UNIT 8 UNIVERSE AND SPACE EXPLORATION

Structure

8.1 INTRODUCTION

Whenever you look at the sky on a dark night we see a cluster of stars. Some stars are very bright and large in size and some are very dull and small. Some stars form groups. These groups are in certain recognisable shapes.

Some stars are always seen at fixed positions but some stars like objects keep on wandering which are called **planets.** Scientists all over the world study the characteristics of stars using telescopes, spectroscopes, spectrograph, radio telescopes and satellites.

One should have experience of this field to understand the relative motion of heavenly bodies in the sky. However, you can see the sky at night to get first hand experience of movement of stars, planets and constellations. In order to understand the movement of 'Phases of Moon', a simple model can be prepared. Some idea of nebula, galaxies, inter galatic space, satellar evolution and origin of universe are included in this unit.

Artificial satellites have been used effectively to know about the heavenly bodies. The advancement in space voyage has opened a new dimension of activities to study the universe. We hope that exploration of inter-sateller space through man-made space vehicles would help in obtaining more and more knowledge about universe.

The aim of the present unit is to arouse curiosity for further study of this challenging field, especially in view of the fact, that the understanding of the structure and origin is some what baffling as per the latest data.

8.2 OBJECTIVES

After going through this unit, you will be able to:

- identify different components of the universe;
- classify heavenly bodies into different categories;
- explain different theories of origin of universe;

- design self assessment questions and activities based on our 'universe and earth system';
- develop manipulative skills and innovative skills to teach this particular topic;
- possess detailed knowledge about solar system and motion of planets;
- be familiar with the origin of stars and energy generation in stars;
- be familiar with different galaxies;
- be familiar with satellites and the mechanisms of their launching; and
- know about the importance of satellite communication, weather forecasting and weather monitoring.

8.3 ORIGIN OF THE UNIVERSE

Main Concepts

i) The universe originated by unknown cosmological explosion.

ii) The universe is expanding in all directions. This fact is supported by Doppler's red shift.

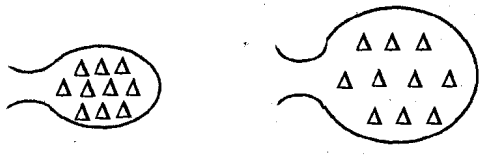
Teaching-Learning Process

The teacher can give brief history of the universe

15-20 billion years ago the whole universe was concentrated at a point in space. Due to a tremendous cosmological explosion different fragments were formed which are still moving away from each other. Our universe consists of billions of galaxies and each galaxy consists of thousand billions of stars. On the large distance scales of 10^8 - 10^9 light years, distribution of the galaxies seem to be quite uniform.

Various theories have been put forward to explain the origin of the universe.

The Big Bang Theory : According to this theory the whole universe originated from a single point due to cosmological explosion and different components of the universe were produced. **A model can be shown in the class** to give the idea of expanding universe. Dots or points painted on the surface of an expanding balloon can depict a picture of the expanding universe.



Deflated balloon **Inflated balloon**

Fig. 8.1

Hubble observed and photographed the galaxies outside the Milky Way and proved that galaxies are moving away from one another. Also, astronomers have recorded the frequencies of the light coming from many galaxies. They found these frequencies to be less than those expected, and shifted towards red light. This is known as the red shift. The reason for this shift is the doppler effect which states that decrease in the frequency of wave received by an observer i.e. earth, is caused by the motion of the source i.e. galaxy, away from the observer. Thus the doppler red shift also proves that universe is expanding. Fig. 8.2 diagrammatically illustrates the situation the speed of the galaxies increases as their distance increases from our Earth.

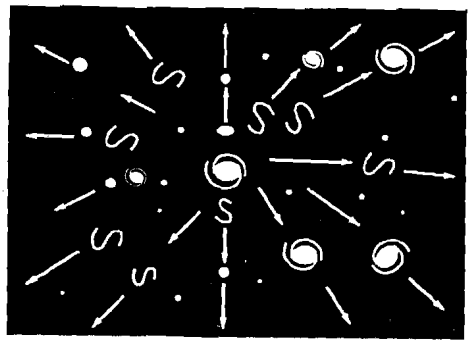


Fig. 8.2 : Movement of galaxies in universe

Quasars are very small star like outermost objects of the universe and are moving away with 90% the velocity of light. These are cosmic source of light and radio waves. Their existance also supports the Big Bang Theory.

Pulsating Theory : At present the galaxies are moving away but they also experience cumulative gravitational force. If the mass-energy content is above a critical value; the galaxies will slow down under the influence of the gravitational force. After sometime the galaxies will start moving toward each other and will be again concentrated at a point. Again the cosmological explosion will occur and universe will be created again. According to some Astronomers this process will repeat again and again. This theory is called Pulsating Theory.

The Steady State Theory : Some part of the observation of the sky reveal that the density of the universe appears to be constant. We are living in a homogeneous universe in which all points are alike. According to this theory new galaxies are formed in the empty space created due to the outward motion of the galaxies. It follows that for the density to remain constant new matter must be created at the same rate at which the expansion would decrease the density.

By and large, the evidences available are in favour of Big Bang theory.

Methodology used : In this chapter the field study-cum-enquiry method is used. Visit to planetorium will enable you to make the students to gain better knowledge of related concepts. Big Bang theory is explained by the demonstration shown in Fig. 8.1.

Teaching aides : Charts, transparencies and films and opaque projection.

Check Your Progress

Notes : a) Write your answers in the space given below.

b) Compare your answers with those given at the end of the unit.

1. What is meant by the term Universe?

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2. What is the age of the Universe?

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3. Distinguish between a star and a planet.

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4. What is a galaxy ?

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5. How many galaxies are there in the Universe ?

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6. What is the appropriate mass of the Universe ?

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8.4 UNIVERSE AND ITS DIMENSIONS

Main Concepts

i) Dimensions of the Universe are of the order of billions of light years.

ii) Inter-galactic distances have a magnitude of millions of light years.

Teaching-Learning Process

Astronomy is the oldest branch of science. It is based on meticulous observations and analysis. Astronomy is the study of the Universe. It is the study about the position, motion, size, origin and properties of objects around our earth and far-far away from our solar system. The sun is only one of the billions and billions of stars that exist in the universe. These stars are uniformly distributed in space. These stars are in huge clusters. Clusters of stars, dust particles and gaseous matter is called a galaxy. There are billions of galaxies in the universe which are moving away. Hubble measured distances upto 10^9 light years. This shows that dimensions of the universe are larger than this limit. The nearest galaxy to the one that we live in is 2×10^6 light years away. The size of galaxies may be 1000,000 light years or larger.

Radio telescopes can scan galaxies upto 10^{10} light years. The inter-galactic distances have a magnitude of millions of light years. The distance of various galaxies are given in Fig.8.2

Hubble measured the velocities of stars at different distances which is indicated in the following Fig. 8.3.

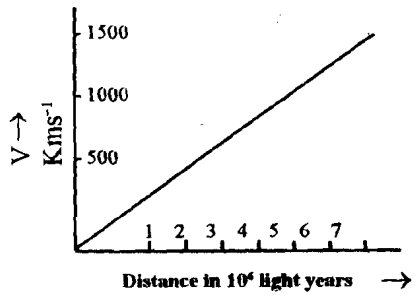

Fig. 8.3

Fig. 8.3 clearly indicates that the more the galaxy's distance from earth, the faster it's moving away from the earth.

Methodology used : Discussion method. The lesson is developed by discussion method. The lesson will be interesting if skill of handling of pupils response is adopted.

Teaching aid : Charts, transparencies, and films.

Check Your Progress

Notes : a) Write your answers in the space given below.
b) Compare your answers with those given at the end of the unit.

7. What is one light year ?

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8. What is age of our Universe ?

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9. What are quasars ?

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10. What is size of our Universe ?

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11. What is the length of Milky Way ?

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12. What is the order of distance of the next star nearest to us than the sun ?

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13. What is one par-sec ?

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14. Explain the reason for expressing the distance between heavenly bodies in terms of light years.

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8.5 ORGANISATION OF EARTH SYSTEM

Main Concepts

i) Earth is a unique planet.

ii) Our Earth is an active planet. Several phenomena are occurring within and on the surface of earth and in the atmosphere.

iii) The organisation of earth into different layers is called differentiation (under influence of gravity).

iv) Relative position of continents is still changing.

Teaching-Learning Process

The earth began as a cold aggregate of planetesimals (Small chunks of cosmic matter) which consisted of silicon, iron and magnesium with traces of other elements. The planetesimals collided with each other and stuck on. Their kinetic energy was converted into heat. Radioactive disintegration and gravitational attraction gave rise to the temperature of the earth. The most important role was played by gravitational attraction. Once melted, about 800 millions years after its formation, the earth began to reorganise itself under the influence of gravity and this process is called **differentiation**. Three distinct layers were formed - the outer most CRUST, the underlying MANTLE and the central CORE. The following figure 8.4 depicts the different layers and their characteristics.

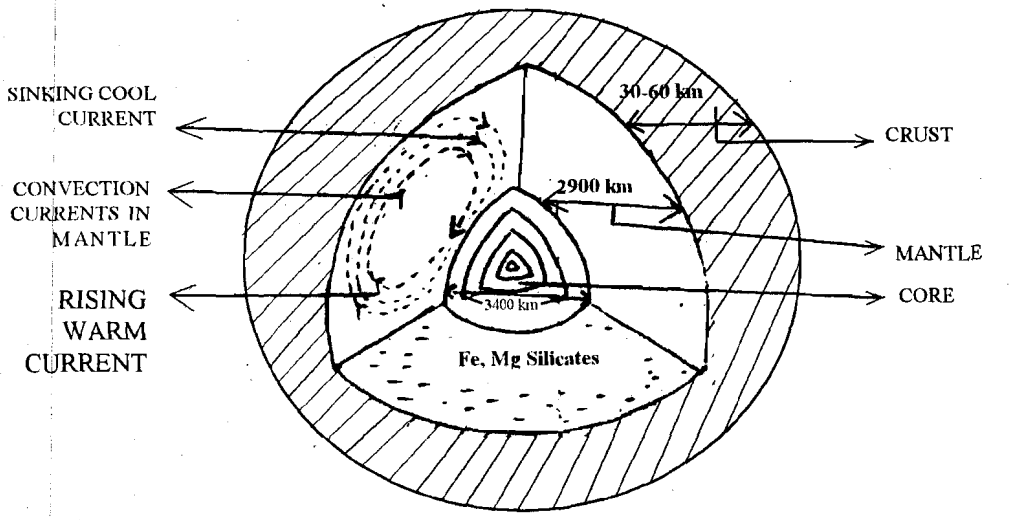


Fig. 8.4 : Layers of the Earth

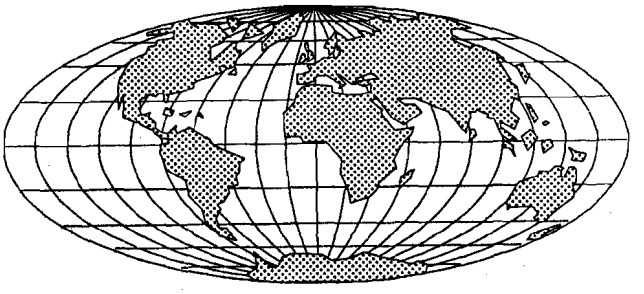
The crust and the mantle together contain all mineral deposits. The core is extremely hot with a temperature of 4000° C and also very high pressure (3.7×10^7) Nm. Metals are present in molten state in this layer. Due to the extreme heat in the core, convection currents arise in the mantle carrying heat from interior to the surface causing volcanic eruptions and earthquakes.

The gases and water vapours which were trapped in the molecules of primitive material were liberated to form the atmosphere and oceans during the process of differentiation. The first organisation of earth took place within 500 million years of its formation. The teacher can explain the evolution of life on earth by preparing a chart showing their development on the earth. He/she must also explain the important aspects pertaining to different spheres of the earth system the lithosphere, the atmosphere, the hydrosphere and biosphere, such as interrelationships among the four spheres and biogeochemical cycles occurring in between the different spheres. Also, the teacher should highlight the maintenance of balance and effects of disturbance in the inter-relationships of the four spheres.

The continents of the earth seem to be the scattered pieces of a single continent called pangea. The following figures show the changing organisation of the continents.

Methodology used : This sub-unit can be taught by field study-cum-enquiry method. The differentiation of earth system is explained using the chart and transparencies. Field trips to mines can also be arranged to make the lesson more interesting.

Teaching aid : Charts, transparencies and films.



Pangaea

Fig. 8.5 : Pangaea 200 million years ago

180 million years ago. The original Pangaea landmass has split into two major continental groups. The southern group, Gondwana-land, had itself started to break up. India and Antarctica

— Australia becoming isolated. A rift had begun to appear between South America and Africa and in the East, Africa was closing up the Tethys Sea.

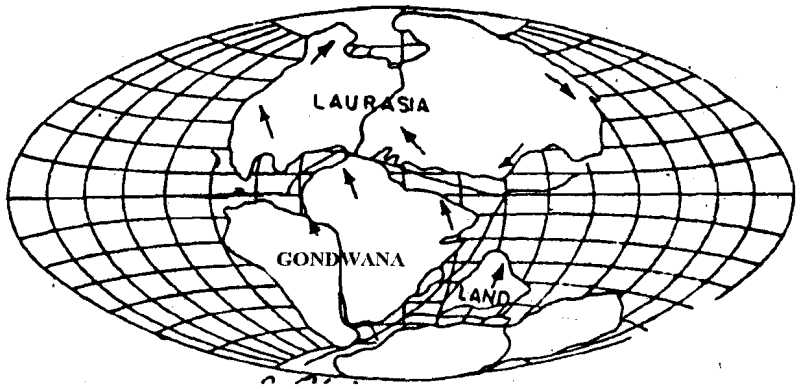


Fig. 8.6(a) : 180 million years ago

135 million years ago. Both Gondwana land and Laurasia continued to drift northwards but the widening of the splits in the North Atlantic and Indian Oceans persisted. The South Atlantic rift continues to lengthen and a further perpendicular rift appeared which will eventually separate Greenland from North America. India continues heading northward towards Asia.

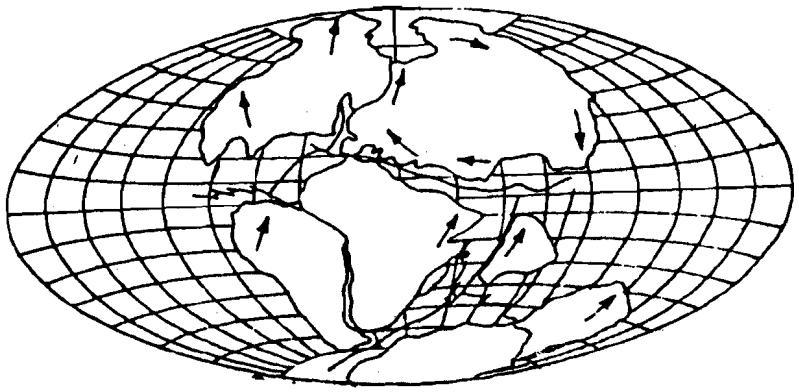


Fig. 8.6 (b) : 135 million years ago

65 million years ago. South America, completely separated from Africa, moved quickly north and westwards. Madagascar broke free from Africa but, as yet, there is no sign of the Red Sea rift which will split Africa from the Arabian Peninsula. The Mediterranean sea is recognizable. In the South, Australia is still connected to Antarctica.

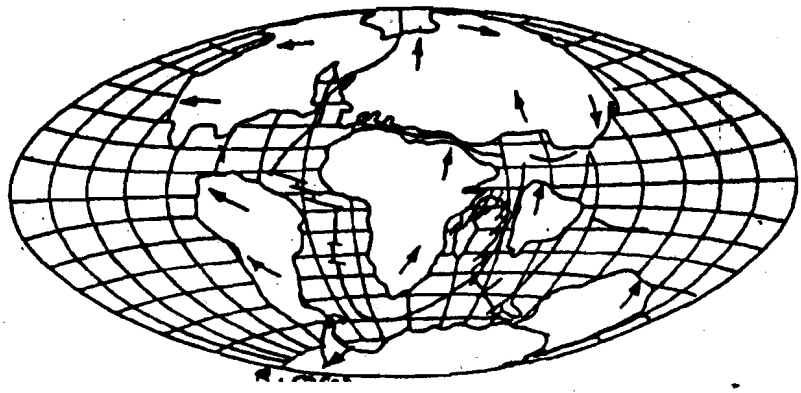


Fig. 8.6(c) : 65 million years ago

Present earth : India has moved northwards and is colliding with Asia, crumpling up the sediments to form the folded mountain range of the Himalayas — South America has rotated and moved west to connect with North America. Australia has separated from Antarctica.

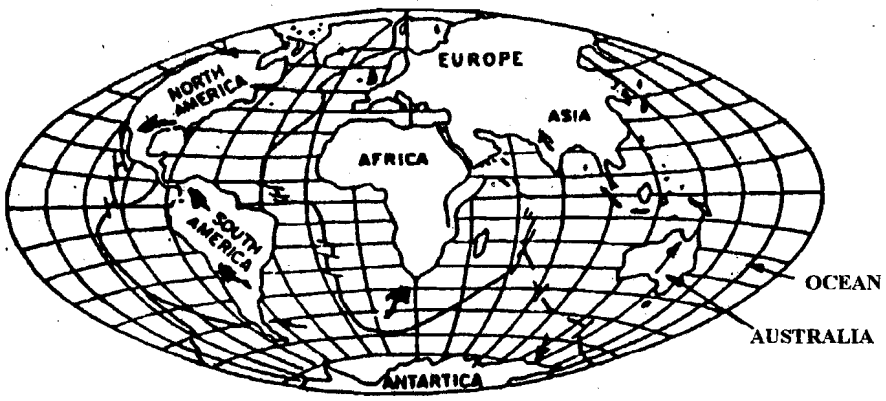


Fig. 8.6(d) : Present earth

Check Your Progress

Notes : a) Write your answers in the space given below.

b) Compare your answers with those given at the end of the unit.

15. What is the green house effect ?

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16. What is ozone layer ? What is its importance ?

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17. What are planetesimals ?

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18. What is the process of differentiation ?

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8.6 MINERALS AND COAL DEPOSITS

Main Concepts

i) Minerals, coal and oil are natural resources from which man prepares tools, machines and commodities for his daily life.

ii) Minerals, oil and coal are the collection of useful materials buried under the upper surface of the earth.

iii) Coal and oil were formed under pressure and temperature from the biomass.

Teaching-Learning Process

Most of the minerals are contained in the lithosphere which is a large reservoir of resources so useful to man. The minerals of the lithosphere provide the basic material from which man prepares tools, machines and commodities for his daily life. The lithosphere is also the repository of fuels-coal, oil and gas without which civilisation would have been impossible. Look at the figure 8.7 showing the minerals deposited in the earth.

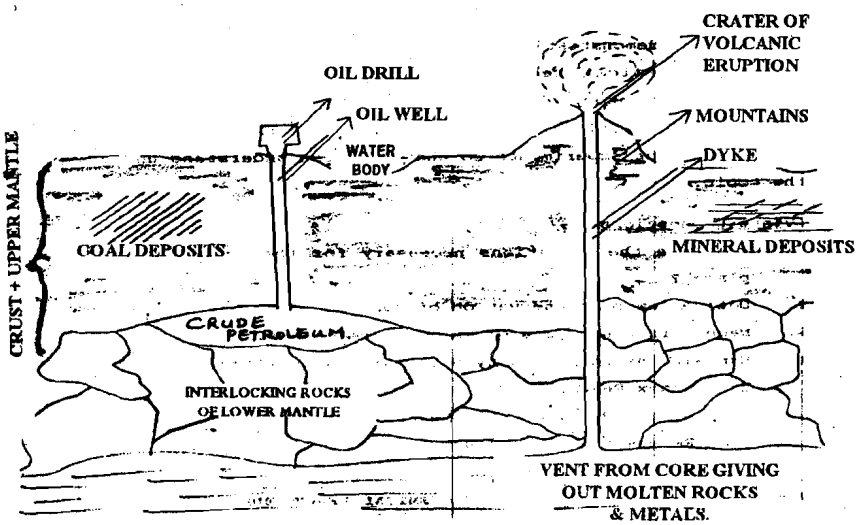

Fig. 8.7 : Mineral deposits in the Earth

Coal deposits are a major source of energy. A balance is kept by nature between resources and environment. Resources are concentrated deposits of some chemical compounds and minerals. Earth resources are created by long acting processes that extract certain materials from the earth system and concentrate it in a given region.

About 0.25 billion years ago the earth was covered by dense forests. The biomass of the forests were buried inside the earth by a fortunate sequence and converted into coal, oil and gas. As a result, the CO_2 extracted from the atmosphere was not returned to the atmosphere and thus green house effect was reduced.

We must make limited use of these resources because they are limited, Let us think what would happen when these resources will be finished?

Methodology Used : Field study-cum-enquiry method and discussion method. The differentiation of earth system is explained by charts and models. The models used in geography can be used while teaching this unit. Use of films and transparencies will make this unit more interesting.

Teaching aids : Charts, transparencies, films and field trips.

Check Your Progress

Notes : a) Write your answers in the space given below.
b) Compare your answers with those given at the end of the unit.

19. How is coal formed ?

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20. How was petroleum formed ?

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21. What are minerals ? How were they stored inside earth ?

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8.7 SOLAR SYSTEM

Main Concepts

i) Solar system is a small component of Milky Way galaxy. It consists of nine planets, asteroids, comets which revolve around the sun.

ii) Age of the solar system is 5000 billion years.

Teaching-Learning Process

It is assumed that about 5 million years ago our young sun was surrounded by a disc shaped cloud of left over gases. These gases condensed to form small objects called planetesimals which were constantly colliding with themselves and reassembling. Thus planets were formed. During the formation of planets many large size objects were hurled here and there.
They were colliding with other objects. The craters on the surface of the Moon are the evidence of such collisions.

There are 9 planets comprising Solar System alongwith satellites of planets, asteroids and large number of comets.

TABLE 8.1

MEMBER	Distance from Sun (10^6 Km)	Radius 10^3 Km.	Mass (lines of Earths Mass)	Density in 10^3 Kgm^{-3}	Surface gravity	Period of revolution	Atmosphere	Satellite
SUN		696.00	332946	1.41	27.9 years	250 x 10^6	H_2 H_e	9 planets comets, Asteroids
MOON	150	1.74	0.0123	3.34	0.17	27.8 days	Vacuum	0
MERCURY	58	2.44	0.055	5.43	0.38	87.97 days	Vacuum	0
VENUS	108	6.05	0.815	5.24	0.91	224.70 days	CO_2	0
EARTH	150	6.38	1.000	5.52	1.00	365.26 days	N_2, O_2 80r, 19y CO, CO_2, H_2, O_2	1
MARS	228	3.39	0.107	3.94	0.38	686.48 days	CO_2 97% N_2 3%	2
JUPITER	778	71.40	317.8	1.33	2.54	11.89 years	H_2, HO CH_4, NH_3	16
SATURN	1431	60.00	95.16	0.70	1.08	29.46 years	H_2, HO, CH_4 NH_3	24 + Rings
URANUS	2886	25.40	14.50	1.3	0.91	84 years	H_2, HO, CH_4 He	5+ Rings
NEPTUNE	4529	24.30	17.20	1.76	1.19	164 years	H_2, HO.CH_4 He	2
PLUTO	5936	0.50	.0026	1.17	0.057	247.60 years	?	1

You can discuss the properties of different members of Solar System with the help of the above table.

Methodology used : This Sub-unit can be taught by discussion/field study-cum-enquiry method. The lesson is developed with the help of students. Skill of explanation will also be very effective in this sub-unit.

Teaching aids : Static or dynamic model, Charts, Epidiascope, Overhead projector.

Check Your Progress

Notes : a) Write your answers in the space given below.
b) Compare your answers with those given at the end of the unit.

22. What is a planet?

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23. Which is the nearest planet from the earth?

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24. Which planet has maximum number of satellites?

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25. Why does moon have no atmosphere?

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26. What are meteorites? Why are they visible?

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27. Which planet has maximum mass?

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28. Distinguish between meteor and meteorite?

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8.8 STARS AND LIFE HISTORY OF STARS

Main Concepts

i) Energy is generated in stars by the process of thermo-nuclear fusion.

ii) Two types of forces (strong and weak) play important role in evolution, life and death of a star.

iii) Black holes attract all kinds of matter and radiations towards it.

iv) Stars are not permanent, they have a process of birth and evolution, taking thousands of years.

Stars are self luminous objects. Energy is released in stars by **Thermo-nuclear fusion.** In most of the stars hydrogen is converted into Helium. In some stars energy is released by the fusion of Helium. The total energy radiated by a star is called its luminosity. The central temperature of stars varies from 10 to 30 million degrees. **Teacher can explain the formation of star and its final stages with the help of following diagrams using charts/transparencies/opaque projection.**

The life history of a star can be depicted by the following flowchart :

1. Contraction, due to gravitational force of hydrogen and helium gas at about 173°C.

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2. Temperature goes on rising to 107°C leads to formation of **protostar.**

↓

3. Nuclear fusion occur $4^1_1 H \rightarrow {}^4_2He$ + Energy (heat + light).

↓

4. Internal pressure due to excessive heat stops further contraction.

↓

5. After millions of years of nuclear fusion, the core shrinks due to stoppage of reactions and outer shell expands forming the **Red Giant** stage.

6.

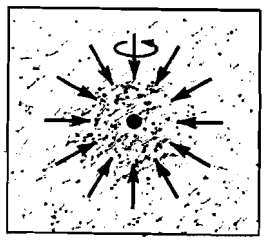
A star having mass equal to or less than the sun loses shell, and the core condenses to form heavier nuclei with large amount of light energy. This is the **white dwarf.**

$3\,{}^{4}_{2}He \rightarrow {}^{12}_{6}C$ + Energy.

A star 30-50 times the mass of sun undergoes uncontrolled contraction causing a very dense point mass which even absorbs light completely, thus called **black hole.**

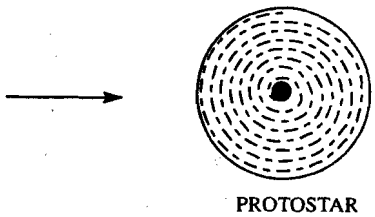
A star 10 times the mass of sun continues to contract. Fusion of carbon and helium lead to release of a lot of energy causing the shell to explode. (**Supernova**) The core contracts further to form a very dense lump called **neutron star.**

The stages are further exemplified by the following figures.



Temperature inside the Core is –263°C

Fig. 8.8 (a)



Temperature inside the Core is about 100°C

Fig. 8.8 (b)

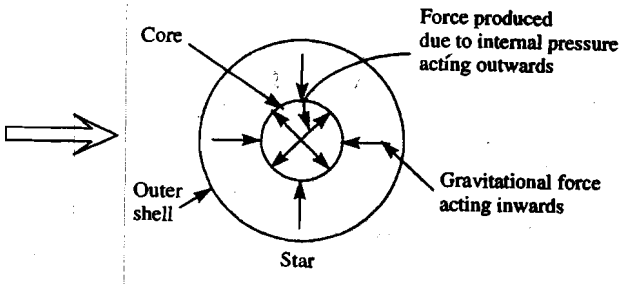


Fig. 8.8 (c)

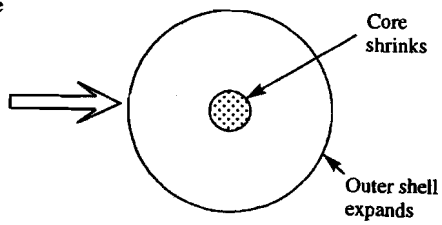


Fig. 8.8 (d)

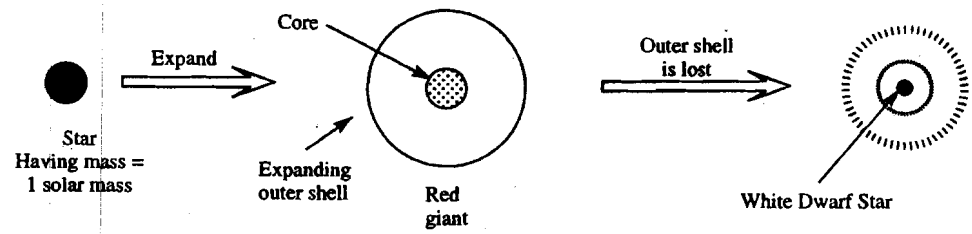


Fig. 8.8 (e) : Formation of white dwarf star.

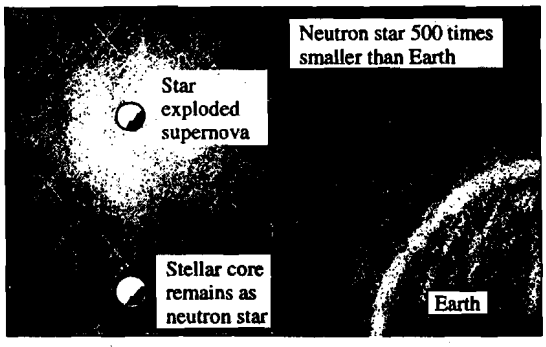


Fig. 8.8 (f): Formation of a supernova and neutron star

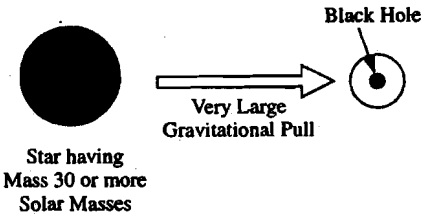


Fig. 8.8 (g) : Formation of Black Hole.

Methodology used: This unit is very interesting and is taught by drawing different diagrams as shown in figures above. Charts and projection can be used. The film show will be the most effective tool in this unit.

Check Your Progress

Notes : a) Write your answers in the space given below.

b) Compare your answers with those given at the end of the unit.

29. What is neutron star ?

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30. What are white dwarf and black hole ?

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31. How is a star changed into white dwarf and neutron star ?

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32. What is Sun ?

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33. What is supernova explosion

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8.9 GALAXIES AND THEIR ORIGIN

Main Concepts

i) Galaxy is a cluster of billion of stars, dust and gases.

ii) A galaxy is a small fragment of big cosmological explosion.

iii) There are billions of galaxies and all galaxies are not alike.

Teaching-Learning Process

The stars are found in large bunches or clusters. Such cluster is called a GALAXY. There are more than hundred billion (10^{11}) galaxies. There are more than 10^{11} stars in each galaxy. The galaxies are of different types.

i) Normal Galaxy

ii) Radio Galaxy

Normal Galaxies emit small amount of radiations as compared to total amount of radiation emitted in the universe. Depending upon their shapes, the normal galaxies can be divided into three groups.

a) Elliptical Galaxies (18%), b) Spiral Galaxies (80%), c) Irregular Galaxies (2%).

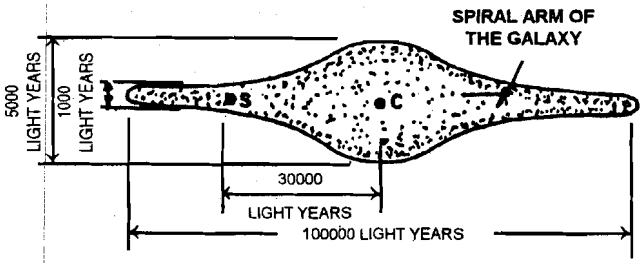
Radio Galaxies : These galaxies emit million times more radiation than normal galaxies.

Fig. 8.9 : Spiral galaxy

Fig. 8.10 : Irregular galaxy

Fig. 8.11 : Elliptical galaxy

Milky Way: Our galaxy is Milky Way (normal galaxy) which is a spiral galaxy. Its length is 100,000 light years. Its mass is 3×10^{41} kg. It contains about 10^{11} stars. The galaxy nearest to the Milky Way is Andromeda Galaxy.



C = Galactic Centre,

S = Represents the position of the Sun

Fig. 8.12 : Milky way : Transverse view

Fig. 8.13 : Milky way : Aerial view

The Milky Way rotates about its centre. Each star moves in an orbit with its own speed.

The distribution of galaxies in the universe is not uniform. All the galaxies are moving away from one another. Their speed increases as the distance between them increases. This fact is supported by the Doppler's Red Shift of the galaxies.

Methodology used: i) Explanation method

ii) Group discussions

This unit is taught by explanation method and lesson is developed with the help of students. The film show if possible can be arranged.

Teaching aids : Charts, transparencies, opaque projection, and films.

Check Your Progress

Notes : a) Write your answers in the space given below.

b) Compare your answers with those given at the end of the unit.

34. What is a Galaxy ?

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35. What are radio Galaxies? How are they different from normal galaxy?

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36. Explain structure of Milky Way.

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8.10 SATELLITE AND SPACE EXPLORATION

Main Concepts

i) Artificial satellites help man in communication, weather forecasting in the field of meteorology, geographic and geological survey of earth.

ii) Inter-planetary vehicles have widened the knowledge of solar system and outer space.

iii) Space exploration is very important in providing important information about the origin of the Universe.

Teaching-Learning Process

Artificial satellites are playing very important role in space exploration, weather monitoring, weather forecasting, long distance communications, field of meteorology and geographic and geological survey of earth. These aims of space exploration must be discussed **student - teacher may refer to Science Reporter, newspapers, magazines and gather information** about the space exploration.

Voyager 2, is one of the most sophisticated and successful space probe ever launched by mankind. This space probe gave information about Jupiter, Saturn, Uranus and Neptune. Fig. 8.14, illustrates the path followed by Voyager.

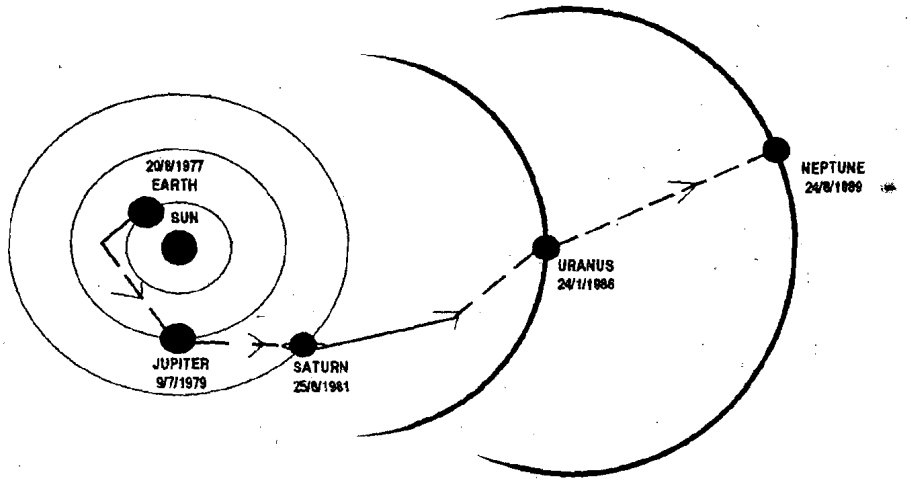

Fig. 8.14

Table 8.2

	Name of space mission associated country	Date of its launching	Remarks
1.	*Sputnik*-I (USSR, now Russia)	Oct. 4, 1957	First ever artificial satellite launched in space.
2.	*Spuntnik-II* (USSR, now Russia)	Nov. 3, 1957	First satellite to carry a living dog into space.
3.	*Score* (USSR, now Russia)	Dec.18, 1958	First communication satellite put into space.
4.	*Lune-3* (USSR, now Russia)	Oct. 4, 1961	First space probe, which sent photographs of the far side (not visible from the earth) of the moon.
5.	*Vostok-1* (USSR, now Russia)	April 12, 1961	First space flight by a man (Yuri Gagarin).
6.	*Mercury-4* (USSR)	May 4, 1961	Second spaceflight by man (Alan Shepherd).
7.	*Vostok-II*	Dec. 4, 1963	First Spaceflight by a women (Volentena Tereshkova).
8.	*Vostok-III* (USSR, now Russia)	Oct., 1964	First man to walk in space (Alexei Leonov). He spent 10 minutes outside the spacecraft.
9.	*INTELSAT-I* (USSR, now Russia)	April 6, 1965	First communication satellite for commercial use.
10.	*Venca-3*	Nov.16, 1965	First spacecraft to land on Venus.
11.	*Surveyor-I* (USA)	June 2, 1966	--
12.	*Surveyor-V*	Sept., 1967	--
13.	*Luna-9*	Oct. 21, 1968	First successful landing by a spacecraft on the moon's surface.
14.	*Soyuz-4* (USSR, now Russia)	Jan. 14, 1969	First experimental space station.
15.	*Apollo-II* (USA)	July 16, 1969	Neil Amstrong became the first human-being to set foot on the moon. Edwin Aldrin followed after 8 minutes.
16.	*Luna-26* (USA)	Dec. 1992	-
17.	*Mars-2* (USA)	May 19, 1971	First landing of a space probe on Mars (planet).
18.	*Pioneer -10* (USA)	March 2, 1972	First space probe to explore the asteroid belt, and to take Photographs of Jupiter from the close range.
19.	*Landsat* (USA)	July, 1972	First satellite for remote sensing.
20.	*Apollo-Soyuz* (USA + USSR)	July 15, 1975	First international link-up of two satellites in space (test project).
21	*INTELSAT-II*	1966	Communication satellite
22.	*INTELSAT-III*	1968	Communication satellite
23.	*INTELSAT-IV*	1971	Communication satellite
24.	*INTELSAT-V*	1981-83	Communication satellite
25.	*INTELSAT-VI*	1986	Communication satellite

Table 8.3

	Name of satellite	Date of launching	Name of the country which launched it	Remarks
1.	Rohini	July 18, 1980	India	Success
2.	APPLE	June 19, 1989	ARIANE	Success
3.	Rohini	May 31, 1989	India	Failure
4.	Bhaskare-2	Nov.20, 1982	USSR (now Russia)	Success
5.	INSAT-IA	Sept. 4, 1982	USA	Failure
6.	INSAT-IB	Aug.30, 1983	USA	Success
7.	SROSS-1	March 24, 1987	India	Failure
8.	INSAT-1C	July 12, 1988	USA	Failure
9.	SROSS-2	July 13, 1988	India (ASLV)	Failure
10.	INSAT-1D	June12, 1990	USA	Success
11.	IRS-1B	Aug. 29, 1991	USSR (now Russia)	Success
12.	SROSS-3	May 19, 1992	India (ASLV)	Success
13.	INSAT-2A	July 10, 1992	ARIANE (European launch vehicle)	Success
14.	INSAT-2B	July 23, 1993	ARIANE	Success
15.	IRS-1E	Sept.20, 1993	PSLV D1	Failure
16.	SCROSS-C2	May 10, 1994	India (ASLV-D4)	Success
17.	IRS-P2	Oct. 15, 1994	PSLV D2	Success
18.	INSAT-2C (Life 7 years)	Dec. 7, 1995	India by the European launch vehicle ARIANE	Success

Methodology used : The teacher can discuss history of space exploration and space research in India to make the lesson more interesting. By using the data in Tables 8.2 & 8.3.

Geostationary Artificial Satellites can be used for spying purposes from the outer space. These can be used to know events related to military purposes. The satellite can be used to find the exact location of a distressed conditional ship in the sea.

Teaching aids : i) Charts, static or working models, transparencies, film on satellites.

Check Your Progress

Notes : a) Write your answers in the space given below.

b) Compare your answers with those given at the end of the unit.

37. What is a Satellite?

.....

.....

38. What is a geostationary satellite?

.....

.....

39. What does INSAT stand for ?

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40. What is meant by weather monitoring and weather forecasting?

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41. What is Van Allen radiation belt?

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8.11 LET US SUM UP

The universe contains everything from finest fundamental particles, to big structures such as planets, stars, super stars and galaxies. Even with the latest development in astronomy using Hubble's space telescope and radio astronomy, the true picture is far from clear. The cosmologists do not know how old or how big is the Universe. Nor is it possible to assert as to what most of it is made up of. The latest studies, however, have revealed that we can say with some confidence that :

— The Universe started out in a very hot and dense state.

— It originated between 8-25 billion years ago.

— It has been expanding onwards ever since.

— Galaxies are clusters of stars and have a definite pattern.

— A planet is orbiting the star 47 Ursac Majoric (34 light years from the earth) which has a mass 2.5 times of Jupiter.

— Amongst the planets, our planet **Earth is the only living planet.** Space probes have helped man to understand the outer space to a better and greater extent.

— Two more planets, which are outside the Milky Way have been recently detected.

8.12 UNIT-END EXERCISES

1. Discuss the cosmological theories of the universe
2. How will you estimate the mass of 'Milky way' ?
3. Discuss importance of minerals in the development of India.
4. Name the constituents of the solar system and discuss their characteristics.
5. Give life history of stars.
6. Explain how energy is liberated in stars.
7. Explain structure of our Galaxy.
8. Discuss the aims of space exploration.
9. Give a brief history of space exploration in India.
10. Give a brief account of voyager space probes. What information have been given to us about the outer planets?
11. Explain the purpose of PSLV and ASLV.
12. Discuss application of space science in satellite communication.
13. Mention factors which made earth to lead in biological revolution.
14. Define the terms: Magma, Volcanic eruption, Earthquake, Lithosphere and Ozone layer.

8.13 ANSWERS TO CHECK YOUR PROGRESS

1. Universe is the total of all the matter, energy, and space that man is capable of experiencing. The universe is currently best described in terms of a four-dimentional curved spaceline continum.
2. 8 - 25 billion years.
3. Stars have their own source of light and energy. They appear fix with respect to neighbouring stars. Planets are visible by light reflected by them and appear wandering in space.
4. Cluster of stars, gases, matter and energy forms a galaxy.
5. 10^{10} or even more.
6. $10^{10} \times 10^{41}$ kg.

7. 9.45×10^{15} Km.
8. 8 to 25 billion years.
9. Quasi stellar radio sources. These are outermost objects of the universe. Velocity of their recession is 90% of velocity of light.
10. 100,000 light years.
11. 1.49×10^{11} m.
12. 4.3 light years.
13. 3.20 light years or 3.08×10^{16} m.
14. Since the order of distance is very high.
15. The heating up of earth's atmosphere due to the trapping of infra red rays by carbon dioxide layer in the atmosphere is called green house effect.
16. A layer of Ozone around the earth surface is at a height of 30 km. It is responsible for absorbing a large proportion of the Sun's ultra violet radiations.
17. Initial stage of planets — Cold gas and dust in condensed form in the shape of chunks are called planetesimals.
18. The reorganisation of earth due to gravitational attraction.
19. Coal was formed by the process of carbonization when biomass of buried planets changed into coal at high temperature and pressure in absence of air.
20. Petroleum was also formed by the process of carbonization with biomass of animals.
21. Minerals are useful material stored inside the earth. The biomass of the forests (0.25 billion years ago) and some useful material were buried under the earth and converted into minerals.
22. Heavenly body revolving in definite orbit about the Sun.
23. Mercury
24. Jupiter
25. All of the gas malecules have escaped from gravitation pull of the moon because gravitational force on a particle on moon in 1/6 of the force of earth.
26. They are rocky material. When they enter into earth atmosphere heat is produced due to friction with atmosphere and light is emitted out by meteorites.
27. Jupiter
28. Meteorites are able to reach the surface of the earth while meteors are small in size and burn out in earth's atmosphere before striking the earth surface.
29. They are also called Pulsar. They consist of neutrons. Neutron stars are formed after the death of star where mass is more than 1.4 times solar mass.
30. Small bright object highly dense star. They are remanants of stars that have consumed nearly all their available hydrogen and initial mass of star was < 1.4 times mass of the Sun.
31. See above two answers.
32. Cluster of billions of stars, gases, dust and energy.
33. Explosion of star shell due to carbon helium fusion.
34. Clusters of stars.
35. These galaxies emit more radio wave than visible light. Light coming from normal galaxy is far more than radio galaxy.
36. Refer to Sec. 8.9.
37. A body that rotates in orbit round other body of greater mass.
38. A satellite which appears stationary with respect to earth. Its time period of rotation is 24 hours.
39. Indian National Satellite.

40. Weather monitoring is the analysis of weather conditions. Weather forecasting is the forecast of weather taking help of astrophysics.

41. A belt of charged particles trapped within earth's magnetic field. i) from 2400 km to 5600 km, ii) from 1300 km to 1900 km.

8.14 SUGGESTED READINGS

Science Reporters.

NCERT : *Teaching of Science in Secondary Schools.*

NCERT : *Science of Xth Class.*

NCERT : *Physics For Class XI & XII.*

Fundamental Physics, Pradeep Publications.

Sehgal & Chopra : *Senior School Physics.*

Basic Principle of Physics, Pitambar Publishing Company.

Physics, Arya Book Depot.