

Chapter 2

The Origin and Evolution of the Earth

Very Short Answer Type

1.What do you mean by the big splat?

Answer:

The origin of the moon as a satellite of the earth is the result of big collision which is called “the big splat”.

2.Which hypothesis was given by Hoyle?

Answer:

Hoyle gave concept of steady .state. It considered the universe to be roughly the same at any point of time. However, with greater evidence becoming available about the expanding universe, scientific community at present favours argument of expanding universe.

3.What do you mean by dwarf planets?

Answer:

According to International Astronomical. Union (IAU) on August 24,2006, a planet is a celestial body that

- orbits around the sun
- has sufficient mass so that it assumes a hydrostatic equilibrium (nearly round) shape.

The non-satellites bodies fulfilling these two rules are called dwarf planets.

Pluto is now considered a dwarf planet. Ceres, Eris, Makemake, Haumea are some other dwarf planets.

4.What are different stages of development of atmosphere?

Answer:

In the early stage the atmosphere with hydrogen and helium is supposed to have been stripped off as a result of intense solar winds. In the second stage during the cooling of the earth, gases and water vapour were released from the interior solid

earth. Continuous volcanic eruptions contributed water vapour and gases to the atmosphere. As the earth cooled, the water vapour released started getting condensed. Third stage was the stage of photosynthesis.

5.What do you mean by degassing?

Answer:

The early atmosphere largely contained water vapour, nitrogen, carbon dioxide, methane, ammonia and very little of free oxygen. The process through which the gases were outpoured from the interior is called degassing.

6.Name different hypothesis associated with the formation of the earth.

Answer:

Nebular Hypothesis: It was given by Laplace.

Collision Hypothesis: It was given by Sir James and Harold Jeffrey.

Accretion Hypothesis: It was given by Schmidt and Carl Weizascar.

The Big Bang Theory: It was given by Edwin Hubble.

7.Who gave their opinions about the formation of the moon? What did they opine?

Answer:

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” or “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.

8.What do you mean by light year?

Answer:

A light year is equal to the number of kilometers travelled by light per second. It is a measure of distance and not of time. Light travels at a speed of 300,000 km/second. Therefore, the distances the light will travel in one year is taken to be one light year.

9.What do we get to know by the study of celestial bodies?

Answer:

We get to know about the origin, evolution and function of each and every celestial bodies.

10.What do you mean by terrestrial planets?

Answer:

The terrestrial planets were formed in the close vicinity of the parent star where it was too warm for gases to condense to solid particles. Mercury, Venus, Earth and Mars are called terrestrial planets.

11.Which gases were found in excess in earlier atmosphere?

Answer:

In the earlier atmosphere there was mainly hydrogen and helium.

12.How did atmosphere originate?

Answer:

Gases were released from the earth's interior such as water vapour and other gases. There were water vapour, nitrogen, carbon dioxide, methane, ammonia and little free oxygen. The process of outpouring the gases from the interior of the earth is called degassing. The process of differentiation created the present atmosphere.

13.How were stars formed?

Answer:

The distribution of matter and energy was not even in the early universe. These initial density differences gave rise to differences in gravitational forces and it caused the matter to get drawn together. These formed the bases for development of galaxies which contains millions of stars.

14.What are jovian planets?

Answer:

Jupiter, Saturn, Uranus and Neptune are called Jovian or Gas Giant planets. Jovian means jupiter-like. Most of them are much larger than the terrestrial planets and have thick atmosphere, mostly of helium and hydrogen.

15.Name the experts who modified nebular hypothesis.

Answer:

In 1950, Otto Schmidt in Russia and Carl Weizascar in Germany revised the ‘nebular hypothesis’, though differing in details. They considered that the sun was surrounded by solar nebula containing mostly the hydrogen and helium along with what may be termed as dust. The friction and collision of particles led to formation of a disk-shaped cloud and the planets were formed through the process of accretion. However, scientists in later period took up the problems of origin of universe rather than that of just the earth or the planets.

16.What kind of evidences have been given by Edwin Hubble?

Answer:

Edwin Hubble, in 1920, provided evidence that the universe is expanding. As time passes, galaxies move further and further apart.

Short Answer Type

1.Why are the terrestrial planets rocky?

Answer: Terrestrial planets are rocky because:

- The terrestrial planets were formed in the close vicinity of the parent star where it was too warm for gases to condense to solid particles.
- The solar wind was most intense nearer the sun; so, it blew off lots of gas and dust from the terrestrial planets.
- The terrestrial planets are smaller and their lower gravity could not hold the escaping gases.

2.What is the basic difference in the arguments related to the origin of the earth given by (a) Kant and Laplace (b) Chamberlain and Moulton.

Answer:

a. Kant and Laplace's Principle: The hypothesis considered that the planets were formed out of a cloud of material associated with a youthful sun, which was slowly rotating. According to this principle which emerged in 1796, the interior of the earth must be gaseous because the earth has originated from gas form.

b. Chamberlain and Moulton: In 1900, Chamberlain and Moulton considered that a wandering star approached the sun. As a result, a cigar-shaped extension of material was separated from the solar surface. As the passing star moved away, the material separated from the solar surface continued to revolve around the sun and it slowly condensed into planets. Later on, the arguments considered of a companion to the sun to have been coexisting. These arguments are called binary theories.

3.What is meant by the process of differentiation?

Answer:

Starting from the surface to the central parts, we have layers like the crust, mantle, outer core and inner core. From the crust to the core, the density of the material increases. This process of the earth forming material got separated into different layers is called differentiation.

4.What was the nature of the earth surface initially?

Answer:

The planet earth initially was a barren, rocky and hot object with a thin atmosphere of hydrogen and helium. This is far from the present day picture of the earth. It is said that in initial stage the earth was in liquid form. Certainly, there must have been some events- processes, which may have caused this change from rocky, barren and hot earth to a beautiful planet with ample amount of water and conducive atmosphere favouring the existence of life.

5.What were the gases which initially formed the earth's atmosphere?

Answer:

Hydrogen' and helium were the gases which initially formed the earth's surface. The early atmosphere with hydrogen and helium is supposed to have been stripped off as a result of intense solar wind. This happened not only in the case of earth, but also in all the terrestrial planets which were supposed to have lost their primordial atmosphere through the impact of solar winds. During the cooling of the earth, gases and water vapour were released from the interior solid earth. Continuous volcanic eruptions contributed water vapour and gases at atmosphere. It was the first ,, stage of atmosphere development.

6.What is the opinion of present day scientists about the origin of moon?

Answer:

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” or “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 4.44 billion years ago.

7.What are the difference between terrestrial planet and jovian planets?

Answer:

The main differences between the two are summarized below:

- The terrestrial planets were formed in the close vicinity of the planet star where it was too warm for gases to condense solid particles. Jovian planets were formed at a quite distant location.
- The solar wind was most intense nearer the sun, so it blew off lots of gas and dust from the terrestrial planets. The solar winds were not all that intense to cause similar removal of gases from the Jovian planets.

Geography

- The terrestrial planets are smaller and their lower gravity could not hold the escaping gases. Jovian planets are bigger and have high gravity.

8.Inner planets are terrestrial while outer planets are Jovian. Why?

Answer:

Inner planets are terrestrial while outer planets are Jovian because the terrestrial planets are smaller and their lower gravity could not hold the escaping gases. Jovian planets are bigger and have high gravity. Moreover, the solar wind was most intense nearer the sun, so it blew off lots of gas and dust from the terrestrial planets. The solar winds were not all that intense to cause similar removal of gases from the Jovian planets.

9.How did earth develop its different layers?

Answer:

During the formation of the moon, due to the giant impact, the earth was further heated up. It is through the process of differentiation that the earth forming material got separated into different layers. Starting from the surface to the central parts, we have layers like the crust, mantle, outer core and inner core. From the crust to the core, the density of the material increases.

10.Differentiate between inner planets and outer planets.

Answer:

The difference between inner planets and outer planets inner planets outer planets

Inner Planets	Outer Planets
1. Mercury, Venus, Earth and Mars are called Inner Planets	1. Jupiter, Saturn, Uranus, Neptune and 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

Geography

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

Long Answer Type

1. Write an explanatory note on the 'Big Bang Theory'.

Answer:

The Big Bang Theory, also called as expanding universe hypothesis. Edwin Hubble in 1920 provided the evidence that the universe is expanding. The galaxies move farther as the time passes. It says that galaxies are moving away from each other. The universe appears to be growing larger.

The Big Bang Theory:-

1. In the beginning, all matter forming the universe existed in one place in the form of a 'tiny ball' with an unimaginably small volume, infinite temperature and infinite density.

2. At the Big Bang “tiny ball” exploded violently. This led to a huge expansion. It is now/ generally accepted that the event of big bang took place 13,7 billion years before the present. The expansion continues even to the present day. As it grew, some energy was converted into matter. There was particularly rapid expansion within fractions of a second after the bang. Thereafter, the expansion has slowed down. Within first three minutes from the Big Bang event, the first atom began to form.

3. Within 300,000 years from the Big Bang, temperature dropped to 4,500k and gave rise to atomic matter. The universe became transparent.

4. The expansion of universe means increase in space between the galaxies. An alternative to this was Hoyle’s concept of steady state. It considered the universe to be roughly the same at any point of time. However, with greater evidence becoming available about the expanding universe, scientific community at present favours argument of expanding universe.

2.List the stages in the evolution of the earth and explain each stage in brief.

Answer:

The earth was mostly in a volatile state during its primordial stage. Due to gradual increase in density the temperature inside has increased. As a result the material inside started getting separated depending on their densities. This allowed heavier materials (like iron) to sink towards the centre of the earth and the lighter ones to move towards the surface. With passage of time it cooled further and solidified and condensed into a smaller size. This later led to the development of the outer surface in the form of a crust. It is through the process of differentiation that the earth forming material got separated into different layers. Starting from the surface to the central parts, we have layers like the crust, mantle, outer core and inner core. From the crust to the core, the density of the material increases.

The origin of life as a kind of chemical reaction, which first generated complex organic molecules and assembled them, This assemblage was such that they could duplicate themselves converting inanimate matter into living substance. The record of life that existed on this planet in different periods is found in rocks in the form

of fossils. The microscopic structures closely related to the present form of the blue algae have been found in geological formations much older than some 3,000 million years. It can be assumed that life began to evolve sometime 3,800 million years ago

3.Explain how did life evolve on the earth?

Answer:

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4.Explain different phases of evolution of planets.

Answer:

Evolution of planets can be understood in three stages:

1. Formation of Disc; The stars are localised lumps of gas within a nebula. The gravitational force within the lumps leads to the formation of a core to the gas cloud and a huge rotating disc of gas and dust develops around the gas core.
2. Formation of Planetesimals: In the next stage, the gas cloud starts and getting condensed and the matter around the core develops into small rounded objects. These small rounded objects by the process of collision develop into what is called planetesimals. Larger bodies start forming by collision and gravitational attraction causes the materials to stick together. Planetesimals are a large number of smaller bodies.
3. Formation of Planets: In the final stage, these large number of small planetesimals accrete to form fewer large bodies in the form of planets.

5.Explain the earliest theory associated with the origin of the earth.

Answer:

A large number of hypotheses were put forth by different philosophers and scientists regarding the origin of the earth. One of the earlier and popular arguments was by German philosopher Immanuel Kant. Mathematician Laplace revised it in 1796. It is known as Nebular Hypothesis. According to this theory there was a hot and rotating gas cloud called Nebula in the space. From Nebula there was a gradual loss of heat due to its rotation which resulted in cooling of its outer surface. This gradual cooling caused contraction in size of Nebula, but its speed increased due to angular momentum. The outer layer was separated from the remaining part of Nebula.

The centre of Nebula became 'Sun' and the planets were formed of the smaller units. The lighter material gases and the heavier dust particle gave the fact of inner and outer planets. In 1950, Otto Schmidt in Russia and Carl Weizasear in Germany somewhat revised the 'nebular hypothesis', though differing in details. They considered that the sun was surrounded by solar nebula containing mostly the hydrogen and helium along with what may be termed as dust. The friction and collision of particles led to formation of a disk-shaped cloud and the planets were formed through the process of accretion.

6.Explain the modern theory associated with evolution of the earth.

Answer:

In modern theory the evolution of the earth is associated with Big Bang Theory. It was put forth by Edwin Hubble in 1920. In the beginning, all matter forming the universe existed in one place in the form of a 'tiny ball' with an unimaginably-small volume infinite temperature and infinite density. At the Big Bang "tiny ball" exploded violently. This led to a huge" expansion. it is now generally? accepted that the event of big. bang took place 13.7 billion years before the present. The expansion continues even to the present day. As it grew, some energy' was converted into matter. There was particularly rapid expansion within fractions of a second' after the bang. Thereafter, the expansion has slowed down. Within first Big Bang event, the first atom began to form.

Within 300,000 years from the Big Bang, temperature dropped to 4,500k and gave rise to atomic matter. The universe became transparent. The expansion of universe means increase in space between the galaxies. An alternative to this was Hoyle's concept of steady state. It considered the universe to be roughly the same at any point of time. However, with greater evidence becoming available about the expanding universe, scientific community at present favours argument of expanding universe.

7.Explain the collision and accretion I hypothesis associated with the evolution of the earth?

Answer:

Collision hypothesis and accretion hypothesis are described below in short.

1. Collision Hypothesis: It was given by Sir James and Harold Jeffrey.

- According to this theory, a large nebula 'wandering in the space came very close to smaller nebula (Sun) and its huge upsurge of matter on the surface of smaller nebula. The matter was detected from the smaller nebula and on cooling condensed into planets.

2. Accretion Hypothesis: It was given by? Schmidt and Carl Weizascar.

- According to them, solar system started out as a cloud of gas and dust drifting in a space called nebula. This gaseous cloud exploded violently to form supernova. The exploitation left the vast spinning cloud and gases and thus to collapse under its own gravity and develop as denser core.
- The denser core became larger and hotter and began to burge. Later it developed into protostar which finally evolved as 'infant Sun.
- Away from its central surface, particles of dust began to clump together and converted into first smaller fragments of rocks and then becoming larger bodies which were called planetesimals which collided with one another to form rocky inner planets like Mercury, Venus, Earth and Mars and the remaining were outer planets.

8.How' was the layered structure of the earth developed?

Answer:

The planet earth initially was a barren, rocky arid hot object with a thin atmosphere of hydrogen and helium. This is far from the present day picture of the earth. It is said that in initial stage the earth was in liquid form. Certainly, there must have been some events- processes, which may? have caused this change from rocky, barren and hot earth to a beautiful planet with ample amount of water and conducive atmosphere favouring the existence of life.

The earth was mostly in a volatile state during its primordial stage. Due to gradual increase in density the temperature inside has increased. As a result the material inside started getting separated depending on their densities. This allowed heavier materials (like iron) to sink towards the centre of the earth and the lighter ones to move towards the surface. With passage of time it cooled further and solidified and condensed into a smaller size. This later led to the development of the outer surface in the form of a crust. It is through the process of differentiation that the earth forming material got separated into different layers.

9.What role did carbon dioxide pipy in the formation of oceans?

Answer:

The carbon dioxide in the atmosphere got dissolved in rainwater and the temperature further decreased causing more condensation and more rains. The rainwater falling onto the surface got collected in the depressions to give rise to oceans. The earth's oceans were formed within 500 million years from the formation of the earth.

Multiple choice and Answers

1.How many planets are there in solar system?

- (a) 5
- (b) 7
- (c) 8
- (a) 9.

Answer:

- (c) 8

2.What is the distance between the earth and the sun?

- (a) 149.6 million kms
- (b) 15.98 million kms
- (c) 169.34 million kms
- (d) 179.67 million kms.

Answer:

- (a) 149.6 million kms

3.Which expert gave the nebular hypothesis?

- (a) Immurial Kant
- (b) Lalpace
- (c) Chamberlain
- (d) Moulton.

Answer:

- (b) Laplace

4.Which expert gave the Collision hypothesis?

- (a) Immanuel Kant
- (b) Lalpace
- (c) Chamberlain
- (d) Sir James and Harold Jeffrey.

Answer:

- (d) Sir James and Harold Jeffrey

5. Which theory is most widely accepted regarding origin of the universe at present?

- (a) Collision hypothesis
- (b) Big Bang Theory
- (c) Nebular hypothesis
- (d) Binary Theory.

Answer:

- (b) Big Bang Theory

6. About how many years back did stars originate?

- (a) About 3 to 4 billion years before
- (b) About 5 to 6 billion years before
- (c) About 6 to 7 billion years before
- (d) About 4 to 5 billion years before.

Answer:

- (b) About 5 to 6 billion years before

7. What is the diameter of milky way?

- (a) Between 80 thousand to 1,50,000 light years
- (b) Between 1 lakh to 2 lakh light years
- (c) Between 2 lakh to 3 lakh light years
- (d) Between 2,50,000 to 3,00,000 light years.

Answer:

- (a) Between 80 thousand to 1,50,000 light years

8. Which of the following is not an inner planet?

- (a) Jupiter
- (b) Mercury
- (c) Venus
- (d) Earth.

Answer:

- (a) Jupiter

9. Which of the following is not an outer- planet?

- (a) Jupiter
- (b) Saturn
- (c) Uranus
- (d) Mars.

Answer:

- (d) Mars

10. By which elements is the terrestrial planets formed?

- (a) Rocks and Metals
- (b) Hydrogen and helium
- (c) Liquid elements
- (d) All of the above.

Answer:

- (a) Rocks and metals.

11. Which one of the following figures represents the age of the earth?

- (a) 4.6 million years
- (b) 13.7 billion years
- (c) 4.6 billion years
- (d) 13.7 trillion years.

Answer:

- (b) 4.6 billion years

12. Which one of the following has the longest duration?

- (a) Eons
- (b) Period
- (c) Era
- (d) Epoch.

Answer:

- (a) Eons

13. Which one of the following is not related to the formation or modification of the present atmosphere?

- (a) Solar winds
- (b) Differentiation
- (c) Degassing
- (d) Photosynthesis.

Answer:

- (b) Differentiation

14. Which one of the following represents the inner planets?

- (a) Planets between the sun and the earth
- (b) Planets between the sun and the belt of asteroids
- (c) Planets in gaseous state
- (d) Planets without satellite(s).

Answer:

- (d) Planets without satellite(s)

15. Life on the earth appeared around how many years before the present?

- (a) 13.7 billion
- (b) 3.8 million
- (c) 4.6 billion
- (d) 3.8 billion.

Answer:

- (d) 3.8 billion.