dark after the sunset, the sky appears dotted with thousands of bright objects. When viewed from the earth, the objects which appear to twinkle are called **stars**. These stars emit the light of their own.

Most of the stars are bigger than the earth. Some stars are even much bigger than the sun. They appear small because they are very far away from us. Stars are only visible at night but it does not mean that they are not present

in the sky during daytime. They cannot be seen during the day because of the bright light of the sun.

There are other star-like bodies in the sky which do not twinkle but appear to shine with a steady light. They are called **planets**. They do not emit light of their own but reflect the light received from the stars. Planets revolve around the stars while rotating around themselves. The earth is also a planet. It revolves around the sun while rotating on its axis from west to east.

We see another bright body in the sky at night *i.e.*, the **moon**. The moon revolves around the earth. Such bodies which revolve around a planet are called **satellites** or **moons**.

We can see around 3,000 stars through our naked eyes. The other stars can be seen through a telescope. The stars are very far away from each other.

THE SOLAR SYSTEM

All the heavenly bodies like the planets, satellites, asteroids, comets and meteors which constitute the universe move around the sun to form a **solar system**. The word solar is derived from the Latin word *sol* which means the sun. We will now study in brief in this chapter about these heavenly bodies.

THE SUN

Stars are the celestial bodies that continuously emit heat and light. The sun is also a star located at the centre of the solar system. It is about 4.5 billion years old and comparatively, it is younger than many other stars. The sun appears large as compared to other stars because it is nearer to the earth. Though many stars are bigger than the sun, still they appear to be tiny or dot-like because they are far

away not only from the earth but also from the sun. Most of the stars are so far away from the earth that even light from them takes millions of years to reach the earth. The distances of stars are, therefore, expressed in terms of **light years**. *One light year is the distance travelled by light in one year at a speed of about 300,000 kilometres per second.* Light year is a unit of distance and is equal to $300,000 \times 365 \times 24 \times 60 \times 60$ km or 9.46×10^{12} kilometres.

The approximate distance of the sun from the earth is 150,000,000 km, which means that light takes around 8 minutes and 20 seconds to reach from the sun to the earth with a speed of about 3.0×10^8 ms⁻¹.

The diameter of the sun is about 100 times the diameter of the earth and its mass is more than a million times the mass of the earth. At the surface of the sun, the temperature is about 6000°C but near the centre of the sun, the temperature is about 15 million degree celsius.

The sun is full of hydrogen and helium gases, so it is a glowing ball of hot gases. It is the only source of heat and light for all the planets of the solar system. For the existence of life on the earth, heat and light are the essential factors which we receive from the sun. This is an endless process with which we are blessed.

The sun is considered to have four layers although there is no clear boundary between these layers.

Corona : It is the outermost layer of the sun's atmosphere. It is full of gas particles although the density of gas particles is very low. It has a temperature of about 6,000°C.

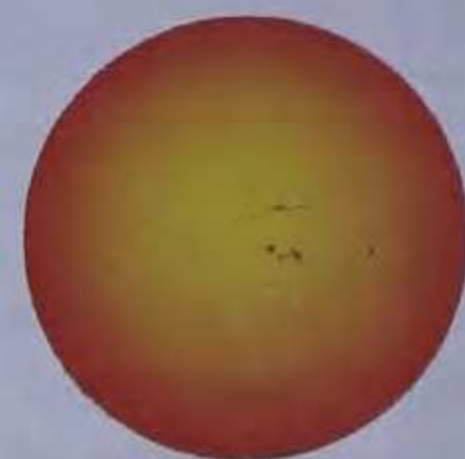


Fig. 1.2 The sun

Chromosphere : The layer which is below the corona is called the chromosphere. It is several thousand kilometres thick (about 2,500 km), but sometimes, this can expand even up to 16,000 km because gases can flow and spread. The average temperature of the chromosphere is about 28,000°C.

Photosphere : It is a layer below the chromosphere. It is about 550 km thick and we usually refer to it as the **surface of the sun**.

Core : Main mass of the sun is at its centre. This is called the core of the sun. At the edge of the core, the temperature is about 1 million degrees centigrade, but near the central region, it is believed to be about 15 million degrees centigrade. The fusion of hydrogen into helium produces very high energy. This energy produced increases the temperature.

PLANETS

At night if you look carefully at the sky, you will observe that some objects do not twinkle like stars. Our ancestors noticed that they appear to change their positions with respect to the stars. They called them planets which means wanderers. In Hindi, planets are called *Grah*.

The planets also receive most of the heat from the sun.

Planets which are nearer to the sun travel at a faster speed than those which are far away. The earth is the only planet which is known to sustain life in the planetary system.

Planets revolve around the sun in large elliptical paths called **orbits**. Every planet has its own orbit and each planet traverses through

its own orbit while revolving around the sun. In ancient times, people called them wandering stars. Gradually they were named as Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto (Fig. 1.3).

According to the latest theory there are now only eight classical planets while Pluto which was the ninth planet is known as a dwarf planet.

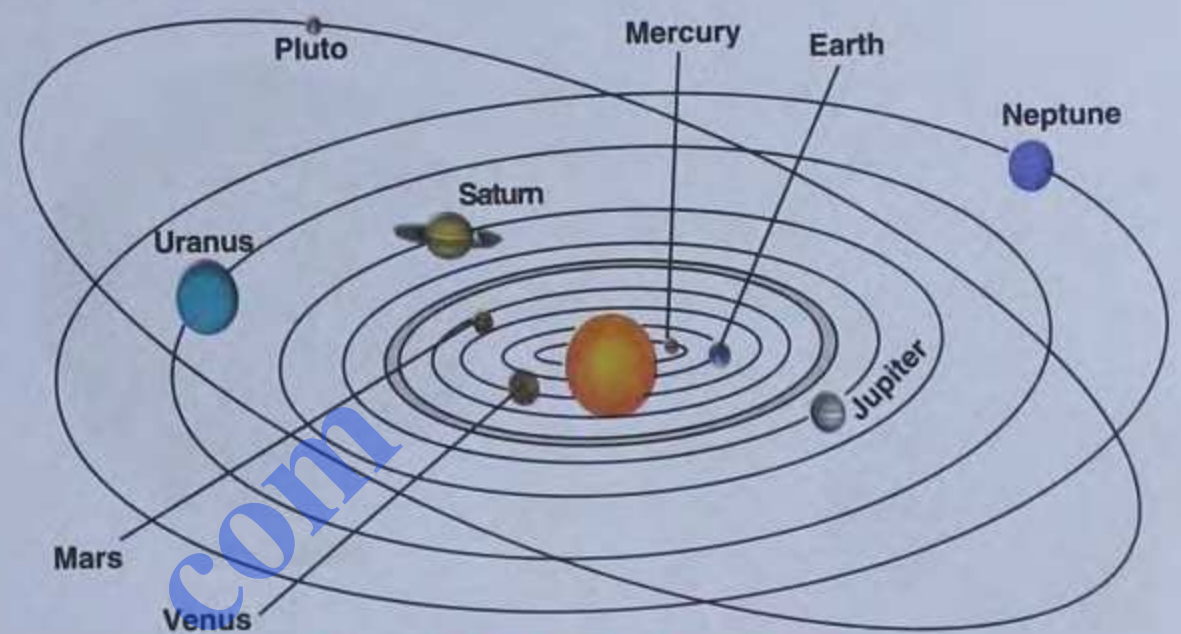


Fig. 1.3 The Solar system

A classical planet is a celestial body that:

- (1) orbits around the sun.
- (2) has sufficient mass for its self-gravity to pull it into a nearly spherical shape.
- (3) has a clear neighbourhood around its orbit.

Why Pluto is not a classical planet :

It fails to meet the third condition. Its oblong orbit overlaps the orbit of Neptune.

Other dwarf planets are Eris, Haumea, Makemake and Ceres.

Thus, a new definition of classical planet and dwarf planet has been given by International Astronomical Union (IAU) after a meeting in prague with 2500 scientists.

So as a result we now say that there are only eight planets revolving around the sun.

All these planets are spherical in shape. Compared to the sun, the planets are quite small and relatively cool.

Besides revolving around the sun, every planet rotates about its own axis. The sun also rotates about its own axis. The time taken by a body to complete one full rotation is called its **period of rotation**.

(A) CLASSICAL PLANETS

1. Mercury (Budh) :

Mercury is the planet nearest to the sun. It is the smallest and the second hottest planet of the solar system. Though Mercury is not a star, but it is also known as morning star as it is visible in the east just before the sunrise. Life is not possible on this planet as there is no atmosphere. It does not have any satellite.



MERCURY

2. Venus (Shukra) :

Venus is the brightest planet in the entire solar system. The bright appearance of Venus is due to its cloudy atmosphere, which reflects almost three-fourth of the sunlight that falls on it. This atmosphere makes Venus the hottest planet in our solar system because it traps heat and causes greenhouse effect. The mass of Venus is nearly 4/5 times that of the earth, while both are nearly the same in size. Life is not possible on this



VENUS

planet too. It also does not have any satellite.

3. Earth (Prithvi) :

The earth is the third planet in terms of distance from the sun. It is a planet which has a large quantity of water. It is surrounded by a thick layer of atmosphere which contains nitrogen, oxygen, carbon dioxide, etc. Life exists on this planet. The earth rotates about an imaginary axis that passes through its North and South Poles. The axis of rotation of the earth is slightly tilted with respect to the plane of its orbit. The day and the night on the earth occur due to this rotation. It also revolves around the sun in its orbit. The earth completes its journey around the sun in 365.25 days, which we call a year. The earth has only one satellite, which is called, the moon.

The change in seasons on the earth takes place due to the tilting of its axis of rotation and the change in its position with respect to the sun. Figure 1.4 shows the position of the earth in its orbit at four different times of the year. Note that the tilting of the axis of rotation of the earth is always in the same direction. As a result, the tilting of the northern and southern hemispheres of the earth towards the sun keeps changing throughout the year. When the northern hemisphere is tilted towards the sun, we experience summer, while it is winter season in the southern hemisphere. Autumn and spring occur when the earth is in-between its orbit.

On June 21, we have the longest day in the northern hemisphere while it is the shortest in the southern hemisphere.

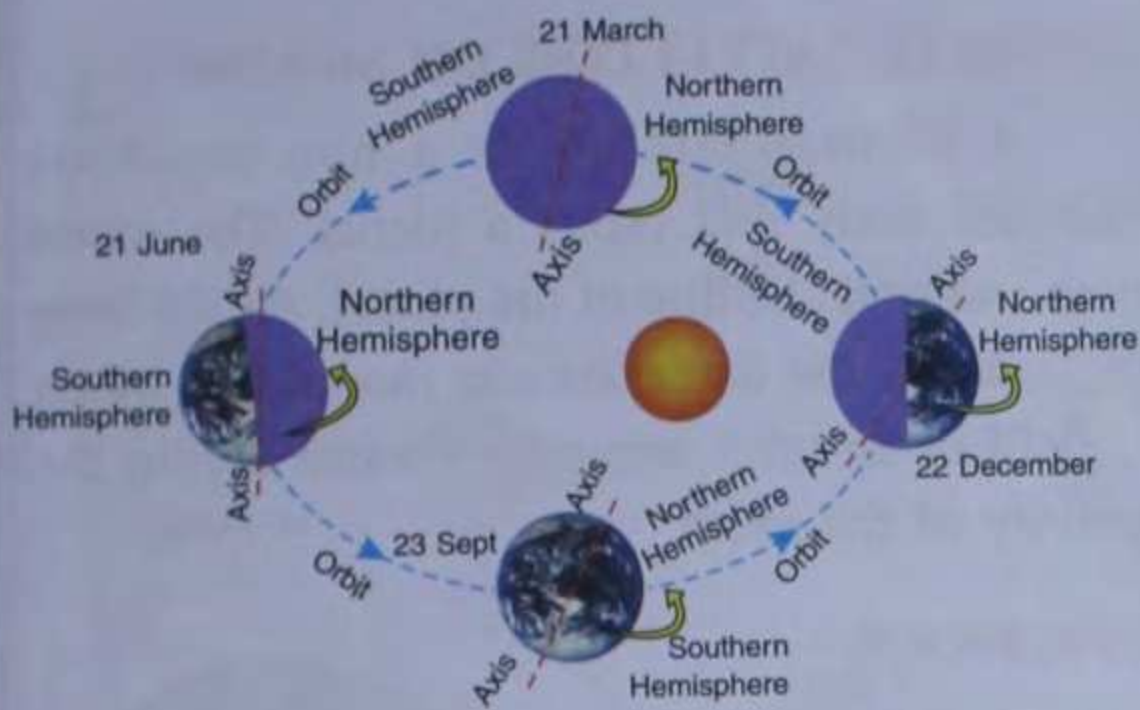


Fig. 1.4 Occurrence of change in seasons due to the earth's position in its orbit around the sun and the tilting of its axis of rotation

On December 22, the length of the day is the shortest in the northern hemisphere and the longest in the southern hemisphere. On September 23 and March 21, the duration of day and night is equal in both the hemispheres.

4. Mars (Mangal) :

Mars is the fourth planet from the sun. The surface of Mars is reddish in colour, because a large amount of iron oxide is present so it is called the red planet. Its atmosphere contains very little amount of oxygen, nitrogen and carbon dioxide. It has a thin atmosphere that makes it easier to view its surface from the earth. Astronomers have noticed certain changes on the surface of Mars that gave them an idea that water may also be present on the planet and it may have life in some form. However, so far, no evidence of water or life has been found on it although possibility of their existence is still being investigated. Mars has two natural



MARS

satellites or moons named Phobos and Deimos.

5. Jupiter (Brihaspati) :

It is the largest planet of the solar system and is about 318 times heavier than the earth. It receives much less light and heat of the sun compared to the earth and Mars. Yet, it appears the brightest of all the planets in the sky except Venus and occasionally Mars. Jupiter's bright appearance is due to its thick atmosphere that reflects most of the sunlight falling on it. It can be seen through the naked eye. Its atmosphere mainly consists of hydrogen and helium. Its cloud-like outer regions consist of methane in a gaseous form while ammonia is present in a crystalline form. It has 67 satellites of its own.



JUPITER

6. Saturn (Shani) : Saturn is the second largest planet of the solar system. It is about 95 times heavier than the earth. The most distinguishing feature of Saturn is its beautiful rings that encircle the planet. There are three distinct rings which are not visible through a naked eye and can be seen only through a telescope. Looking at Saturn through a telescope is a fascinating experience. It is also visible through the naked eye. It has 48 satellites. One interesting thing about saturn is that it is the least dense among all the planets. Its density is less than that of water.



SATURN

7. **Uranus** : When observed through a telescope, Uranus appears as a small disc although its diameter is almost four times that of the earth. Hydrogen and methane have been detected in the atmosphere of Uranus. Its distance from the sun is almost two times that of the Saturn. It is peculiar in the sense that it rotates from east to west, whereas all other planets rotate from west to east. It has 27 satellites.



URANUS

8. **Neptune** : Neptune is about 17 times heavier than the earth. Being very far away from the sun, it is a cold planet and is not visible through naked eye. It has 14 satellites.



NEPTUNE

(B) DWARF PLANET

Pluto : As stated earlier, Pluto is a dwarf planet as its orbit overlaps the orbit of Neptune. Its distance is maximum from the sun and hence it is the coldest and the darkest. Its size is small which is about 0.002 times the mass of earth. It is not visible through the naked eye. It has *five* satellites. It takes 248 earth years to orbit it.



PLUTO

NATURAL SATELLITES OR MOONS

A natural satellite is a non-luminous celestial body that orbits a planet. The moon is the natural satellite of the planet. As we have read above, the earth has one moon. The moon is held in an orbit around the earth due to the gravity of the earth.

THE MOON

The moon is the only natural satellite of the earth which is a non-luminous body. It only shines due to the light received from the sun. As seen through the naked eye, the moon consists of bright and dark patches (low-lying plains). These bright patches are the mountains and craters. The American astronauts Armstrong and Aldrin who landed on the moon in their Apollo 11 space vehicle in July 1969, found that the moon is just a rocky desert with no water and no vegetation. Since the gravitational pull on the moon's surface is only about one-sixth of that on the earth's surface, so there is no atmosphere on the moon. The moon's surface has a day temperature of nearly 100°C and its night temperature is around -168°C . Hence, life is not possible to exist on the moon.



THE MOON

Phases of Moon : As we know that the moon does not have its own light *i.e.*, it is a non-luminous body, it only reflects the light coming from the sun. When the light gets reflected from the moon, it (moon) becomes visible to us.

The moon as we see from the earth appears to change its shape everyday from a thin **crescent** to the **full moon**. This is

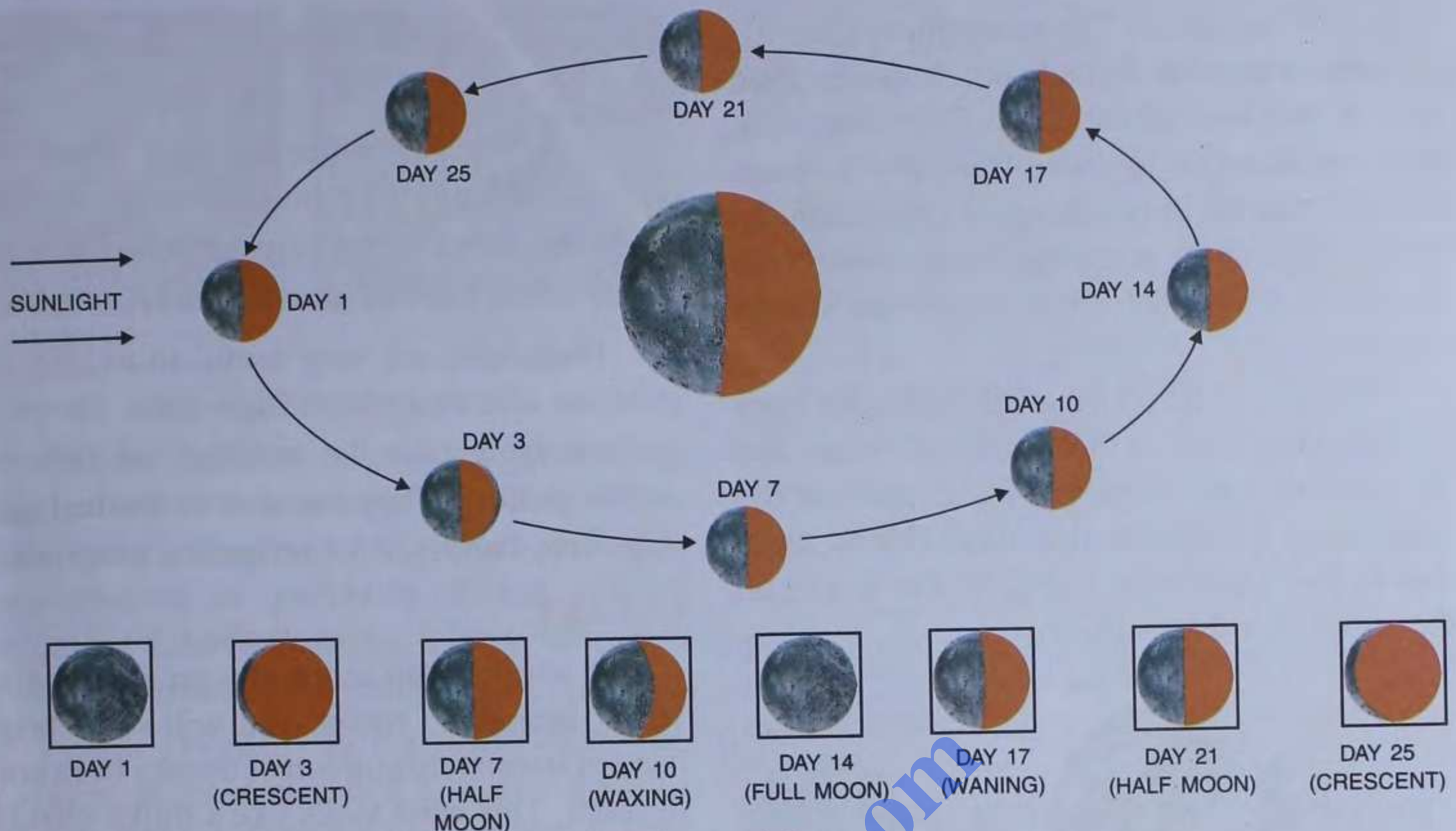


Fig. 1.5 Phases of the moon

because, we see only that part of the moon which reflects the light of the sun to us. The rest of the moon is dark. These different shapes of the moon as seen from the earth are called **different phases** of the moon.

When the side of the moon facing us gets no sunlight at all, we cannot see the moon. We call this a New Moon Day (day 1).

As the moon moves along its orbit, a small portion of the side facing us gets sunlight and we can see the crescent Moon (day 3).

In a week, we can see half of the moon (Day 7).

In 10 days time, we can see three quarters of the moon. This is called gibbous moon or waxing (Day 10).

In 14 days time, the entire side of the moon facing us gets sunlight. We can see Full Moon (Day 14).

After this, the phases are reversed as shown in Fig. 1.5.



Do You Know ?

The time period between one full moon to the next full moon is slightly longer than 29 days. In many calendars this period is called a month.



Intext Questions



1. Can we hear any sound on the moon ?
2. Why does the moon change its shape every day ?

SIZE AND SHAPE OF MOON

The moon is almost like a spherical ball with a diameter of about 3500 km. Its distance from the earth is about 3,84,000 km. There is a very large variation of temperature on the

surface of the moon. The moon moves around the earth in an oval-shaped path. It moves from west to east around the earth. From the earth, however, it seems to move from east to west. This is because, the earth spins faster than the moon. The moon completes one rotation on its axis as it completes one revolution around the earth.

TIDES : The water level of the sea rises or falls twice a day exactly after 12 hours and 24 minutes. **This regular rise or fall of the water level of sea is called tide.** This happens due to the gravitational pull of the moon on the surface of the earth.



Fig. 1.6

Consider four points A, B, C and D on the surface of the earth, (Fig. 1.6). Clearly, these points are at different distances from the moon.

At A, the sea water is strongly attracted by the moon's gravitational pull and hence water tends to bulge outwards (as shown by the arrow). At B also, it bulges outwards, because the earth as a whole, experiences a gravitational pull due to moon. Consequently, both at A and B, the level of sea water rises which is called **high tide**.

On the other hand, the sea water at C and D is at a lower level because of the less attractive force. This is due to the varying distances as compared to the point A

with respect to the moon. This is called **low tide**.

At any place on the seashore, a high tide occurs only after 12 hours and 24 minutes while the time interval between a high tide and a low tide is about 6 hours and 12 minutes.

High tides are very useful to us. We can generate electricity with high tides. Heaps of garbage lying near the seashore are removed with high tides. They can also move the bigger ships into harbours for unloading purposes.

GALAXY

If you look up at the sky on a clear night when there is no moon, you will see a bright band of stars stretching across the sky from north to south. This band looks like a milky cloud of stars, and is called **Milky Way**. In other words, this Milky Way is known as **galaxy**. A galaxy is a huge group of stars, gas and dust bound together by gravity. In fact, galaxies are the building blocks of the universe.

According to an estimate, there are about 10^{11} galaxies in this universe. On an average, it has been estimated that there are about 10^{11} stars in each galaxy. Galaxies can be spiral, elliptical or irregular. A new type of galaxy was discovered recently, called a "starburst galaxy".

The Milky Way : Our own galaxy is known as Milky Way (*Akash Ganga*). It is a spiral galaxy. When viewed from above, the stars are seen to be arranged in spiral arms that emerge from the nucleus of the galaxy (Fig. 1.7a). From the earth, we get a side view of the Milky Way (Fig. 1.7b). This is because the earth itself is a part of the galaxy. The Milky Way extends to about 1,00,000 light years. The Indian name of the Milky way galaxy is Akash Ganga.



1,00,000 LIGHT YEARS
(a) View from above



30,000 LIGHT YEARS
(b) Side view

Fig. 1.7 The Milky Way

Constellations : Since ancient times, people were fascinated by the stars. They named group of stars as per their shapes or patterns. These groups are called **Constellations**. There are about 88 constellations known so far.

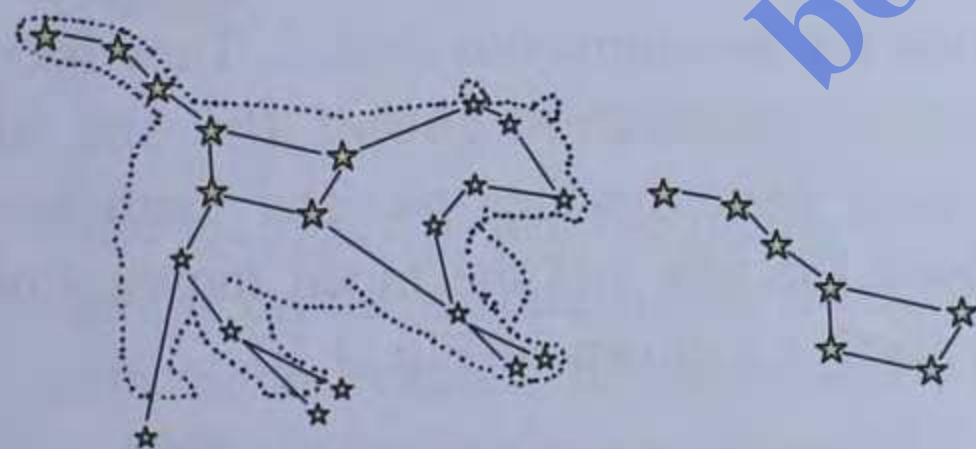
Orion (Vyadha) is a constellation seen in winter. It resembles like a hunter. Another is **Ursa Major (great bear or Saptarishi)**. There are seven major stars including the pole star in Ursa Major. It gives the look of a great bear. A constellation Scorpio (*Vrischika*) is usually seen in summer in the month of April in the northern hemisphere at

night. It closely resembles a Scorpion [see Fig. 1.8(c) given below].

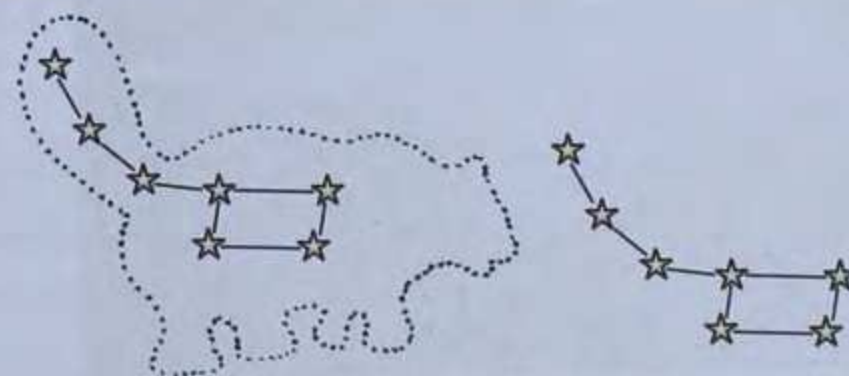
Due to the earth revolving around the sun, different constellations appear in the sky at different times of the year. Also, a particular constellation everyday appears four minutes earlier than it did a day before. The pull of the sun keeps these revolving bodies in fairly stable orbits. The speed of the revolution of each body depends on the size of its orbit and its distance from the sun at a particular time.

Differences between a galaxy and a constellation

Galaxy	Constellation
It is a collection of billions of stars.	It is a group of only few stars.
It does not form any fixed pattern of any animal or an object.	It forms the shape of an animal or an object.
There are around 10^{11} galaxies in the universe.	There are only 88 constellations known so far.



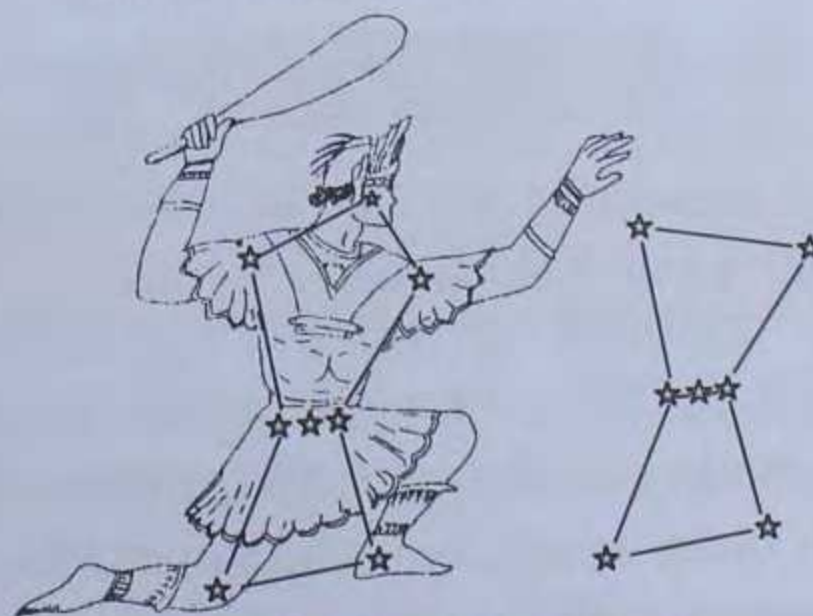
(a) URSA MAJOR (GREAT BEAR)



(b) URSA MINOR (LITTLE BEAR)



(c) SCORPIO constellation



(d) ORION appears like a hunter

Fig. 1.8

MEASUREMENT OF DISTANCE IN UNIVERSE

The heavenly bodies like stars, planets, satellites, *etc.*, may appear close to the earth but in reality, they are very far away. These distances cannot be measured in metres or kilometres as it would be inconvenient to write.

Therefore, these distances are measured in light years and parsec. One light year is the distance travelled by light in one year.

$$1 \text{ light year} = 9.46 \times 10^{12} \text{ km}$$

$$1 \text{ parsec} = 3.26 \text{ light year.}$$

COMETS : A comet is a luminous celestial body which moves about in the solar system in an elliptical orbit. Comets develop long shiny tails when their orbits bring them close to the sun. When a comet is far away from the sun, there is no tail of the comet. Halley's Comet (last seen in 1986) is a periodic comet which reappears after every 76 years (Fig. 1.9).



Fig. 1.9 Halley's Comet



Intext Questions



Halley's comet was last seen in 1986. In which year will it be seen again ?

METEORS : They are small heavenly bodies made up of rocks and metals. They move in outer space, but sometimes, they are pulled by the earth's gravity and try to enter the atmosphere. They instantly become luminous

and evaporate due to the heat produced by friction on entering the earth's atmosphere. They are popularly known as **shooting stars** but they are actually not the stars.

METEORITES : Some of the bigger meteors which do not completely burn on entering the earth's atmosphere and reach the earth's surface are called **meteorites**. They are capable of forming craters on the earth's surface.

ASTEROIDS : Asteroids are minor planets made up of rocks which revolve around the sun mainly between the orbits of Mars and Jupiter. More than 3000 asteroids have been detected so far. An Italian scientist, G-Piazzi discovered the biggest asteroid called **Ceres** on January 1, 1801. Asteroids are considered to be the pieces of a planet which breaks up due to the gravitational pull of Jupiter.

ECLIPSE : We know that the sun is a luminous body, whereas the earth and the moon are non-luminous bodies. They become visible when the light of the sun after striking them reaches us. The earth moves around the sun and the moon moves around the earth as shown in Fig. 1.10.

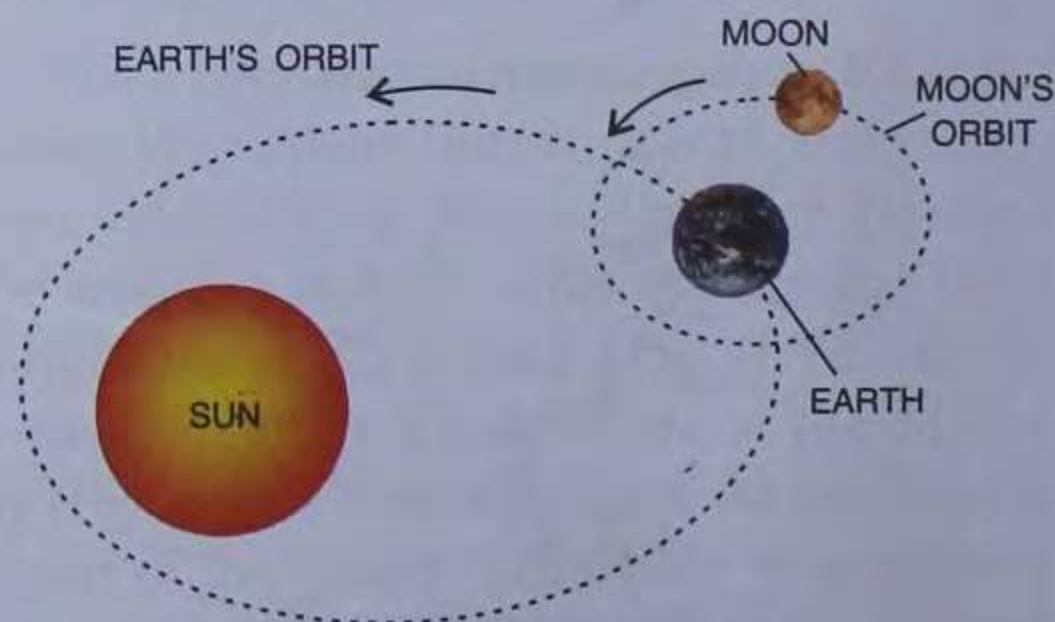


Fig. 1.10 The orbits of the earth and the moon

The sun is bigger than the earth and the earth is bigger than the moon. At times, the sun, the earth and the moon come in a straight line. The earth or the moon which comes in between, casts a shadow and forms an eclipse.

1. Lunar Eclipse : When the moon moves into the shadow of the earth *i.e.* when the earth comes in-between the sun and the moon, it is called **lunar eclipse**. The earth casts its shadow on the moon. If the moon is in the **Umbra** core of the earth's shadow, it is known as **total lunar eclipse**. If the moon is in the **Penumbra** core partially and the rest in the umbra core, it is known as **partial lunar eclipse**. Lunar eclipse always occur on a full moon day *i.e.*, when the sun, the earth and the moon happen to be in a straight line.

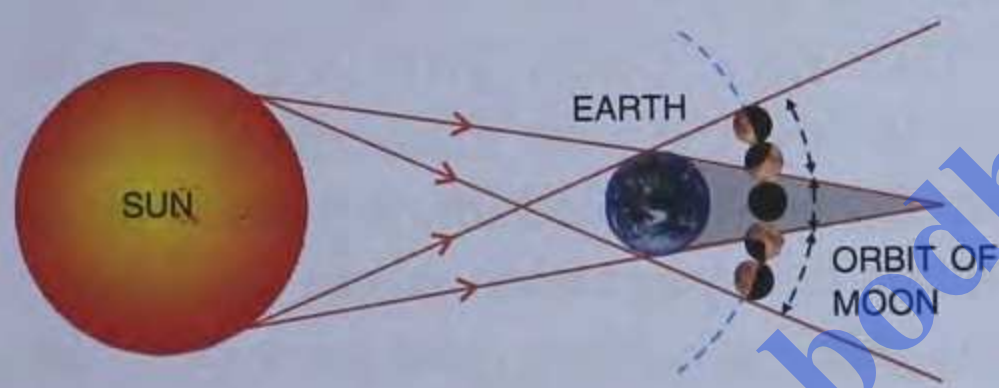


Fig. 1.11 Lunar Eclipse

2. Solar Eclipse : When the moon casts its shadow on the surface of the earth, it is called **Solar Eclipse**. The portion where the shadow falls, becomes dark during daytime. At the time of total eclipse, only the flames of the outer edge of the sun are visible. The rest appears as a dark patch.

On a new moon day, when the sun, the moon and the earth are in a straight line with moon in-between the two, it will cast a shadow on the surface of the earth. If we are in that shadow region, we will not be able to see that

part of the sun which is covered by the moon. This is known as **solar eclipse**.

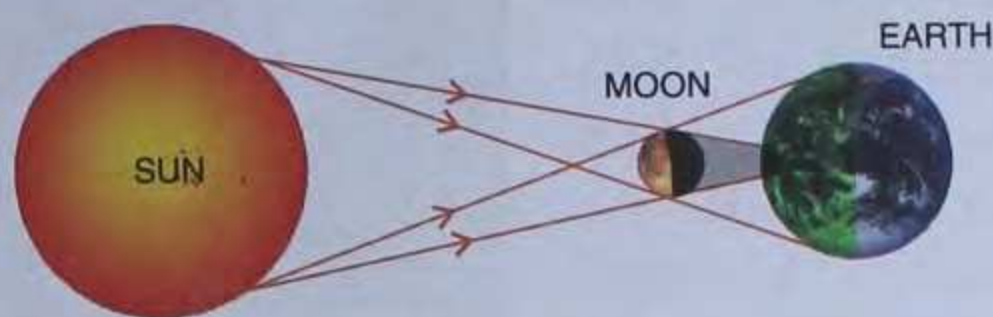


Fig. 1.12 Solar Eclipse

Precautions : Any type of eclipse should not be seen with the naked eye. There should be proper protection, since the direct rays of the sun are very strong, which are harmful to our eyes. The eclipse should be seen,

- through a glass piece which is blackened with soot.
- by taking a cardboard and making a small hole in it. The cardboard is then placed in front of a wall. Through the hole, the image of the sun will be formed on the wall. This image of the solar eclipse can be safely seen with the naked eye.

ARTIFICIAL SATELLITES

We know that the moon is a natural satellite of the earth. A large number of man-made satellites have been launched into space. These satellites are called **artificial satellites**. They revolve around the earth's surface exactly like heavenly bodies.

An artificial satellite is launched into an orbit with the help of specially designed rockets to a height of 200 km from the earth's surface with a minimum speed of 8 km s^{-1} . As the height of the orbit of an artificial satellite increases, its speed in the orbit decreases and the time period of revolution in the orbit increases.

The first artificial satellite SPUTNIK – I was launched by the Soviet Union (USSR)

on October 4, 1957. Within few months, the USA also launched its first satellite called "EXPLORER" on January 31, 1958. Since then, the space technology has progressed by leaps and bounds.



Fig. 1.13 Artificial Satellite

The first Indian satellite ARYABHATTA was launched on April 19, 1975. Bhaskara, Rohini, Apple and INSAT (stands for Indian National Satellite) are some of the other artificial satellites launched by the Indian scientists. The first Indian remote sensing satellite IRS-1A was launched on March 17, 1988 while India's first Mars orbiter, Mars Orbiter Mission (MOM) was launched on November 5, 2013. Artificial satellites are useful to us in many ways :

1. In television and radio transmission.
2. In telecommunication such as long distance telephone calls, telex and fax.
3. In weather forecasting, such as rainfall, snowfall, storm, etc.
4. In remote sensing.
5. In gathering information about other heavenly bodies in space.
6. In locating minerals and studying agricultural yield on the earth by photographing land from above.

EXPANSION OF UNIVERSE

Galaxies are not stationary and are moving away from each other. This was first observed



Fig. 1.14 The big bang and the expanding universe

by Edwin Hubble. He also suggested that, the larger distance between two galaxies, faster they move away from each other. This led to the conclusion that the universe is expanding.

Big Bang Theory

Since the galaxies in the universe are racing away from each other, it is believed that they may have originated from a single point in the space. This led to the most widely accepted theory about the origin of the universe – THE BIG BANG THEORY. According to this theory, the total matter in the space was initially concentrated into a mass of about 100 million light years wide. About 15 million years ago, this very dense mass exploded (thus the name, big bang) and as a result, matter flew in all directions through the space, leading to the formation of galaxies.

Differences between a planet and a satellite

Planet	Satellite
It is a heavenly body which revolves around the sun and rotates on its axis.	It is a heavenly body which revolves around its planet and rotates on its own axis.
It has a bigger size.	It has a smaller size.
There are 9 known planets in the solar system out of which 8 are classical planets and pluto is a dwarf planet.	There are 154 natural satellites known so far in the solar system.

Various parameters of the planets

Planet	Distance from the sun (in million km)	Diameter (in kilometres)	Time taken to rotate about its axis	Time taken to revolve around the sun	No. of moons#
Mercury	58	5000	176 days	88 days	—
Venus	108	12100	243 days	225 days	—
Earth	150	12800	24 hours	365¼ days	1
Mars	227	6750	24 hrs and 37 min.	687 days	2
Jupiter	778	142700	9 hrs and 54 min.	12 years	67
Saturn	1427	120500	10 hrs and 34 min.	29½ years	62
Uranus	2870	50800	17 hrs and 14 min.	84 years	27
Neptune	4500	48600	16 hrs and 46 min.	165 years	13

RECAPITULATION

- The branch of physics which deals with the study of heavenly bodies is called astronomy.
- A group of stars, dust and low density gases bound together by their gravity is called a galaxy. We belong to a galaxy called the Milky Way (*Akash Ganga*).
- The stars which appear in the form of a closed group in some pattern are called constellations. There are about 88 constellations.
- One light year is the distance travelled by light in one year.
- All planets revolve around the sun in elliptical orbits with different time periods of revolution.
- The eight planets in order of their distance from the sun are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune.
- Pluto is a dwarf planet.
- Asteroids are minor planets which revolve around the sun, mainly between the orbits of Jupiter and Mars.
- Comets are luminous celestial bodies. They have a bright head with long tails.
- Moon, meteors and meteorites are the other heavenly objects in the solar system.
- Artificial satellites are useful in weather forecasting, telecommunication, remote sensing, gathering information about other heavenly bodies, etc.
- Galaxies are observed to be moving away from each other. Hubble concluded that the universe is expanding.

TEST YOURSELF

A. Short answer questions

1. Write *true* or *false*. Rewrite the false statements correctly.

- (a) Kilometre is a convenient unit for measuring distances in the universe.
- (b) The earth is the largest planet of the solar system.
- (c) Mercury is seen in the sky just before the sunrise.
- (d) The moon is not a luminous body.
- (e) Orion is a member of the solar family.
- (f) The sun is a glaring ball of gases, mostly hydrogen and helium.
- (g) Ceres was the first asteroid discovered by an Italian scientist G. Piazzi.
- (h) Meteors form craters on the surface of the earth.
 - (i) Ursa Major is a constellation.
 - (j) A comet's tail always points away from the sun.

2. Fill in the blanks :

- (a) A group of stars forming a recognizable shape is known as
- (b) The is the star nearest to the earth.
- (c) is the only planet where life exists in our solar system.
- (d) are the building blocks of the universe.
- (e) The temperature of the sun at the centre is°C.
- (f) is the only planet which rotates on its axis from east to west.
- (g) is a periodic comet.
- (h) All stars except the star appear to move from east to west.
- (i) The moon is a celestial body that revolves around the
- (j) There are..... constellations known so far.

3. Tick the correct answer :

- (a) The branch of science that deals with the heavenly bodies is called
 - (i) Astrology
 - (ii) Anatomy
 - (iii) Biology
 - (iv) Astronomy.
- (b) Pole star belongs to the constellation
 - (i) Ursa Major
 - (ii) Ursa Minor
 - (iii) Orion
 - (iv) Scorpio
- (c) The planet with rings around itself is
 - (i) Uranus
 - (ii) Mercury
 - (iii) Saturn
 - (iv) Neptune
- (d) India's first satellite put in space was
 - (i) Bhaskara
 - (ii) Aryabhata
 - (iii) Rohini
 - (iv) INSAT-1A
- (e) An instrument used to observe heavenly bodies is called
 - (i) Telescope
 - (ii) Camera
 - (iii) Microscope
 - (iv) Periscope
- (f) The planet farthest from the sun is
 - (i) Jupiter
 - (ii) Neptune
 - (iii) Mercury
 - (iv) Saturn
- (g) The streak of light caused by heavenly bodies burning completely while moving through the atmosphere is called
 - (i) a comet
 - (ii) a meteor
 - (iii) an asteroid
 - (iv) a meteorite
- (h) Our solar system belongs to the
 - (i) Whirlpool galaxy
 - (ii) Seyfert galaxy
 - (iii) Milky Way galaxy
 - (iv) Radio galaxy
- (i) The time taken by light to reach from the sun to the earth is
 - (i) 6 minutes 14 sec
 - (ii) 8 minutes 20 sec
 - (iii) 20 minutes 8 sec
 - (iv) 14 minutes 6 sec
- (j) The first satellite sent to space was
 - (i) Sputnik-I
 - (ii) Aryabhata
 - (iii) Explorer
 - (iv) INSAT-1A

4. Match the following :

- | | |
|--------------------------|---------------|
| (a) Shooting star | 1. Milky Way |
| (b) Constellation | 2. Moon |
| (c) Brightest planet | 3. Meteors |
| (d) Artificial satellite | 4. Venus |
| (e) Galaxy | 5. INSAT-1A |
| (f) Periodic comet | 6. Halley |
| (g) Natural satellite | 7. Ursa Major |
| (h) Star | 8. Sun |

5. Find the odd-one out. Give reasons.

- (a) Orion, Scorpio, Ursa Major, Pole star
- (b) Planet, Sun, Meteor, Comet
- (c) Uranus, Moon, Mercury, Jupiter
- (d) Uranus, Mars, Jupiter, Saturn

6. Answer the following questions :

- (a) What is the universe ?
- (b) What is a solar system ?
- (c) Who is the head of the family of the solar system ?
- (d) State whether the sun is a planet or a star.
- (e) What is photosphere ?
- (f) Which planet has life ?
- (g) Name the coldest planet.
- (h) Name the brightest planet.
- (i) Name five artificial satellites.

- (j) List four ways in which artificial satellites are useful to us.
- (k) Name two units in which large distances in the universe are measured.
- (l) What is the relation between a light year and kilometres ?
- (m) What is the true relationship between a light year and parsec ?
- (n) How many stars are there in each galaxy ?
- (o) How many galaxies are known ?
- (p) How many stars are there in our universe ?
- (q) A particular star is 10 parsec away from the earth. Calculate the distance of that star in light years and in kilometres.

B. Long Answer questions :

- 1. Describe the solar system.
- 2. What is a planet ? Name the various planets.
- 3. Give the differences between a star and a planet.
- 4. Define a satellite. Describe the salient features of a natural satellite.
- 5. Define the terms :
 - (a) Comet
 - (b) Meteors
 - (c) Meteorites
 - (d) Asteroids
- 6. Differentiate between classical and dwarf planet.