

UNIT – V

Earth and Space

Chapter 9 *Earth and the Solar System*

EARTH AND OTHER PLANETS

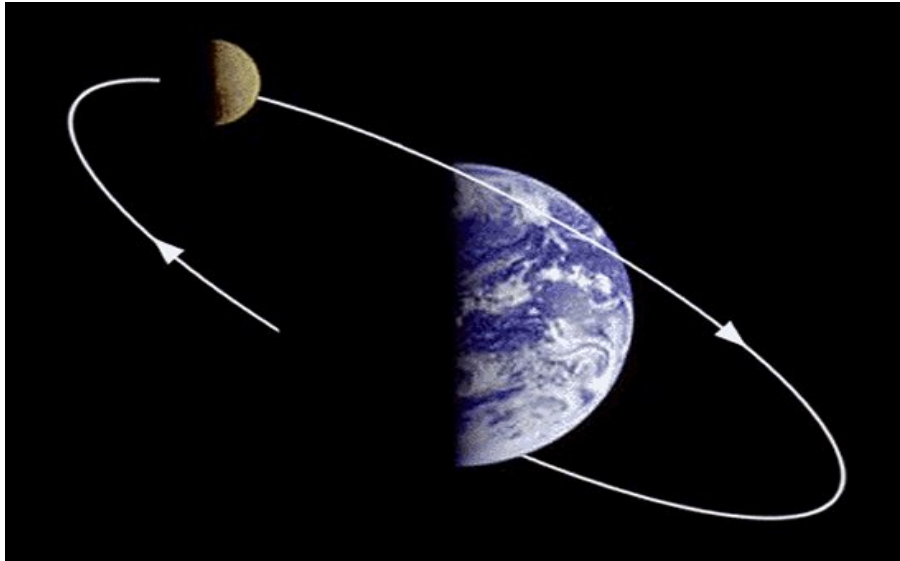
A solar system contains planets, moons, and other objects that orbit around a star or the star system. The solar system in which we exist includes the sun, nine planets, their moons and various comets, asteroids and other small bodies. There are two types of planets– inner planets (the Mercury, Venus, Earth and Mars) as they are closest to the sun, and outer planets (the Jupiter, Saturn, Uranus, Neptune and Pluto).



The inner planets are relatively small, made of rock and iron, and contain few or no moons. The outer planets (except Pluto) are usually large, gaseous, and are made primarily of hydrogen, helium, and ice. These planets usually have rings and/or many moons. Our solar system is only a small part of the universe. The radii of various planets and their distance from the sun is given below:

Planet	Distance from sun (km)	Radius (km)
Mercury	57, 910,000	2,440
Venus	108,200,000	6,052
Earth	149,600,000	6,378
Mars	227,940,000	3,397
Jupiter	778,330,000	71,492
Saturn	1,429,400,000	60,268
Uranus	2,870,990,000	25,559
Neptune	4,504,300,000	24,766
Pluto	5,913,520,000	1,137

Satellite is anything that orbits another object. A body that has a primary orbit around a planet is called moon. The earth has only one moon which is a rocky sphere that orbits about once a year. The number of moons of different planets are given below.



Number of moons								
Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune	Pluto
0	0	1	2	16	18	20	8	1

READING CHECK:

How would you define a solar system?

READING CHECK:

What are inner and outer planets?

READING CHECK:

Name the outer planets.

READING CHECK:

How would you define moon and satellite?

READING CHECK:

Which planet has maximum number of moons?

READING CHECK:

Which planets do not have any moon?

PLANETS AND THEIR MOON

All the planets move around the sun in a counterclockwise direction. In addition, all the planets except Venus and Uranus rotate on their axis. If we look from the side the solar system looks flat because most of the planets (except Mercury and Pluto) orbits in the same plane. In general, the mini-systems of the planets and their moons follow the same pattern. Moons mostly orbit in flat planes around their planets in a counterclockwise direction with some exceptions among the moons of Jupiter, Saturn, and Neptune.



It is widely believed that the solar system is formed from a rotating cloud of dust and gas. As it spun, the gravity caused the collapsing of cloud on itself which then took the shape of the rotating disk. The disk

contained the clumps of matter. A large clump of matter was present at the centre of the disk. This mass resulted in the formation of the sun. The lumps which were present in the leftover gas and dust formed the planets, moons, and other objects in the solar system

READING CHECK:

How would you discuss the movement of planets?

READING CHECK:

How does a solar system can be compared with a pancake?

READING CHECK:

How would you discuss the movement of moons?

READING CHECK:

What do you know about the origin of the solar system?

READING CHECK:

How would you explain the formation of the sun?

READING CHECK:

How would you explain the formation of planets, moons and other objects in the solar system?

THE SUN AND OTHER STARS

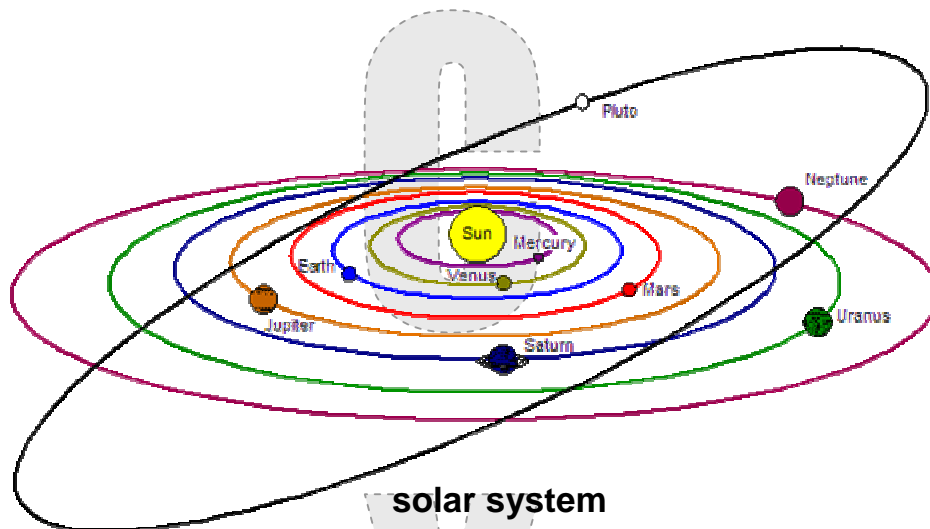
The collection of millions of solar systems that revolve around a point in the space is known as galaxy.



Universe



Galaxy



solar system

There are three types of galaxies depending on shapes – spiral (looks like a flattened pinwheel), elliptical (shaped like eggs), or irregular (any other shape). The most common types of galaxies are spiral and elliptical.

The galaxy in which we remain is the Milky Way – a spiral galaxy. All the stars we see in the night belong to this galaxy. Our solar system is located on one of the spiral arms and it orbits the centre of galaxy about once every 200 million years.

There are some common features in various types of galaxies. All galaxies have the same chemicals (hydrogen, helium and a small amount of heavier elements), the same forces (such as gravity and electrical forces) and the same kind of energy (including the different kinds of light in the electromagnetic spectrum).

READING CHECK:

How would you define a galaxy?

READING CHECK:

What are the different types of galaxies?

READING CHECK:

What is the difference in the shape of various types of galaxies?

READING CHECK:

What is the Milky Way galaxy?

READING CHECK:

What is the location of our solar system?

READING CHECK:

What are the common features in various types of galaxies?

READING CHECK:

Which same chemicals are present in various types of galaxies?

READING CHECK:

Which same chemicals are present in various types of galaxies?

LIFE-CYCLES, AGE, AND CHARACTERISTICS OF STARS

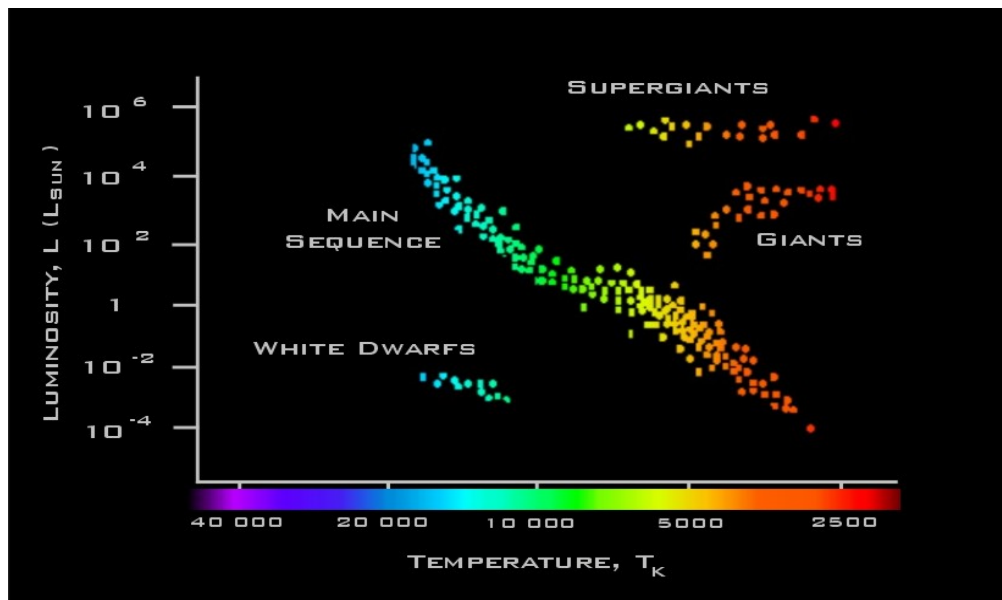
All stars are a glowing ball of hot gases (mostly hydrogen and helium). All are different from each other in terms of distance from the sun, size, temperature, color, brightness, and age. The star which is nearest to the sun is Proxima Centuri. It is 4.3 light years away. The Polaris is another star which is 390 light years away. The sun can be called a medium sized star in terms of diameter, mass and volume. There are small, hot stars which are as small as the earth (called white dwarfs). On the other hand, there are large, cool stars (called supergiants) which can be hundreds of times wider than the sun

Sun	
Age	4.6 billion years
Radius	695,000
Mass	2×10^{30} kilograms
Surface temperature	5500°C
Color	Yellow

Stars vary widely in their surface temperatures. The color of a star is determined by its surface temperature. The sun is a medium temperature yellow star

Star Color and Temperature	
Color	Average Surface Temperature
Blue	30,000°C
White	9,500°C
Yellow	6,000°C
Orange	5,000°C
Red	3,000°C

Around the year 1910, a graph was developed by two astronomers Ejnar Hertzsprung and Daniel Russell, which is known as Hertzsprung-Russell or H-R diagram. This graph shows the relationship between star's brightness and its average surface temperature.



The Sun is present in the diagonal line of the stars that moves from upper left to lower right called the main sequence which shows the relationship between temperature and brightness: hotter stars burn brighter.

A Star is formed when clouds of gas compress enough to ignite the nuclear fusion. The life cycle of the star is determined by its mass. After million years of their formation most of the stars enter the main-sequence phase. In this stage the process of burning and using up hydrogen takes place. For an average star this process lasts about 10 billion years

After all the hydrogen is used the low mass stars collapse and become white dwarfs. White dwarfs are small, bright and dense. They can radiate heat for billion of years. When that energy is gone the star stops glowing and becomes a black dwarf.

In case of medium-sized star the process of expansion and contraction takes place. When hydrogen burns away the core shrinks but expansion of star takes place because gravity can no longer hold the outer layers in tightly. The star becomes a red giant. After another billion years or so red giants collapse into white dwarfs and then cool into black dwarfs

Very massive stars turn into the supergiants which are large, cool, red stars that burns helium in the core. When all the helium is used up the contraction of core takes place again. If the supergiant is massive enough, it will collapse into a neutral star which is extremely dense, rapidly spinning core of neutrons. Most massive stars collapse into black holes. A star may blow off some of its gas at different stages in its life-cycle. These gases then become the material from which new stars are formed.

READING CHECK:

What are stars?

READING CHECK:

How do different stars vary from each other?

READING CHECK:

How will you define white dwarfs?

READING CHECK:

What are supergiants?

READING CHECK:

Why color of the sun is yellow?

READING CHECK:

What is the color of the star with average surface temperature of 30,000oC?

READING CHECK:

What is a H-R diagram?

READING CHECK:

What is the location of the sun in the H-R diagram?

READING CHECK:

Which factor determines the life-cycle of a star?

READING CHECK:

Discuss the formation of the black dwarfs in case of the low-mass stars?

READING CHECK:

Discuss the formation of a red giant in case of a medium-sized star?

READING CHECK:

Discuss the formation of a neutral star in case of a very massive star?
