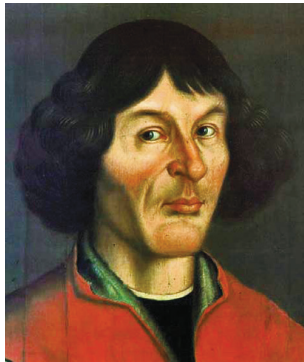




The Planet Earth and the Solar System



Long, long ago it was believed that the earth was the centre of the universe and the sun, moon and stars revolved around it. For centuries this theory was accepted as true. Aristotle, a Greek philosopher, even gave this theory a written form. It was some time in the 16th century that a Polish priest, Nicolaus Copernicus who lived in Germany, proved this theory wrong. Some years later Galileo Galilei, an Italian astronomer, also insisted that the sun was the centre of the universe. He had used a refracting telescope to study the universe and proved the earth-centred theory wrong. Today we all know that the earth is a part of the solar system with the sun at its centre.



Nicolaus Copernicus

CELESTIAL BODIES

All objects that we see in the sky are called **heavenly bodies** or **celestial bodies**. They include the stars, planets, satellites, comets, meteors and asteroids. Our own earth is also a part of this system and thus it is also called a heavenly body or celestial body. The word 'celestial' is derived from Latin word 'celestis' which means sky.

OUR UNIVERSE

It is believed that 4,600 million years ago stars and planets were formed from a giant cloud of gases and tiny dust particles called **nebula**. Nebula is a Latin word, meaning dust

and cloud. This nebula was spinning and had its own gravity. Fragments of the nebula were attracted to each other and collided at great speed. This collision caused release of gases such as hydrogen and helium, which gave out enormous amounts of heat, and thus the universe including its stars, planets, galaxies and other bodies within, was created. This explosion was so powerful that some matter is still spinning away from it.

Did you know?

The sun is a star. It is a medium sized star. There are many stars which are bigger than the sun. Since these bigger stars are far away from the earth they appear smaller than the sun. The sun is nearer to our earth and hence appears bigger than the others.

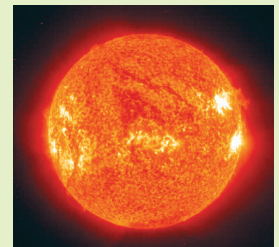


Fig. 1.1 : Nebula

Galaxy

Millions of stars, gas and dust, held together by the force of gravity, form a galaxy. The

THE BIG BANG

It is believed that 15 million years ago a hot ball of matter exploded with a big bang. This created matter, energy, space and time. This big bang released gases like helium and hydrogen. Later this created the universe including stars, galaxies, planets etc.

universe consists of millions of galaxies. The universe is still expanding as new stars are being born. Our solar system belongs to one of these galaxies called the Akash Ganga or the Milky Way. This galaxy is named so because it is like a white band. It consists of millions of stars – the sun is one such star.

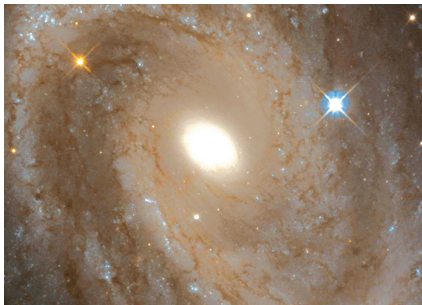


Fig. 1.2 : Galaxy

Stars

Stars are huge burning balls of hot gases which glow and shine in space. They are self-luminous. They appear as tiny specks in the sky as they are far away from us. Stars appear to twinkle. This happens because light from the star has to pass through different layers of the atmosphere with varying densities.

All star except the 'Pole Star' appear to move from east to west, due to the rotation of the earth on its own axis from west to east.



Fig. 1.3 : Stars

Did you know?

- Light travels at a speed of 3,00,000 km per second.
- The distance that light travels in a year is called a light year.
- The light from Proxima Centauri, the nearest star to our sun takes four years to reach us.
- The light from the sun takes about eight minutes to reach the earth.

Constellations

Stars group or cluster together to form fantastic patterns of creatures, monsters, brave heroes and beautiful heroines. Groups of bright stars that appear close together in the sky are called **constellations**. Legendary tales

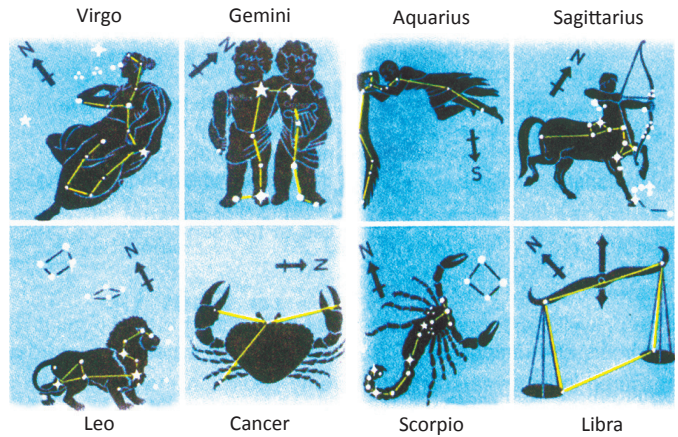


Fig. 1.4 : Some Constellations

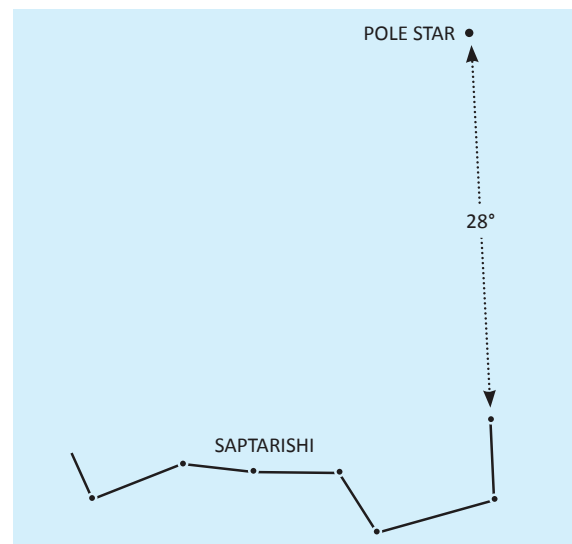


Fig. 1.5 : The Saptarishi

of courage, beauty and evil surround these stars. One of the most famous constellations is the **Big Bear** or **Ursa Major**. The constellation **Saptarishi** (sapta – seven, rishi – sage) or Small Bear is easily recognisable in the night sky. It is a group of seven stars.

In the past, people used to determine directions in the night with the help of the position of stars. The **Pole Star** is one such star which helps us to determine the north direction. It is also called the North Star and always stays in the same position – above the North Pole.

THE SOLAR SYSTEM

The family of the sun, eight planets and approximately 173 satellites with many asteroids, comets and meteors make up the solar system.

The word ‘Solar’ is derived from a Latin word ‘solaris’ which means sun. The solar system, hence, means ‘family of the sun’.

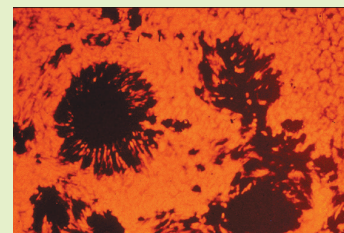
The Sun

The sun is the centre of the solar system. All planets and satellites revolve around it. It is the source of all energy in the solar system. It sustains all life on the earth. Without the sun’s heat and energy, our earth would become a cold and lifeless planet. It is about 150 million kilometres away from the earth. The sun is made up of hydrogen and helium. There is a great deal

Did you know?

What are sun spots?

These are areas of the sun which are slightly less hot. They appear as barrier spots on the otherwise shining sun. These are not stationary.



of pressure at the centre and it causes the release of enormous amounts of energy.

The surface temperature of the sun is 6000°C, and the interior is at 20 million degrees celsius. The distance between the sun and earth is about 150 million km. The light from the sun takes approximately eight minutes to reach the earth.

Planets

Our solar system consists of eight planets. They can be listed according to their distance from the sun : as Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune. The largest planet is Jupiter whereas the smallest planet is Mercury.

The planets move around the sun on fixed paths. These paths are elongated. This movement is called revolution. The paths on which they move are called orbits. Each planet has its own fixed orbit. While planets revolve around the sun, they also move around on their own axis. This movement is called **rotation**.

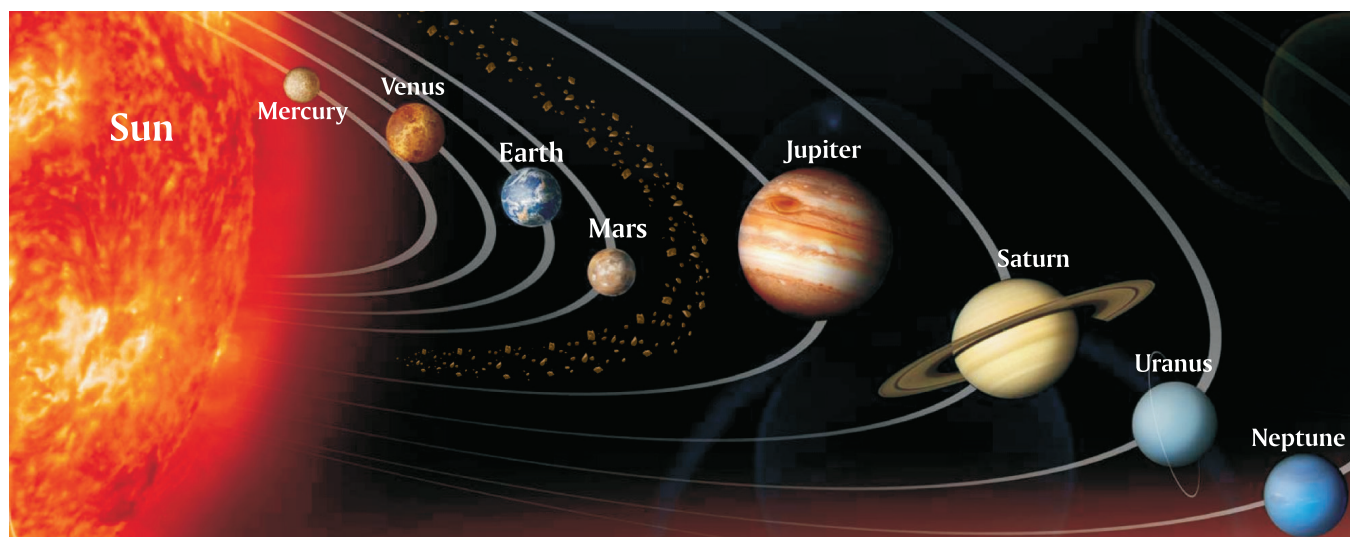


Fig. 1.6 : The Solar System — the Sun and the Eight Planets

PLUTO — OUT OF ORBIT!

“The Solar System consists of nine planets.” This statement in textbooks round the world is set to change. Pluto has lost the coveted honour and now there are only eight planets left in the Solar System. Pluto finds itself demoted to the status of a “Dwarf Planet.”

The decision was taken on August 24, 2006 at Prague in Czech Republic after heated deliberations by members of the International Astronomical Union (IAU). Apart from dwarf planet, another new term, “Small Solar-System Bodies,” was coined which includes all other heavenly objects of the Solar System orbiting the Sun, such as comets, asteroids, trans-neptunian objects, etc. (except satellites).

Planet : A planet is a celestial body that (a) is in orbit around the Sun; (b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape and (c) has cleared the neighbourhood around its orbit. In accordance with that, the eight planets are : Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune.

Dwarf Planet : A dwarf planet is a celestial body that (a) is in orbit around the Sun; (b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape, (c) has not cleared the neighbourhood around its orbit, and (d) is not a satellite. IAU thus resolved that Pluto is a dwarf planet by this definition and is recognised as the prototype of a new category of trans-Neptunian objects, to be called ‘plutonian objects’.

Small Solar System Bodies : All other objects orbiting the Sun shall be referred to collectively as ‘Small Solar System Bodies’.

Source : *Science Reporter, October 2006.*

Planets move around the sun in anti-clockwise direction, *i.e.*, west to east. Planets have no heat or light of their own. They reflect the light of the sun.

The word ‘planet’ means ‘wanderer’ in Greek. Planets were named so because they always seem to wander. All planets do not take the same time to complete a revolution. Planets close to the sun have smaller orbits as compared to planets further away from the sun. Hence, Mercury takes only 88 days to complete one revolution as compared to our Earth which takes 365 days and 6 hours to complete it.

Planets are categorised into two categories, *i.e.*, inner and outer planets.

- (i) **Inner planets:** Mercury, Venus, Earth and Mars are the inner planets. These are very close to the sun and made up of rocks. There are also known as terrestrial planets.
- (ii) **Outer planets:** Jupiter, Saturn, Uranus and Neptune are the outer planets. These are huge planets made up of gases and liquids.

Mercury is nearest to the sun whereas Neptune is farthest. Saturn has a ring around it. Venus is closest to the earth. Venus is considered as ‘Earth’s twin’ because its size and shape are very much similar to that of the earth.

Planets are spherical in shape. They move around the sun in elliptical path, called orbits, from west to east. Each planet takes a different time to complete one revolution and rotation.

Satellites

Satellites are celestial bodies which revolve around planets. They are the smaller companions of planets. They move in the same way as the planets move around the sun.

Satellites do not have their own heat and light. They reflect the light of the sun. Satellites revolve around the planets in fixed orbits. Over 170 satellites have been discovered so far in our solar system. The moon is the earth’s only satellite. Mercury and Venus have no satellites, Jupiter has 67 and Saturn has 62. These are the natural satellites.

A COMPARATIVE STUDY OF THE PLANETS

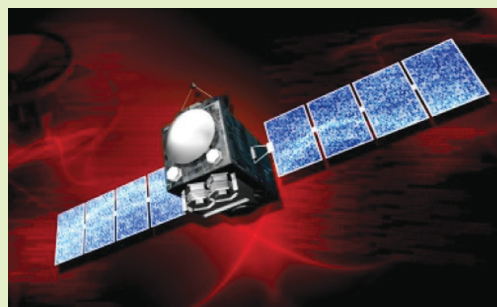
Name	Significant facts	Distance from the Sun	Diameter	Rotation time	Revolution time	No. of discovered moons till 2006
Mercury	<ul style="list-style-type: none"> • Nearest to the Sun • Hottest and smallest planet 	58 million km	4878 km	58.6 Earth days	88 Earth days	0
Venus	<ul style="list-style-type: none"> • Brightest planet in the sky • Same size as the Earth, has an iron core like the Earth • Called 'morning star' when it appears in the east before sunrise and 'evening star' when it appears in the west after sunset. 	108 million km	12,104 km	243 Earth days	225 Earth days	0
Earth	<ul style="list-style-type: none"> • Largest and densest among the inner planets • The only planet with life • Called the Blue Planet 	150 million km	12,756 km	24 h	365.25 Earth days	1
Mars	<ul style="list-style-type: none"> • Known as the Red Planet because of its colour 	227 million km	6750 km	24 h 37 min	687 Earth days	2
Jupiter	<ul style="list-style-type: none"> • Largest planet; known for its Red Spot 	778 million km	142,984 km	9 h 55 min	11.86 Earth years	67
Saturn	<ul style="list-style-type: none"> • Has three rings (bands) around it 	1,427 billion km	120,536 km	10 h 40 min	29.46 Earth years	62
Uranus	<ul style="list-style-type: none"> • Lightest among the outer planets 	2,870 billion km	51,118 km	17 h 14 min	84.07 Earth years	27
Neptune	<ul style="list-style-type: none"> • Coldest among the major planets 	4,497 billion km	49,528 km	Around 16 h	164.8 Earth years	14

Artificial satellites have also been launched from time to time. India's space programme was initiated by the launching of the artificial satellite 'Aryabhata' in 1975. Since then, India has not looked back. These satellites have proved extremely useful in telecommunication, meteorology, television relay and broadcasting, which even issues a warning for fishermen, sailors and pilots against disasters like storms and excessive rains.

Sriharikota Island has been developed by India as a launch base with the most modern launch infrastructure for satellite launching.

Did you know?

The word satellite finds its origin in the Latin word 'satelles' which means a companion.



Artificial satellites

Comets

You must be knowing about Halley's Comet that appeared in 1986. Well! Comets are icy, rocky masses which have a solid nucleus surrounded by a cloud of glowing gases called the coma. It has a tail made up of gas and dust.



Fig. 1.7 : Halley's Comet

A TALE OF TAILS

Comets have glowing tails that always points away from the sun. These tails are created because when the comet comes close to the sun it starts to melt. Now the solar wind does its job and blows this tail of gas many, many kilometres far away. The sunlight does the rest of the job – it makes the tail shine.

Asteroids

Scientists say that asteroids are bits and pieces of rocks that were left when our solar system was made. They are also called planetoids or minor planets. They orbit the sun and are small rocky bodies. The asteroid belt of our solar system lies between Mars and Jupiter. This belt stretches from about 250 million to 600 million km from the sun.



Fig. 1.8 : Asteroids

Meteors

Meteors are smaller than comets. They could be dust or chunks of rock from comets or asteroids. They are tiny lumps of burning matter, and streak through the solar system. Those meteors that enter the earth's atmosphere are called **meteors** and those that crash upon the earth are called **meteorites**. Usually meteors burn up in the sky and disappear as gas and dust when they enter the earth's atmosphere. They move at a great speed. This creates friction and generates heat. Meteors at times start burning due to this heat. That is why, sometimes, meteors are also called **shooting stars**.

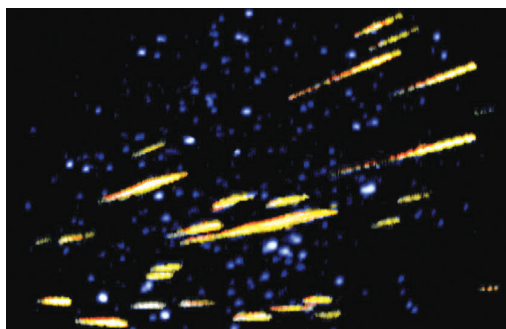


Fig. 1.9 : Meteors

Differences between Stars and Planets

Stars	Planets
● Are hot	● Temperature depends on their distance from the sun
● Have their own heat and light	● Do not have their own heat and light
● Give out light	● Receive light
● They twinkle	● They do not twinkle
● Are uncountable	● They can be counted



Fig. 1.10 : Our Earth

Our Unique Earth

Our earth is a unique planet in the whole solar system. It is the only planet which supports life. The earth is the third nearest planet to the sun. In size, it is the fifth largest planet. It is slightly flattened at the poles. That is why its shape is described as a **Geoid** which means an earth-like **shape**.

No one really is sure about how the earth was created. But scientists say that billions of years ago there were clouds of hot gases and dust which created the sun. These clouds began to bunch together and gradually formed the earth and other planets. After this the debris from Big Bang also joined the earth. Life started in water and later developed to survive on land. All plants and animals that we see around us today, were evolved from the forms of life which existed millions of years ago. When algae evolved they started using up carbon dioxide from the atmosphere and releasing oxygen. Thus, the air on the planet became completely changed.

WHY IS THE EARTH A UNIQUE PLANET?

There are many reasons for this –

- The earth is neither too far away nor too close to the sun. The heat which it receives from the sun is optimum for life to flourish here.
- The earth has the elixir of life, 'water'. About two thirds of the earth is covered by water. Therefore, the earth is known as the 'Blue Planet'.
- It has atmosphere which acts like a blanket and protects us from the harmful rays of the sun, moderates the climate, causes rainfall, and is rich in oxygen.
- The interaction between the air, water and land allows life to flourish. In the biosphere we find plants, animals and other organisms together with the physical environment with which they interact. This is known as the ecological system or ecosystem.

THE MOON — THE EARTH'S COMPANION

The earth's companion is the moon. It is about 3,84,000 km away from the earth. Its diameter is about 3480 km. It appears larger and brighter than any other celestial body in the night sky. It looks so large because it is closer to us than any other celestial body. The moon shines because it reflects sunlight. The reflected light of the sun from the moon reaches the earth's surface in about 1.3 seconds.

The moon completes one revolution round the earth in 29 days 8 hours. It takes the same time to complete one rotation on its axis. Hence,

we can see only one side of the moon, the other side is turned away from us.

Phases of the Moon

One side of the moon is lighted by the sun. But as the moon moves around the earth, we see only parts of this side. These are called phases of the moon. On the **Full Moon** night or

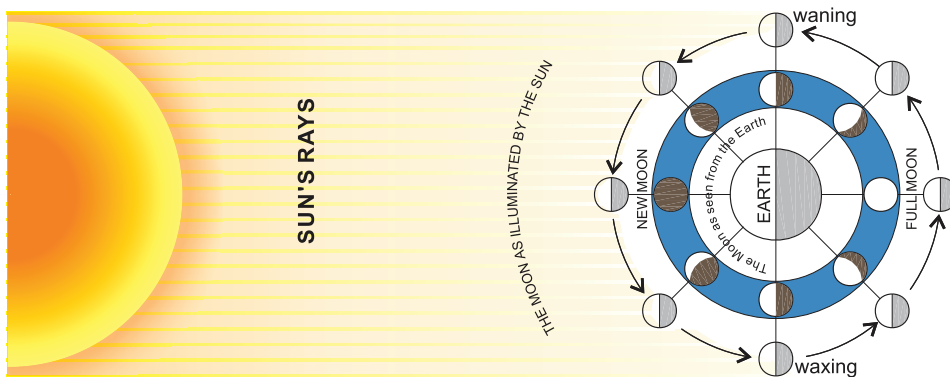


Fig. 1.11 : Changing Phases of the Moon

Poornima, the bright hemisphere is visible to us. Whereas, on the **New Moon** night or **Amavasya**, the dark hemisphere of the moon faces the earth.

In its journey from New Moon to Full Moon, the visible portion increases and the moon is said to wax. Similarly, in its journey from Full Moon to New Moon, the visible portion decreases and the moon is said to wane. The waxing and waning of the moon is known as the phases of the moon.

Did you know?

- Neil Armstrong was the first man to land on the moon on July 20, 1969.
- He was followed by Edwin Aldrin.
- Several space missions have brought back samples of lunar earth. Studies have shown that the surface of the moon is rough and uneven. There is no air or water on the moon.

Points to Remember

- Our solar system belongs to one of these galaxies called the Akash Ganga or the Milky Way.
- Our solar system consists of eight planets. They can be listed according to their distance from the sun : as Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune.
- Satellites are celestial bodies which revolve around planets.
- Satellites do not have their own heat and light. They reflect the light of the sun.
- Asteroids are bits and pieces of rocks that were left when our solar system was made.
- Meteors are smaller than comets. They could be dust or chunks of rock from comets or asteroids.

Glossary

ASTEROIDS	: Small pieces of rocks.
CELESTIAL BODIES	: Bodies which we see in the sky, like stars, planets, comets, satellites, meteors etc.
COMETS	: These are icy, rocky masses surrounded by glowing gases.
CONSTELLATION	: Group of stars that cluster to form patterns in sky.
GALAXY	: A vast cluster of billions of stars.
METEORS	: These can be dust or chunks of rock from comets or asteroids.
NEBULA	: Clouds of dust and gas held together by gravity.
PLANETS	: Objects in space that rotate around their own axes and orbit around a star.
STARS	: Balls of hot gases which glow in space.
SATELLITES	: Celestial bodies which revolve around planets, without any heat and light of their own.

TIME TO LEARN

A. Multiple Choice Questions (MCQs)

1. What is the Sun?
(a) A star (b) A planet (c) A satellite (d) A comet
2. Which of the following was declared a 'dwarf planet' in 2006 and lost the coveted honour of a planet?
(a) Venus (b) Earth (c) Pluto (d) Jupiter
3. The Pole Star indicates the direction to the
(a) South (b) North (c) East (d) West
4. What is the shape of the paths taken by planets to revolve around the Sun?
(a) Rectangular (b) Circular (c) Zigzag (d) Elliptical

5. The asteroid belt is found between the orbits of
 (a) Mars and Jupiter (b) Saturn and Jupiter (c) Uranus and Neptune (d) Venus and Earth
6. Which of the Following planets have no natural satellite?
 (a) Mercury (b) Venus (c) Earth (d) Both (a) and (b)
7. Which planet is considered as 'Earth's – twin'?
 (a) Mercury (b) Venus (c) Saturn (d) Mars

B. Match the following

- | | |
|----------------|--------------------|
| 1. Meteors | (a) Milky Way |
| 2. Sun | (b) Small Bear |
| 3. Big Bear | (c) Ursa Major |
| 4. Saptarishi | (d) Star |
| 5. Akash Ganga | (e) Shooting stars |

C. Very short answer type questions

1. Which planet is nearest to the Sun?
2. Which planet is farthest from the Sun?
3. Which planet has a ring around itself?
4. What is the source of heat and light for all the planets?
5. How many natural satellites do Jupiter and Saturn have?

D. Short answer type questions

1. What are celestial bodies? Give examples.
2. What do you understand by the term 'Big Bang'?
3. Why do stars twinkle?
4. Differentiate between stars and planets.
5. What are asteroids? Where are they situated?

[HOTS]

E. Long answer type questions

1. Explain why is the earth called a unique planet?
2. What are satellites? Explain.
3. Which is the natural satellite of earth? Why do we see only one side of the moon?

F. Activity

- Make a class trip to a planetarium with your teacher or a family trip with your parents. Describe your experience in the class.
- Watch the famous constellations in the night sky with your siblings. There are Big Bear, Saptarishi and the eight constellations of zodiac signs. You can procure a telescope to watch properly. Share your experience in the class.

LIFE SKILLS

A natural way of relaxing is star gazing. At night go to the terrace with your parents or elder brothers and sisters to watch the night sky. Watch stars, moon and other celestial bodies. Share your experience with your classmates the next day.