

Earth as Part of the Solar System

Summary

1. The universe is the vast space around us which includes stars, planets, satellites, etc.
2. Stars are giant balls of gases in space.
3. Stars occur in groups that make an imaginary shape in the night sky called constellations.
4. The sun is a star of medium size.
5. The sun and eight planets orbiting around it consists the Solar System.
6. The eight planets are: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune.
7. The Earth is the third planet from the Sun and is so far the only planet with life on it.
8. Life is possible on the Earth because (a) it is at the right distance from the Sun, so it is neither too hot nor too cold; (b) it has oxygen which is a lifeline for living organisms; and (c) it has water.
9. Meteors or shooting stars are produced when chunks of rocks enter the Earth's atmosphere and burn us in a fiery show.
10. Comets revolve around the Sun in elliptical orbits. They have a bright tail.

Ever since ancient times, man has been gazing at the night sky and wondering about the Moon and the stars shining above. The colourful rainbow, the twilight sky, and the eclipses of the Sun and the Moon—all have bewildered man and kindled his eagerness to know about them. What are these shining bodies? How far are they from us? Why do they shine? What is this celestial body on which we live? There are endless queries in our minds. During the last fifty-odd years, spacecrafts, sky labs, artificial satellites and various probes have been sent to get information as answers to these queries.

The natural bodies in the sky that include the Sun, the Moon, the stars, and many other objects are called celestial bodies or heavenly bodies. The Earth, on which you live is also a heavenly body. The heavenly bodies are found in a large vacuum called space. These make up the universe. The universe is a huge wide open space that holds everything—planets, stars, moons, clouds of dust and gases. No one knows just how vast the universe is. The branch of science that deals with the study of heavenly bodies and space is called astronomy, and one who studies these is called an astronomer. Aryabhatta was a famous astronomer of ancient India.

THE UNIVERSE

One of the most persistently asked questions is about, how the universe was created? There are many assumptions and theories about the



The Big-Bang

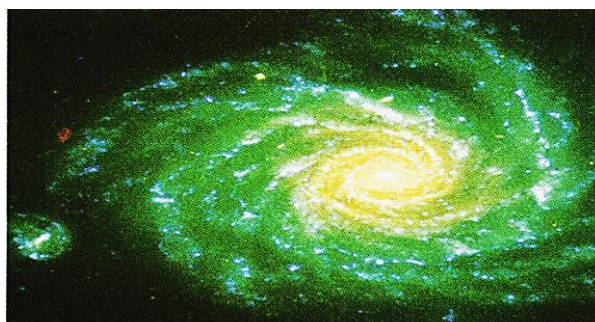
beginning of the universe. But the most accepted one so far is, the Big Bang theory. According to this theory, the universe began with a massive explosion, a big bang, about 15 billion years ago. At the time of this event, all the matter and energy of space was squeezed together into one point under tremendous pressure.

With this explosion, space suddenly expanded outwards into a gigantic spinning cloud. Gravitation caused the dispersed matter to coalesce in to our present solar system.

Q. If all physical bodies attract each other with the force of gravity, then why do they not collide with one another?

GALAXY

Do you see a whitish broad band, like a white glowing path across the sky on a clear night? It is a cluster of millions of stars. This band is the Milky Way galaxy. A galaxy usually contains a few million to over a trillion² stars. There are hundreds of billions of galaxies in the universe. Galaxies come in many different sizes, shapes and brightness. The three typical shapes are: spiral, elliptical and irregular. We also live in a galaxy. Our galaxy is known as the Milky Way (Akashganga). In fact the Sun, the Moon and the eight planets including our Earth— all belong to this galaxy. The milky way is a barred spiral galaxy and forms a band of light in the night sky.



The Milky Way

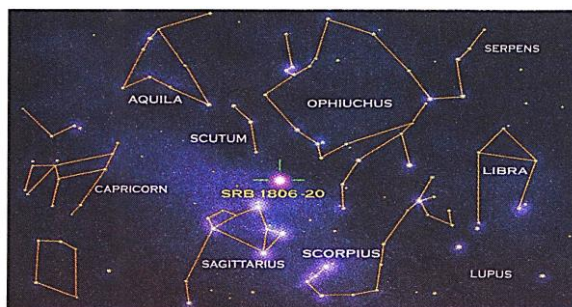
CELESTIAL BODIES

Stars

The heavenly bodies having their own light are called stars. Stars are giant balls of gases. They appear like little dots of light because they are far away from us. A star begins as a collapsing cloud of gases called nebula.

Constellations

While watching the night sky. You may notice various patterns formed by different groups of star. These are called 'constellations'. Constellations are groups of bright stars in the sky. The people of ancient civilisations attributed figures of animals, people and beasts to these groups. The most easily recognizable constellation is the saptarishi which is a group of seven stars. It is a part of large Ursa Major constellation.



Constellations

Geography Reveals

Pole Star (Dhruva Tara) is a star which rises in the east at night and sets in the west in the early morning. The Pole Star is situated right above the poles, hence it appears stationary from the Earth. It shows the north direction and was used for navigation in ancient times.

Asteroids

Asteroids are small, rocky bodies that were left over after the formation of the planets 4.5 billion years ago. They are often known as minor planets. Most of them can be found orbiting the Sun in a belt between Mars and Jupiter. This region in our Solar System is called the Asteroid Belt or Main Belt Asteroids. The word asteroid means star-like. Meteors and Meteorites A meteor (more commonly called a shooting star or falling star) appears as a narrow streak of light across the sky. It appears when a particle or chunk of rocky matter called a meteoroid enters the Earth's atmosphere from outer space and burns up due to friction. When a meteoroid reaches the Earth's surface, it is called a meteorite. Meteorites produce craters on the Earth's surface. The largest meteorite ever found on the Earth fell in Namibia, Africa. It weighed 100 tons.

Comets

A comet is a small member of the Solar System made of rocky material held together by frozen gases. It is like a dirty snowball. A comet travels

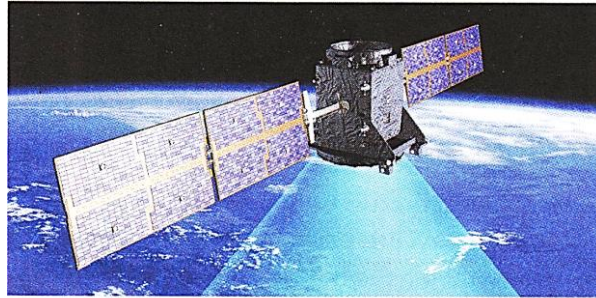


Comet

around the Sun in an oval-shaped path. It is the most spectacular celestial object. It appears as a bright ball of light with a long tail. The head of a comet is made up of rocks and dust while the tail is made of gases. The most famous comet is Halley's Comet which passes the Earth every 76 years. It was last seen in 1986. Can you guess when it will appear again?

Artificial Satellites

Artificial satellites are man-made objects continuously orbiting the Earth or some other body in space. Most artificial satellites revolve the Earth with the same speed as the Earth does. So they appear stationary from the Earth. They complete one orbit around the Earth in 24 hours. These satellites are at a height of about 36,000 km above the Earth. We use them to study the universe, help forecast the weather, transfer telephone calls over the oceans, assist in navigation of ships and aircraft, monitor crops and other resources, and support military activities and for research as well.



Artificial Satellite

Geography Reveals

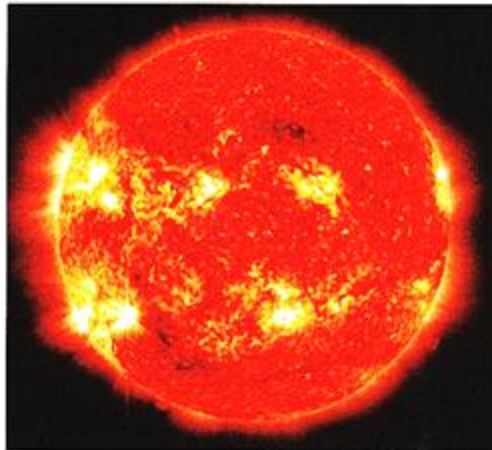
The universe is very vast and the celestial bodies in it lie at great distances. Scientists use a unit called light year to measure the distance in the universe. As defined by the international Astronomical Union (IAUP), A light year is the distance that light travels in one year. A light year is exactly equal to 9,460,472,580.8 km or 9.46 trillion km (approx.)

SOLAR SYSTEM

The Solar System consists of the Sun, and everything bound to it by gravity. This includes the eight planets and their moons, the asteroids, the dwarf planets, the meteoroids and comets. The Solar System is located in the Milky Way galaxy.

SUN

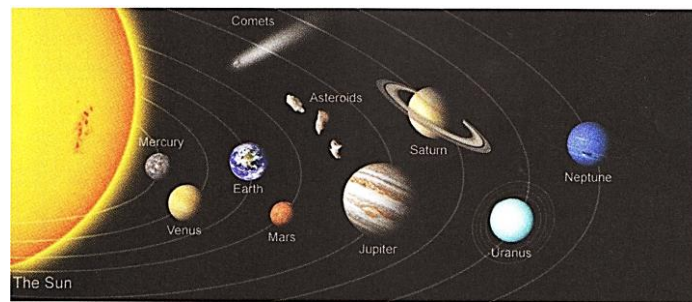
The Sun is the head of our solar family—the Solar System—and the largest member. It is a star of medium size and average brightness. It appears bigger than the other stars as it is comparatively nearer. This huge ball of fire mainly consists of two gases—helium and hydrogen. It is 1.4 million kilometers across—equal to 109 earths set side by side! The Sun lies about 150 million km away from us. At this distance, it takes about 8 minutes for the sunlight to reach us—even though light travels at a speed of 300,000 km/s. The temperature at the core or inner part of the Sun is about 14 million °C while its surface temperature is about 6000 °C.



The Sun

Geography Reveals

Helium is named after 'helios' the Greek word for the Sun, because it was first discovered in 1868 by analysing sunlight.



The Solar System

Our Solar System-Some Basic Facts and Figures

	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune	Moon
Mass (10^{24} kg)	0.330	4.87	5.97	0.642	1899	568	86.8	102	0.073
Diameter (km)	4879	12,104	12,756	6792	142,984	120,536	51,118	49,528	7475
Gravity (m/s^2)	3.7	8.9	9.8	3.7	23.1	9.0	8.7	11.0	1.6
Rotation Period (hours)	1407.6	-5832.5	23.9	24.6	9.9	10.7	-17.2	16.1	655.7
Distance from sun (10^6 km)	57.9	108.2	149.6	227.9	778.6	1433.5	2872.5	4495.1	0.384
One revolutionary takes (days)	88.0	224.7	365.2	687.0	4331	10,747	30,586	59,800	27.3
Number of Moons	0	0	1	2	63	62	27	13	0

Ring System	No	No	No	No	Yes	Yes	Yes	Yes	Yes
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Adopted from NASA

PLANETS

A planet is a large, round heavenly body that moves around a star and shines with the light reflected from the star. Planets of the Solar System move around the Sun in a fixed *elliptical*³ *orbit*⁴. Each planet also rotates about its own *axis*⁵.

The first four planets, i.e. Mercury, Venus, Earth and Mars are called inner planets because they are closer to the Sun.

Jupiter, Saturn, Uranus and Neptune are called outer planets. Outer planets have rings around them and they have many moons.

Geography Reveals

An easy way to memorise the names of the planets in order of their distance from the Sun is to remember this sentence: My Very Educated Mother Just Showed Us Nory.

Q. What keeps the Earth and the other planets in their orbits around the Sun? Why they do not fly off?

Planets of the Solar System

Mercury is the nearest planet to the Sun. It is a small, rocky world—the smallest, in fact. Mercury was visited by NASA's Mariner 10 in 1973 and 1974. Its daytime temperature is 470 °C and the night-time temperature is -183 °C. It takes only 88 days to complete one round along its orbit.

Venus is the second planet from the Sun in the Solar System. It is nearly the same size as the Earth, so it is called the sister planet of the Earth or Earth's twin. It appears to be brightest object in the morning or evening sky; so it is also called the Morning Star or Evening Star. Venus is different from all the other planets because it spins 'backwards' on its axis i.e., from east to west.

Earth is the third planet from the Sun. For a space traveller, the distinguishing features of the Earth are its blue waters, brown and green land masses and white clouds. It is also referred to as the Blue Planet. Earth is not a perfect sphere. It is slightly flattened at the poles. This shape is known as geoid which means earth-like.

Mars is the fourth planet from the Sun. It is known as the Red Planet as its whole surface is covered with red-coloured dust and rocks. It has a very thin and dry atmosphere. Water is locked up as ice at its poles. NASA's Mars Exploration Rovers—which are two robots—landed on Mars on June 10 and July 7, 2003 to explore the planet.

Jupiter lies fifth from the Sun and is the largest in the Solar System. It is made up of clouds of gases. Despite its huge size, Jupiter is the fastest- spinning planet.

Geography Reveals

If you could put all the planets in a pool of water Saturn would be the only one to float.

Saturn, the sixth planet from the Sun is the second largest in the Solar System. Saturn is mainly made up of light gases—hydrogen and helium. This makes the planet light in weight. Saturn has rings. This is its most amazing feature.

Uranus is the seventh planet from the Sun. It is mainly made up of 'ice'—a frozen mixture of water, methane and ammonia. Uranus also has at least a dozen of dark and dusty rings.

Neptune is the eighth and the farthest planet from the Sun. It is 57 times bigger than the Earth, but spins quite rapidly—once in 16 hours and 7 minutes. It has an atmosphere of hydrogen, helium and methane. Its interior is made of ice. The planet has some very strong winds and violent storms. Neptune has at least five dark, narrow rings.

Small planets in the Solar System are known as **Dwarf Planets**. Ceres, Pluto, Haumea and Eris, to mention a few are dwarf planets.

Geography Reveals

Till recently, the Solar System had nine planets But in 2006. The International Astronomical Union adopted a new definition of a planet. Smaller planets in the Solar System are Known as dwarf Planet. Pluto is now Considered a dwarf Planet.

MOONS OR SATELLITES

Moons or satellites are celestial bodies that revolve around a planet. There are at least 100 moons within our Solar System, and presumably many more orbiting the planets of other stars.

Q. Why do you think Mercury and Venus have no moons while the outer planets like Jupiter and Saturn have numerous moons?

The Earth's Moon

The Moon is the brightest object in the night sky but gives off no light of its own. It shines because it reflects light from the Sun. The Moon is the only natural satellite of the Earth and is 378,000 km away from it. The Moon's surface is rocky and covered with dust. It has huge depressions called craters. There is no air on the Moon. The temperature on the surface varies from 105° C during the day to -153° C in the night. Since the Moon has less mass than the Earth, the force of gravity at the lunar surface is only about one-sixth of that on the Earth.

Q. If you weigh 36 units on Earth, what would your weight be on the Moon?

Phases of the Moon

The Moon orbits the Earth in 27 days and 8 hours. It also spins on its axis in about the same time. As a result, the same side of the Moon faces the Earth. However, if you observe the Moon every night for a month, you will see that its size changes every night. The night we see a circular Moon is called the **full Moon** (poornima) night. - Then onwards, the size of the Moon decreases every day and after 15 days it disappears. The night we cannot see the Moon at all is called the **New Moon (amawasya) night**. After the new Moon, the size of the Moon increases every day and once again it becomes a full moon after 15 days. When the Moon is growing, we say it is **waxing** and when it is shrinking, it is said to be **waning**. The various sizes of the Moon visible during the month are called **Phases of the Moon**.



Different Phases of the Moon

Activity

Observe the Moon for 28 days. Draw the shape you see each night in a diary.

Geography Reveals

The Soviet Union launched the first artificial satellite, Sputnik 1, in 1957. Since then, the United States and about 40 other countries have launched and operated satellites. Some satellites, notably space stations have been launched in parts and assembled in orbit. Today, thousands of useful satellites and pieces of space junk are orbiting the Earth.

OUR UNIQUE EARTH

Earth is so far the only planet in the Solar System known to have life on it. This makes it very unique. A few other planets and moons have ice, atmospheres, seasons and even weather, but only on Earth does the right mix come together that supports life. Here are some features of the Earth that help sustain life:

Placement in the Solar System: Distance from the Sun has a great effect on a planet. Mercury and Venus being much closer to the Sun are too hot to support life. Mars and the outer planets are bitterly cold and frigid. Earth is just at the right distance from the Sun—hence it is neither too hot nor too cold.

Right levels of oxygen and carbon dioxide:

Air contains about 78% nitrogen, 21% oxygen and 0.03% carbon dioxide—just the right mix to support life on the Earth. Most living beings require oxygen for respiration which is vital for life. Carbon dioxide is required by plants for photosynthesis—a process in which green plants prepare their own food giving off oxygen. Carbon dioxide is also a prominent greenhouse gas. It traps heat from the Sun during the day, and radiates it back at night. This keeps the Earth's surface warm at night. In its absence the Earth would be frozen at night.

Availability of water: Earth is an ocean planet as three-fourths of its surface is covered by water. Water is vital for all forms of life. Plants need water to survive. In the absence of water they wilt and die, and leave the land barren. Think what would we eat then?

Suitable atmosphere: The layers of gases surrounding the Earth, about 80-100 km thick, help maintain a consistent temperature and pressure on the Earth. They also shield the Earth from collisions with cosmic particles (meteors) and protect us from harmful rays of the Sun.

The Earth's tilt: the Earth's axis is tilted at an angle of 23.5° from the perpendicular. This causes seasons. If the Earth's axis were not tilted, the Sun would remain positioned exactly halfway between the north and the south poles, and there would be no seasonal changes on the Earth. There would be no water cycle, without which life forms would not exist.