



# OUR EARTH IN THE UNIVERSE

## Spotlight

- Formation of the universe
- Celestial bodies and galaxies
- Structure of the solar system
- Earth as a living planet of the solar system

## Gear Up

What do you see if you gaze at the vast space of the night sky above? Do some of the objects appear to move or are they stationary? Have you seen any of these objects during daytime?

You see natural objects like the Sun, the Moon, stars and the planets, including our Earth, in the sky. They are all called celestial bodies. What you see in the night sky is only a very small part of an extremely vast space called universe. It is an unimaginable expanse of cosmic dust, gases, galaxies, stars, clouds, planets and many other celestial bodies. In this chapter, we will learn about some of these celestial bodies.

How did the universe originate? Most scientists believe that some 15 billion years ago, the universe began as a small and very hot cloud of gases and dust with an explosion known as the Big Bang.



Big Bang

Then, it underwent a process of expansion and change about 13.7 billion years ago. Over a long time, atomic particles came together to form molecules

that eventually formed giant clouds of gases and dust particles called nebula. Each nebula had its own gravity and spinning motion. Star formation began 5 to 6 billion years ago out of each nebula. Our Sun was born some 4.6 billion years ago. Over millions of years, the universe with the galaxies and stars as seen now, evolved. This process is still going on.

## Stars and Galaxies

The innumerable tiny twinkling objects we see in the night sky are stars. Stars are luminous bodies that emit light, which comes to us after passing through several layers of the atmosphere with varying temperature, composition and density. This is what makes the stars twinkle.

Stars are made up of hot glowing gases. They produce their own heat and light. The Sun is a star that lies closest to our planet. Stars are found in huge gravitationally bound clusters of millions of stars, along with clouds of gases and dust. We call these clusters galaxies. The clusters vary in shape, size and brightness. Galaxies are often very massive.



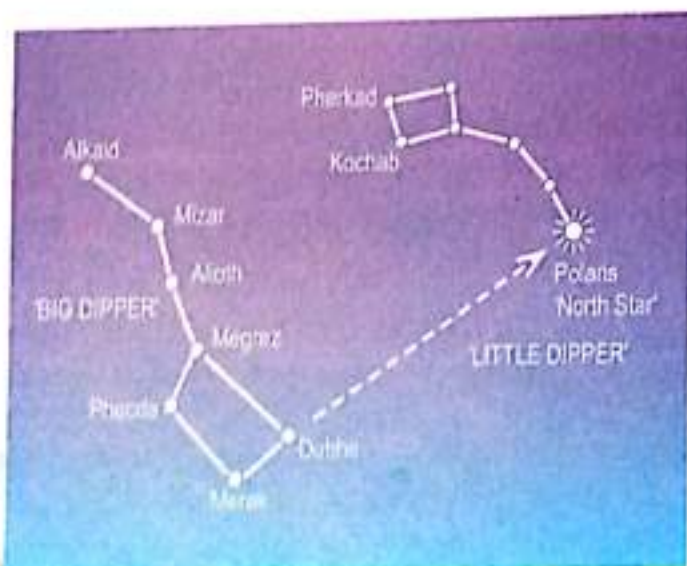
Three shapes of galaxies identified so far are spiral, elliptical and irregular types.

The family of the Sun including planet Earth is a part of a spiral galaxy called the *Akash Ganga* or Milky Way, which appears in the night sky as a hazy white band. It is estimated to have about 100 to 400 billion stars.



Milky Way

Some star groups have been observed to form recognisable patterns in the sky. These patterns are called constellations. The ladle-shaped Big Dipper, which can be seen clearly in the northern skies, is a part of the constellation Ursa Major or Great Bear. The two stars 'Dubhe' and 'Merak' on the Ursa Major are called Pointers, as a line drawn through them points us to Polaris or the Pole Star (*Dhruva Tara*).



The Big Dipper pointing out the Pole Star

Orion (in the shape of a hunter), Leo (having the appearance of a lion), Scorpion (having a scorpion's appearance), Cygnus (like a swan) and Crux (the appearance of a cross) are names of other well known constellations.

### TIME TO THINK

Scientists have determined that both Moon and the Earth have many craters formed by the impact of meteoric bombardment. Why don't we see these craters easily on Earth?

## The Solar System: The Sun and Its Family

The word 'solar' means 'belonging to or related to the Sun'. The family of the Sun is therefore, called the solar system. The solar system has eight planets and their satellites, all of which move around the Sun in fixed elliptical paths called orbits. In addition, there are countless asteroids, meteors and many comets in the solar system.



The Solar System

## Planets

The word planet is originally a Greek word which means wanderer. The planets are spherical in shape but vary in composition and size. Unlike stars, they are opaque bodies with no heat or light of their own. They are visible because they reflect the light of the Sun. They also rotate or spin on their respective axes at different speeds. All planets spin in an anticlockwise direction from West to East. Venus and Uranus are exceptions as they spin in the opposite direction, from East to West. Each planet also takes a different time period to complete one revolution around the Sun.



## GOOD TO KNOW •

Dwarf planets are smaller and lower in mass than the regular planets. These include Pluto, Eris, Ceres, Makemake and Haumea.

Out of the eight planets of our solar system, the first four are inner planets—Mercury, Venus, Earth and Mars. They are made up of rocks, which is why they are called terrestrial planets. The outer planets include Jupiter, Saturn, Uranus and Neptune. They are mainly gaseous in nature and are called jovian planets. All the outer planets have rings around them.

Mercury is the smallest planet in the solar system. It takes only 88 days to complete one revolution and nearly 59 days to complete one rotation. Venus is the hottest planet in the solar system. A blanket of sulphuric clouds and gases in its atmosphere traps its heat, just as the glass roof of a greenhouse prevents the escape of heat accumulated during the day. It is the brightest object in the sky seen without a telescope and is often referred to as the 'Morning Star' or 'Evening Star'. In size, Venus is identical to the Earth and is often called the 'Earth's twin'.



Earth and Venus

Next to Venus, is Earth. It is our home planet. It is the only planet which is known to have life on it. Mars appears to be brick red in colour as it has red oxide in its soil. It is therefore called the 'Red Planet'. Next is Jupiter, which is the largest planet of the solar system. Its mass is twice of all the other planets put together. Jupiter spins much faster than any other planet.

Saturn is a yellowish planet which has beautiful rings that can be seen through a telescope. They are made of dust particles, rock and ice. Uranus has the coldest atmosphere in the solar system. It takes

about 84 years to complete one revolution of the Sun. Neptune is the eighth planet and the farthest from the Sun. It is the fourth largest planet in the solar system.

## Earth—our planet

Earth is the third planet from the Sun. It has only one natural satellite called Moon. Earth takes nearly 24 hours (23 hours 56 minutes and 4 seconds) to complete one rotation. It revolves around the Sun in about 365 days and 6 hours.

Earth is the only planet of the solar system, which is known to support plant and animal life. Let us discuss the reasons for this unique phenomenon.

- ♦ Earth is located at an optimum distance from the Sun, and is neither as hot as Mercury, nor as cold as Neptune.
- ♦ The presence of liquid water over 71 per cent of its surface makes our planet appear blue in colour from space. It is therefore, called a 'Watery Planet' or 'Blue Planet'.
- ♦ The blanket of air surrounding the Earth is called the atmosphere. It not only provides air that humans, animals and plants breathe, but also protects us against extremes of temperature.
- ♦ The outer rocky surface of the Earth is called lithosphere, is a source of soil which supports plant life.
- ♦ The combination of an ever-changing surface, presence of air and water along with moderate temperatures has made life possible on Earth.

## GOOD TO KNOW •

An easy way to learn the names of the planets is: 'My Very Educated Mother Just Showed Us Nightingales.' The first letter of every word tells you the sequence of planets as they appear in the solar system.

## How are stars different from planets?

Stars twinkle while planets don't. If we observe the sky on successive evenings, we will find that stars do not move with respect to each other. Planets appear to be moving with respect to stars. Stars are made of hot glowing gases and produce their own heat and light. They are luminous bodies. Planets



are made of rocks and do not have their own heat or light (non-luminous bodies). They reflect the light of the Sun. Stars are huge in size, while planets are comparatively smaller.

## Satellites

The word satellite means attendant. It is a small celestial body or a man-made device that revolves around a planet. Celestial satellites are also called natural satellites or moons because they have existed in space for millions of years. Just as planets revolve around the Sun, a satellite moves around its host planet. They do not have their own heat or light but reflect the light from the Sun. Every natural satellite also rotates on its axis. Almost all the planets in the solar system have one or more natural satellite, except the Mercury and Venus.

Machines placed by humans to revolve around a host planet are called artificial satellites. They are placed for various purposes like telecommunications, radio and television transmission, observation and forecast of the weather.

PICSTOP



1. What kind of satellite is shown in the image?
2. What does it do?

## Moon

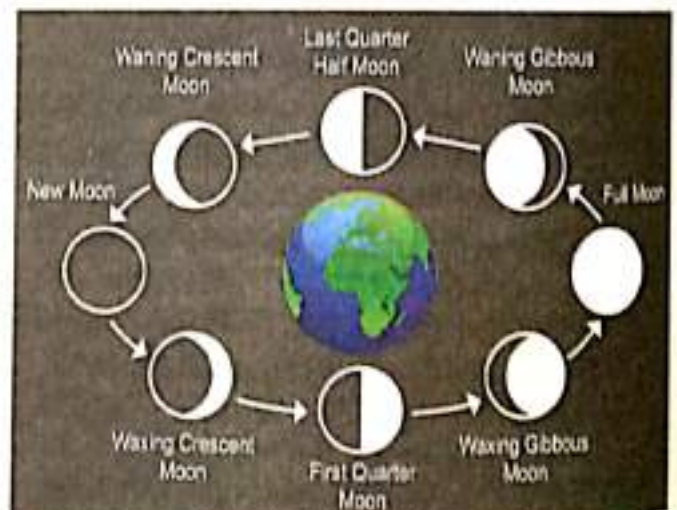
Earth has only one natural satellite known as the Moon. Fifth largest among all natural satellites of the solar family, it is Earth's closest neighbour in space (nearly 3,84,400 km away).



Surface of the Moon

The Moon completes one revolution around the Earth in 27 days and 8 hours. It spins on its axis at about the same time that it takes to complete an orbit of the Earth (rotation time about 27.3 days). As a result, we always see the same side of the Moon from the Earth. The Moon is opaque, and shines because it reflects the light of the Sun, just like a mirror. It takes about 1.28 seconds for the reflected light to reach us.

The Moon appears in the sky in different shapes. These are called phases of the Moon. When it is barely visible, we call it *amavasya* or New Moon. When the whole disc is visible, we call it Full Moon or *purnima*. The phase with an increasing size of the Moon is called waxing and the decreasing phase of the Moon is called waning.



Positions of the Moon in its orbit and its corresponding phases. All the space missions sent to Moon revealed that it is a dead, barren and airless celestial body, dotted with circular depressions called craters, formed



due to meteoric bombardment. Nearly, 300,000 craters have been counted on one side of the Moon. It has many mountains and plains on its surface. Neil Armstrong was the first man to step on the surface of the Moon on 29 July, 1969.

### Other celestial bodies

**Asteroids:** These are rock pieces that lie in the belt between the orbits of Mars and Jupiter. Like planets, they also revolve around the Sun but do not have an atmosphere. They are believed to be fragments of a planet, which disintegrated after its birth. Out of 1,00,000 asteroids, nearly 4,000 have been identified. Ceres is the largest asteroid in the solar system, nearly 700 km across in diameter.

**Meteors:** These are also called 'shooting stars'. Meteors resemble flashes of light in the sky. When a small piece of rock and dust (meteoroid) is drawn into the Earth's atmosphere at a speed of about 70 km per second, it burns due to the friction of the atmosphere. The burning pieces cause a flash of light. Some meteors may not burn out completely and thus, reach the Earth's surface. They are called meteorites.

**Comets:** The word comet originates from the Greek word 'kome', which means hair of the head. They sometimes appear in the sky as beautiful, shining bodies. They are made up of ice, gas and dust. As they approach the Sun, the frozen surface starts to evaporate, forming a cloud of gas and dust with two tails.



Halley's Comet

Solar winds force the gas back along with some dust to form a glowing tail. Comets visit the solar system from time to time from beyond the orbits of Neptune and Pluto. Some appear at very regular intervals such as the Halley's Comet, which reappears every 76 years.

### SUM IT UP

- ♦ Most scientists believe that some 15 billion years ago, the universe began as a small and hot cloud of gases and dust with an explosion known as the Big Bang.
- ♦ The family of the Sun, including planet Earth, is a part of the spiral galaxy called the *Akash Ganga* or Milky Way.
- ♦ Earth is the only planet of the solar system which is known to support plant and animal life.
- ♦ Apart from planets, there are many satellites and other celestial bodies in the universe.

### CORNER

CREATIVE

1. **Class Debate:** After launching twenty satellites, India has shown its strong presence in space.
2. **Draw:** A neat and well-labelled diagram of the eight phases of the Moon.
3. **Think:** Why would footprints of astronauts not be wiped out from the surface of Moon?
4. **Write:** What are the achievements of India in the Mars expedition?

## GLOSSARY

luminous

an object which gives out its own light

elliptical

oval-shaped

opaque

an object that does not allow light to pass through it

mass

the amount of matter in an object

waxing

to appear larger gradually till its full form is visible

waning

to appear to be reducing or decreasing in its area of brightness

crater

a depression or shell hole made due to impact and bombardment on a surface

## EXERCISES

**A. Answer the questions by choosing the most appropriate alternative from those given below.**

- The planet which is known as the Morning or Evening Star is .....  
a. Mercury                      b. Venus                      c. Mars                      d. Saturn
- The smallest planet in the solar system is .....  
a. Saturn                      b. Mars                      c. Mercury                      d. Uranus
- The planet that spins fastest on its axis is .....  
a. Earth                      b. Uranus                      c. Jupiter                      d. Saturn
- The largest asteroid, also called a dwarf planet is .....  
a. Pluto                      b. Mercury                      c. Ceres                      d. Phobos
- Halley's Comet visits our solar system once in every ..... years.  
a. 15                      b. 76                      c. 20                      d. 760

**B. Write (T) for true and (F) for false.**

- Clouds, rainbows, halos and other phenomena seen in the sky are all celestial objects.
- The Earth spins from East to West.
- Full Moon is also known as Akash Ganga.
- Uranus has the coldest atmosphere in solar system.
- Life is possible on Earth because of suitable air, water and temperature.

**C. Fill in the blanks.**

- ..... is the planet nearest to the Sun with the shortest orbit.
- ..... was born some 4.6 billion years ago.
- ..... is a yellowish planet with rings.
- ..... are also known as shooting stars.
- Asteroids lie mainly between the orbits of ..... and .....



D. Study the table given below and answer the following questions:

Object	Distance from Sun in million km	Rotation period (in Earth years)	Revolution period (in Earth years)	Moons
Sun	—	27 days	—	—
Mercury	58	58.6 days	88 days	0
Venus	108	243 days	225 days	0
Earth	150	24 hrs	365 days 6 hrs	1
Mars	228	24 hrs 39 min	687 days	2
Jupiter	778	10 hrs	11 years 9 months	67
Saturn	1,427	10 hrs 14 min	29 years	62
Uranus	2,869	17 hrs 14 min	84 years	27
Neptune	4,496	16 hrs	165 years	14
Earth's Moon	149.6	27 days 8 hrs	27 days 8 hrs	—

1. Which planet is the fastest in the rotation?
2. Which planet takes the longest to revolve around the Sun?
3. Which planet is the farthest from the Sun?
4. Identify the planet that takes longer to rotate than to complete one revolution.

E. Answer the questions in about 50–70 words.

1. What is a constellation? Which two group of stars point to the Pole Star?
2. How are the planets different from stars?
3. Explain why Mars is called the 'Red planet'?
4. How is the waxing phase of the Moon different from its waning phase?
5. Why are meteors called shooting stars?

F. Answer the questions in about 80–100 words.

1. 'The Earth is a unique planet'. Give reasons.
2. What are satellites? Explain its two types with examples.
3. How did the universe originate?
4. Differentiate between planet and satellite.
5. Define asteroid, meteors and comets.

G. Think and answer.

1. What would be different, if the Moon would spin twice on its axis, in the time taken to complete a single revolution on its orbit?
2. Why do we only see the same side of the Moon?

## PROJECT WORK

### Learn about the solar system

- ♦ Divide the class in various groups and assign one planet to each of the group.
- ♦ Let each group prepares a report on the features, structures and conditions of the planet assigned to them.
- ♦ You can also add interesting pictures of the planets and mention any news or recent development related to it.

## LIFE SKILL (CRITICAL THINKING)

We know that the surface of the Moon is not smooth but has craters. How were these craters formed on its surface? Do we have such craters on the Earth? Why can't we see them on the Earth's surface?

### SURF AND LEARN

Use these links to learn more about the topics:

<http://starchild.gsfc.nasa.gov/>

<http://science.nationalgeographic.com/science/space/solar-system/>

<http://solarsystem.nasa.gov/planets/>

### SELF-ASSESSMENT RUBRIC

1. I have the learnt about the Sun and the solar system.
2. I have learnt about the different celestial bodies.
3. I have actively participated in the class discussion.

YES

NO

PARTIALLY