CHAPTER-2 THE ORIGIN AND EVOLUTION OF THE EARTH

This chapter deals with

1. Origin of the earth 2. Early theories 3. Modern Theories 4 .Big Bang theory 5. The star formation 6. formation of planets 7. Our solar system 8. The moon 9 Evolution of the earth 10. Development of lithosphere 11. Evolution of Atmosphere and hydrosphere 12. Origin of life

7.NEBULA

Nebular hypothesis: There is evidence that the nebular hypothesis was first proposed in 1734 by Immanuel Kant, who was familiar with Swedenborg's work, developed the theory further in 1755.[4] He argued that gaseous clouds—nebulae, which slowly rotate, gradually collapse and flatten due to gravity and eventually form stars and planets. A similar model was proposed in 1796 by Pierre-Simon Laplace. It featured a contracting and cooling proto solar cloud—the proto solar nebula. As the nebula contracted, it flattened and shed rings of material, which later collapsed into the planets. While the Laplacian nebular model dominated in the 19th century, it encountered a number of difficulties. The main problem was angular momentum distribution between the Sun and planets. The planets have 99% of the angular momentum, and this fact could not be explained by the nebular model. As a result this theory of planet formation was largely abandoned at the beginning of the 20th century.

8ANGULAR MOMENTUM

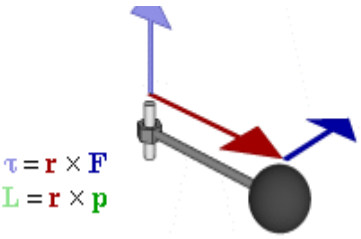
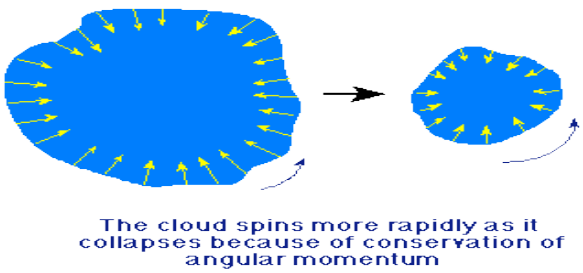
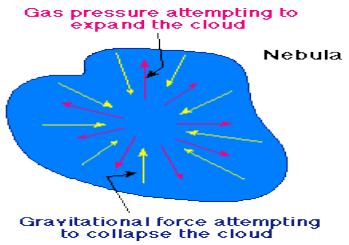


Figure 6angular momentum

The fall of the Laplacian model stimulated scientists to find a replacement for it. During the 20th century many theories were proposed including the *planetesimal theory* of Thomas Chamberlin and Forest Moulton (1901), *tidal model* of Jeans (1917), *accretion model* of Otto Schmidt (1944), *proto planet theory* of William McCrea (1960) and finally *capture theory* of Michael Woolfson. In 1978 Andrew Prentice resurrected the initial Laplacian ideas about planet formation and developed the *modern Laplacian theory*.[4] None of these attempts was completely successful and many of the proposed theories were descriptive. Sir Horald Jeffery **Nebular Hypothesis in its original form was proposed by Kant and Laplace in the 18th century.**

The initial steps are indicated in the following figures .Collapsing Clouds of Gas and Dust-A great cloud of gas and dust (called a *nebula*) begins to collapse because the gravitational forces that would like to collapse it overcome the forces associated with gas pressure that would like to expand it (the initial collapse might be triggered by a variety of perturbations---a supernova blast wave, density waves in spiral galaxies, etc.).



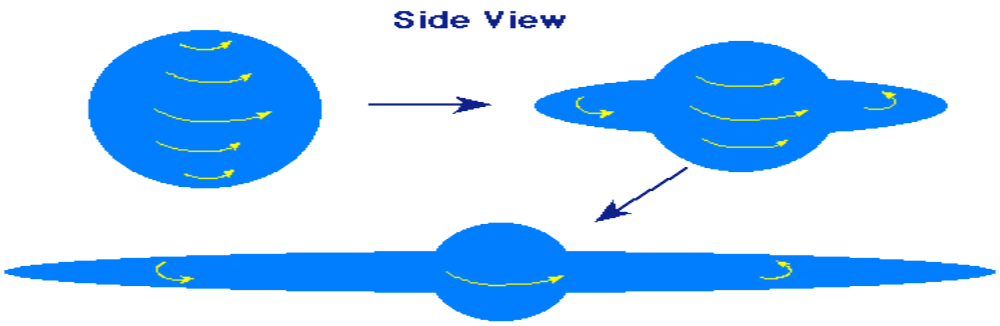


It is unlikely that such a nebula would be created with no angular momentum, so it is probably initially spinning slowly. Because of conservation of angular momentum, the cloud spins faster as it contracts.

The Spinning Nebula Flattens Because of the competing forces associated with gravity, gas pressure, and rotation, the contracting nebula begins to flatten into a spinning pancake shape

In the Nebular Hypothesis, a cloud of gas and dust collapsed by gravity begins to spin faster because of angular momentum conservation

with a bulge at the center, as illustrated in the following figure.



The collapsing, spinning nebula begins to flatten into a rotating pancake

Condensation of Proto sun and Proto planets As the nebula collapse further, instabilities in the collapsing, rotating cloud cause local regions to begin to contract gravitationally. These local regions of condensation will become the Sun and the planets, as well as their moons and other debris in the Solar System.

MODERN THEORIES

Origin of the universe

The Big Bang Theory, also called as expand universe hypothesis.
Edwin Hubble in 1920 provided the evidence that the universe is expanding. The galaxies move farther as the time passes.

Laboratory The Expanding Balloon

In The Expanding Universe, Charles Jenkins tells us that galaxies are moving away from each other. The universe appears to be growing larger.

We can use a balloon to help us understand what is going on in the cosmos. In this activity, the balloon represents the universe. Bits of tape on the surface of the balloon represent some of the galaxies located throughout the universe.

Tools & Materials

Create your own expanding universe with these simple materials

- round balloon
- masking tape
- tape measure
- pen or pencil

clothespin (optional)

The Experiment

Here's what to do:

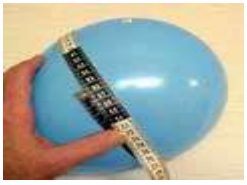
1. Blow up the balloon part way. The partially-inflated balloon represents the universe. Imagine that there are many galaxies both inside the balloon universe and on its surface. Have someone hold the mouth of the balloon closed so that it doesn't deflate, or use a clothespin to clamp the rolled-up mouth closed.

2. Tear off three small bits of masking tape, each about the size of your little fingernail. Draw a round dot in the middle of each bit of tape to represent a galaxy. Label each galaxy as A, B, or C.

3. Place the three bits of tape on the balloon so that the distances between them are all different. These represent three of the many galaxies in the universe.

4. Use your tape measure to find the distance from each masking tape galaxy to each of the others. Also measure the circumference of the balloon at its widest part. This gives you an indication of the size of your balloon universe at this time. Record these measurements for Round 1. (See chart below.)

5. Blow the balloon up a bit more, to represent the expanding of the universe. Measure and record the balloon circumference and the distances between the masking tape galaxies for your next round.



Repeat Step 5 a few more times until the balloon is about as big as it can get without popping. (Try to avoid a Big Bang!

Use a chart like the one below to record your results.

	Changes in Distances between Galaxies as the Universe Expands			
Balloon	Circumference	From A to B	From B to C	From C to A
Round 1				
Round 2				
Round 3				
Round 4				

Observe how the distances between the galaxies changed as the balloon universe expanded. Do you see any pattern or trend?

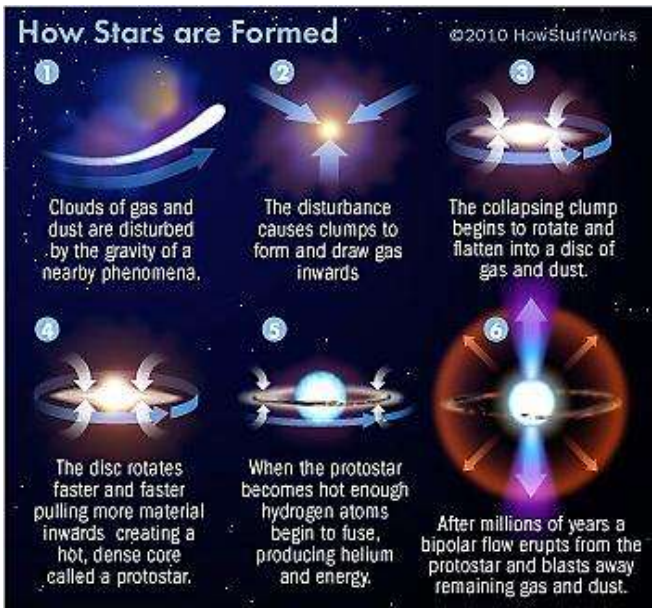
Stages of Big Bang theory

(i) In the beginning, all matter was in the form of tiny ball(singular atom) with unimaginable small volume , infinite temperature and infinite density
(ii) About 13.7 billion years ago the tiny ball exploded violently. The expansion continues even today.
(iii) As a result some energy was converted into matter
(iv) Within fraction of second there was rapid expansion
(v) The expansion slowdown after three minutes and first atom formed
(vi) After 300000 years the temperature dropped down to 4,500 K and gave rise to atomic matter.
(vii) The universe became transparent.

Steady State Theory

The Big Bang Theory is the standard model of cosmology; however, there have been several other models for the universe. One such model, which gained a large following in the 1950 and 60 (before becoming obsolete in the early 70), is the Steady State Model. This model asserts that the general character of the universe is not changing over time (hence, a steady state).

Steady State theory propones the idea that the universe looks the same no matter the viewpoint and that the universe has always looked like this; essentially,the theory states that the universe is uniform throughout both time and space. The advantage of Steady State theory over some other theories is its simple and aesthetic explanations of certain troublesome topics. For example, since the universe is unchanging throughout time, the universe needs no convoluted explanation of its beginning. In addition, to account for the decrease in density that would result from expansion, steady state theory claims new matter constantly must be created in order to maintain a constant density (and therefore a static appearance).



The Demise of Steady State

The Steady State theory offered simple solutions to the way the universe worked, but as observatories looked farther back into the early eras of the universe, astronomers started to see contradictions to the theory. Astronomers found that the universe actually evolves over time. For example, cosmologists discovered different types of stars are more common during different ages of the universe. The final demise of the Steady State theory came in the late 1960's with the discovery of the Cosmic Microwave Background. Steady State Theory could offer no convincing explanation for the CMB and as such, most contemporary cosmologists feel this theory is wrong

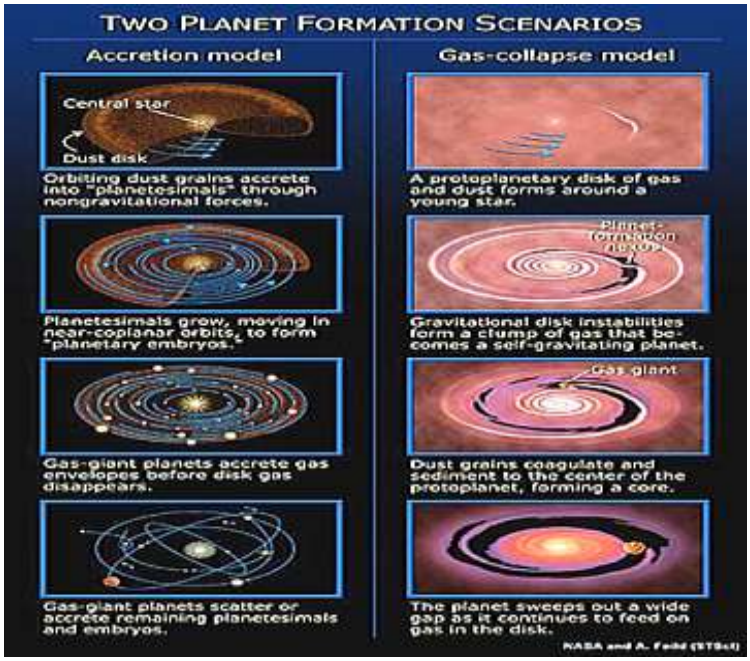
The star formation

1. *The distribution of matter and energy was uneven in the universe.*
2. *The density difference gave rise to differences in gravitational forces*
3. *It caused the matter to get drawn together.*
4. *This is the base for the formation of galaxies*
5. *Galaxy contains large number of stars*
6. *The distance between the start is measured with light years.*
7. *One light year is equal to the distance covered by the light in one year when it travels at the speed of 3 lakh km/hour*
8. *The average diameter of the stars is 80,000 km to 1,50,000 light years*
9. *It starts forming by accumulation of hydrogen gas in the form of cloud*
10. *The denser gases were condensed into stars.*
11. *The formation of star was about 5-6 b y a.*
12. *One light year is 9.461 x10^{12} km*
13. *The mean distance from the Sun to the earth is 8.311 minutes*

*Formation of planets -**Stages in the development of planets***

(i) *The stars are localized lump of gases found in nebula*
(ii) *The gravitational force led to the formation of the core*
(iii) *The huge rotating gas disc and dust develops around the gas core*

(iv) in the next stage the gas cloud starts getting condensed and the matter around the core develops into small rounded objects.

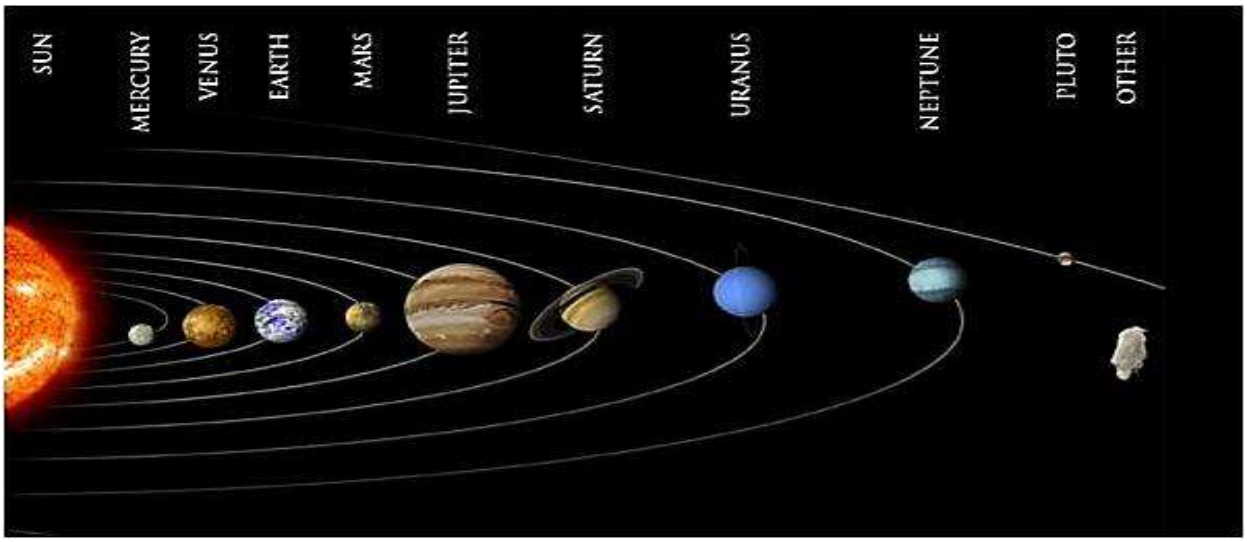


(v)The small rounded objects developed into planetesimals due to the process of cohesion.

(vi)Larger bodies started forming due to collision and attraction.

(vii)At the final stage, the small planetesimals accrete to form large bodies in the form of planets.

Our Solar system



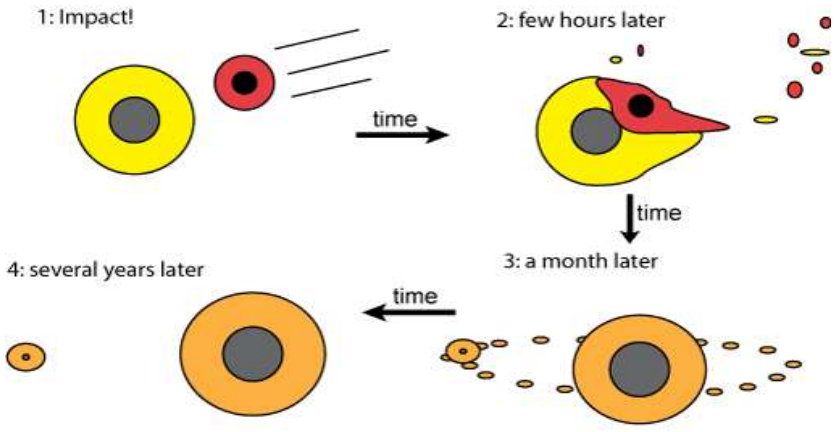
1. Our solar system consists of eight planets
2. The nebula of our solar system started collapsing around 5-5.6 b. y. a
3. The planets were formed about 4.6 b. y .a
4. Our solar system consists of 8 planets, 63 moons, millions of asteroids comets ,huge quantity of gas and dust.
5. There are two types of planets inner planets and outer planets.

THE DIFFERENCE BETWEEN INNER PLANETS AND OUTER PLANETS

INNER PLANETS	OUTERPLANETS
	
1. Mercury ,Venus, Earth & Mars Are Called Inner Planets	*1. Jupiter Saturn Uranus Neptune& Pluto Are Called Outer Planets*
2. They Are Found Between Belt Of Asteroids And The Sun	*2. They Are Found After The Belt Of Asteroids*
3. They Are Also Called Terrestrial Planets	*3. They Are Called Jovian Planets*
4. Smaller In Size	*4. Larger In Size*
5. High Density	*5 Low Density*
6. Solid Rocky State	*6. Gaseous State*
7. They Are Warm	*7. They Are Cold*

THE MOON : THE EARLIER EXPLANATION

In 1838, Sir George Darwin suggested that initially the earth and the moon formed a single rapidly rotating body. The whole mass became a dumb-bell shaped body and eventually it broke. The material separated from the earth was formed as Moon and the place became the pacific ocean. It is not accepted now. the present theory is the giant impact theory./big splat theory. A large size body of Mars collided with the earth and that portion was separated from the earth. The same portion became as a moon which revolves around the earth. The Moon was formed about 4.4 b y a.



A long time ago in a planet system close to home...
A giant impact made the Moon. The Moon is mantle material from the Earth and impactor. Earth today is mantle+core from early Earth + impactor.

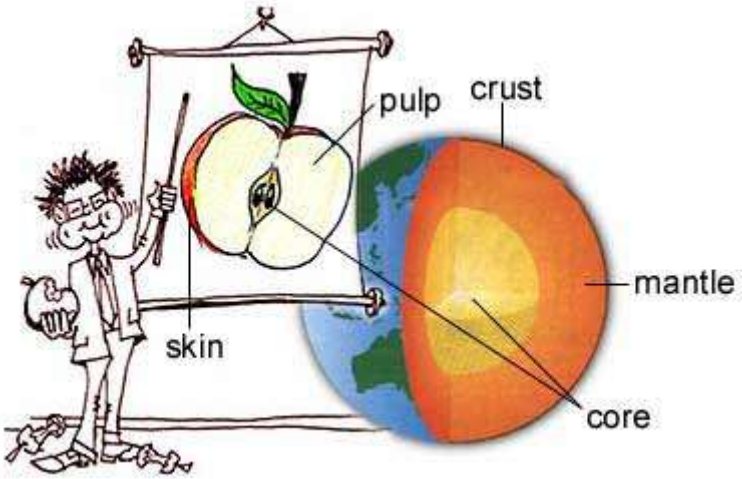
EVOLUTION OF THE EARTH

1. The earth was initially barren rocky and hot Object
2. Hydrogen and helium were present
3. It was formed about 4.6 b y a the earth was Layered structure
4. Lighter layer is formed at the outer surface
5. Density increase to wards inside the core

EVOLUTION OF LITHOSPHERE

1. There was volatile state during its primordial stage 2. Due to high density temperature increased 3. The material started separating depending on their density Light material came out side and heavy material went inside the earth 4. It cooled and condensed into solid which is called lithosphere 5. At the time of formation of the moon the earth again became hot 6. Due to differentiation different layers formed

11. EVOLUTION OF THE EARTH



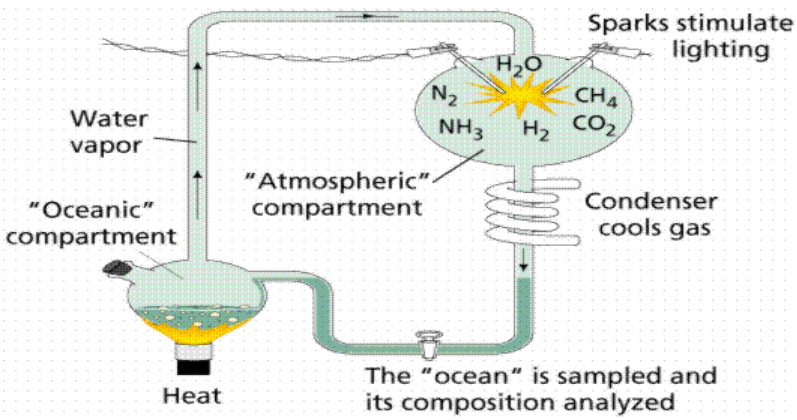
EVOLUTION OF ATMOSPHERE AND HYDROSPHERE

THERE ARE THREE STAGES OF THE FORMATION OF THE ATMOSPHERE

I .IN THE FIRST STAGE : the early atmosphere consist of hydrogen and helium .loss of primordial atmosphere due to solar winds

II. IN THE SECOND STAGE: Gases were released from the earth's interior such as Water vapor and other gases. There were water vapor, nitrogen, carbon dioxide methane, ammonia and little free oxygen. The process of outpouring the gases from the interior of the earth is called degassing. Volcanic eruptions contributed the water vapor and CO_2. The CO_2. Disolved in the rain water and converted into acid rain. Rain water collected into the depressions called oceans. The oceans were formed about 4000 m y a. The life began to evolve about 3.8 b y a. The photosynthesis evolved about 2500 to 3000 m y a oceans began to contribute oxygen to the atmosphere. oceans were saturated with oxygen and flooded into the atmosphere.

III IN THIRD STAGE: Living organisms changed the composition of the atmosphere due to photosynthesis



The last phase of the earth relates to the origin and evolution of life. It is clear that initially the earth or even the atmosphere of the earth was not conducive for the development of life. Modern scientist believes that origin of life is one kind of chemical reaction, took place in the oceans. Due to lightning, the complex organic molecules were combined into a certain form which can duplicate themselves. They are called first single cell animals. They are able to convert inanimate things into animate things. The earliest form of life existed about 3000 m y a . The life began on the earth about 3800 m y a.