16

The Earth – A Living Planet

Mother Earth has every thing to fulfill man's needs but not his greeds.

- Mahatma Gandhi

You have studied in the previous lesson that the Earth is the third planet of the solar system as counted from the sun. The Earth also came into existence almost the same time as the other members of the solar system, i.e. around 4.5 billion years ago. This is the planet we live on and where multitude of diverse life forms have evolved.

In this lesson we will study the brief story of the 4.5 billion years of Earth's life - its changing structure and evolving life support system. We will also study that various components of our environment are in fine balance but facing a threat due to various human activities. This should put us on alert to save our planet.

OBJECTIVES

After completing this lesson, you will be able to :

- explain why life evolved on the Earth, stating conditions necessary for it;
- explain the differentiation of Earth and evolution of atmosphere and hydrosphere in its present form;
- describe the life supporting systems on the Earth, i.e. the biosphere comprising the lithosphere, the atmosphere and the hydrosphere;
- justify that the sun is the ultimate source of all energy on Earth except nuclear energy and geothermal energy;
- explain how the solar energy is cycled in nature and utilised by living beings;
- explain the origin and evolution of life on Earth and suggest some measures to protect the Earth and its life support systems.

16.1 WHY ONLY EARTH HAS LIFE?

You can easily identify living things around you. Earth has life on its surface. Scientists are trying hard to find out whether life exists elsewhere also in the universe, but, till date they could not find any. Let us analyse the possibility of life in our solar system.

16.1.1 Physical conditions necessary for life

For life to exist on a celestial body the following conditions seem to be necessary :

(i) Presence of some elements such as carbon (C), oxygen (O_2), Nitrogen (N_2) and **hydrogen (H_2)** which are involved in the basic structures of complex molecules forming living cells.

(ii) Suitable temperature range on its surface for sustenance of life. Most of the living organisms cannot survive at too high (>70^0C) or too low (<O^0C) temperatures because, life processes cannot be carried out at very high and very low temperatures.

(iii) Presence of a liquid medium, like water, which is a must for transporting nutrients inside a living body.

(iv) Presence of a protective atmosphere having a protective layer like ozone layer, to prevent harmful radiations to reach its surface.

On the Earth all these conditions are satisfied and hence, we have life on it.

16.1.2 Possibility of life on other planets of the solar system

You might be wondering whether there is possibility of any life on any other planets of the solar system. Let's check it. Planet mercury is so close to the sun that it is too hot to sustain life. On the other hand planets Jupiter Saturn, Urenus, Neptune and Pluto are so far away from the sun that due to extremely low temperatures on their surfaces life is impossible.

The narrow belt containing Venus, Earth and Mars seem to be at suitable distance from the sun so that temperature of a planet in the region could possibly allow life to develop on it, if no other phenomenon like green house effect alters its temperature.

The table given below discusses the planets Venus, Earth and Mars and the four physical conditions necessary for life.

Table 16.1 : Conditions necesary for life on different planets

S. No.	Planet	Presence of C, N_2, O_2, N_2	Correct temp. range	Presence of water	Protective blanket
1.	Venus	Yes	No	No	Yes
2.	Earth	Yes	Yes	Yes	Yes
3.	Mars	Yes	No	Yes	No

This shows that no other planet, except Earth, fulfils the conditions necessary for life and hence, Earth is the only planet in Solar system where life has originated, evolved and flourished. Thus, the Earth is a unique planet.

16.1.3 Are we alone in the universe?

This is the next obvious question you will ask. The way the universe came into existence and the way various gallaxies and solar systems are formed, suggest that there is a very high probability of inhabited worlds. In fact, scientists expect millions of such worlds to exist. But all our efferts to contact the extra terriestrial beings have failed by now.

CHECK YOUR PROGRESS 16.1

1. Name two planets of solar system which have a protective layer in their atmosphere.
2. Give one reason to explain why there is no life on Jupiter.
3. Why is the presence of a liquid medium necessary for life to exist on a celestial body ?

4. Mention the region of space in solar system where life may be possible ?
5. Give one reason to explain why planet mercury does not have any atmosphere ?

16.2 WHAT MADE EARTH A SPECIAL PLANET?

What is special with the Earth that has made it an abode of life? The following three factors, it seems, have contributed in this regard.

(i) Right distance from the Sun : The Earth stays at the right distance from the sun in an almost circular orbit. Therefore, it receives just appropriate amount of energy from the sun, so that, the temperature range on its surface is suitable for the origin and evolution of life.

(ii) Appropriate mass and size : The Earth has appropriate mass and radius so that it could provide gravitational field sufficient enough to hold atmosphere.

(iii) Occurence of some natural events on Earth at right time and in desirable sequence so that a life supporting system (called Biosphere) could evolve on its surface.

16.2.1 Birth of the Earth

About 5 billion years ago, when the sun was formed, the leftover gases surrounding it started getting condensed into small chunks of matter called **planetesimals.** The planetesimals as they revolved around the sun aggregated into bigger masses–planets, satellites, asteroids etc. by forces of mutual attraction. The Earth also came into existence the same way around 4.5 billion years ago. When born, it was a cool, condensed aggregate of planetesimals. The primitive Earth then melted because of the following two processes nearly 3.7 billion years ago and assumed its present structure.

(i) Planetesimals were still colliding with it and imparting their kinetic energy and mass to it.

(ii) There were radioactive elements like Uranium (U), Thorium (Th) etc. present in the Earth which released energy as they decayed which was absorbed by the Earth.

The energy gained by these processes increased the temperature of Earth and it melted. This resulted into the **differentiation** of the Earth.

16.2.2 Differentiation of the Earth

As the Earth melted it acquired a spherical shape. The heavier elements from its surface sank towards its centre and formed a central region called the **core.** The lighter materials rose to the outer region. Of these materials, whatever remained on the surface of the Earth as liquid, cooled and solidified to form **crust.** The gases and water vapours trapped within the Earth's material were released from its surface and formed **atmosphere.** Thus, the Earth re-organised itself into different layers of varying densities. The **process of re-organisation of the Earth in different layers of varying densities is called differentiation.**

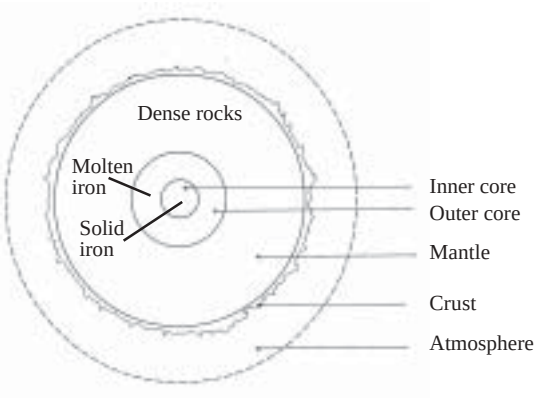


Fig. 16.1 Different layers of earth

Due to differentiation, the mass of the Earth got distributed in four different layers

- The core
- The mantle
- The crust
- The atmosphere

Figure 16.1 shows the various layers of Earth (not on the scale).

Some important characterstics of each layer are given in the table 16.2.

16.2.3 Evidence of differentiation of Earth

The **theory of evolution of solar system** suggests that the Earth also came into being at the same time and in the same manner as the other members of the solar system. Scientists have developed a techinique of finding the age of a rocks. This technique is called uranium dating. Using the technique when we find the age of a meteorite, it comes out to be 4.5 billion years. When we determine the age of oldest rock found in Greenland region of the Earth, it comes out to be only 3.7 billion years. What does this mean? This means that for the first 800 million years the temperature of Earth was increasing due to which it got melted and differentiated during that period. That is why all signs of Earth for the evolutionary history of this period are wiped out.

Table 16.2 : Characterstics of different layers of Earth

Characterstic	Core	Mantle	Crust
Location Constituents	Innermost part Iron and some Nickel	Middle part Silicates of iron and magnesium	Outermost part. A mixture of large number of minerals like silica, alumina etc.
Temperature	very hot ~ 4000 ^{0}C at the centre		
Size	Radius of the core is about 3400 km.	The thickness between core and crust is about . 2900 km	Very thin, only around 10km under the oceans and 35-60 km below the land mass
Density	About 18 gcm^{-3}	4-6 gcm^{-3}	3 gcm^{-3}
Pressure	About 3.7 million atmosphere at the centre.		
State	Inner core though at higher temperature, is solid on account of high pressure. Outer core is liquid.	Mostly solid only a thin outer layer of tar like viscous fluid of molten rocks.	Solid

CHECK YOUR PROGRESS 16.2

1. What material the inner core of the Earth is made of ?
2. What is the thickness of the crust of the Earth ?
3. When did differentiation of Earth took place ?
4. What is the importance of right mass and right size of Earth ?
5. Explain how the inner core of the Earth is solid though its temperature is (about 4000^0C) higher than outer core which is liquid ?

16.3 THE LIFE SUPPORT SYSTEMS

Life on Earth is found in a nearly 20 km thick spherical shell near its surface, called **biosphere**. Living beings are found to interact with each other and with their environment in the biosphere.

(i) Lithosphere, (ii) Hydrosphere, and (iii) Atmosphere.

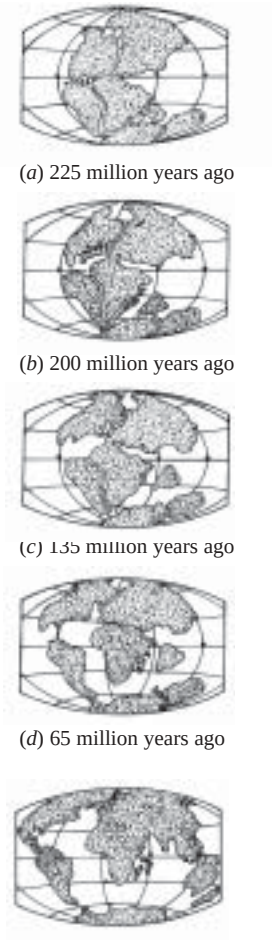
These three parts of the biosphere form the life supporting systems of the Earth. The story of the evolution of life is intimately associated with the evolution of the biosphere.

Let us study the three parts of the biosphere one by one.

16.3.1 Lithosphere

The word lithosphere literally means a layer of rocky materials. It consists of the Earth's crust and the small upper solid part of mantle. Presently, about three fourths of the surface of the lithosphere is covered with water in the form of oceans, and the remaining one fourth is a land mass devided in seven continets, namely – North America, South America, Antarctica, Australia, Asia, Africa and Europe. All these seven continents form six separate land masses, seperated by water bodies – Europe and Asia forming one big entity.

As we look at the present world map we find that these six land masses appear as a jig-saw puzzle and may be adjusted at one place to from a one big land mass. In 1912, German geologist **Alfred Lother Wegener** suggested that in the begining of Earth's history, the continents were a single piece of landmass called **pangaea** (meaning all Earth). Then at about 225 million years ago the pangea fractured and started drifting apart and gradually assumed its present shape. The position of continents at various eras of Earth's history is given in Fig. 16.2.


(*a*) 225 million years ago

(*b*) 200 million years ago

(*c*) 135 million years ago

(*d*) 65 million years ago

(*e*) Present

Fig. 16.2 Position of continents in various eras of the earth's history

Through their studies on Earthquakes, volcanoes and formation of mountain, **geologists** have acquired a lot of knowledge about the interior of the Earth. They have come to the conclusion that the entire land and water bodies of Earth in fact, stay divided into eight large and some smaller pieces called the **Lithospheric plates.** These plates are rigid but they float over coal-tar like molten rocks of mantle, called **magma**. Due to temperature and pressure

difference between the core and the upper part of the mantle, convection currents are set up in magma because of which the Lithospheric plates drift slowly.

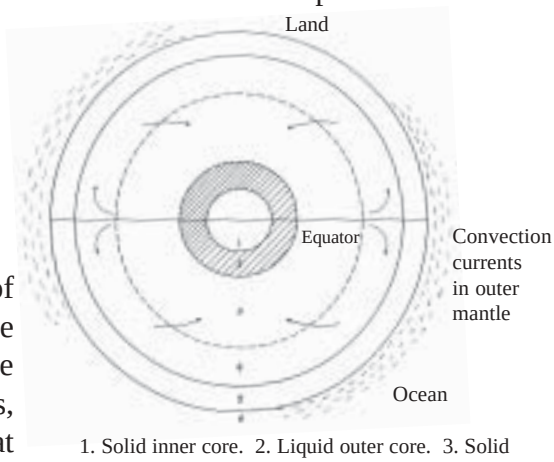
The scientists have estimated that the continents are drifling even today at an average pace of 15 cm per year or so.

16.3.2 Hydrosphere

The water bearing component of biosphere is called hydrosphere-most of it is in the form of oceans (97%) and the rest as Polar ice caps (2.5%) and atmospheric vapours.

The huge water body surrounding the continents is divided into five parts called oceans. The five oceans are :

(i) Pacific ocean
(ii) Atlantic ocean
(iii) Indian ocean
(iv) Arctic ocean
(v) Antarctic ocean



1. Solid inner core. 2. Liquid outer core. 3. Solid inner mantle. 4. Tar like liquid outer mantle. 5. Crust. 6. Surface of earth – land and oceans.

Fig. 16.3 Convection currents in magma drifted lithospheric plates

Oceanologists have explored the floor of the oceans using Ultrasonic echo devices like **SONAR** and found that the ocean floors are uneven. Like lands, they also have planes, hills, valleys and plateaus. The researches show that the average depth of oceans is about 4 km. Though at some places they may be more than 10 km deep.

You know that sea water is salty. Weathering and erosion of rocks makes these salts available for winds and waters which take them to oceans and make them salty. But the percentage of salts in sea water is almost a constant for the duration of a life time. Winds and oceans are a big support for life. Some important functions of oceans are listed below.

(i) They regulate the global temperature.
(ii) The primitive life form originated in the oceans.
(iii) They dissolve atmospheric carbon dioxide and thus help in keeping the biosphere in equilibrium.
(iv) They provide good resources for fossil fuels, minerals, salts and sea foods.
(v) They act as medium for transporting men and materials using ships, boats etc.

16.3.3 Atmosphere

Surrounding the Earth there is a few hundred kilometer thick envelope of air called atmosphere. As we go up in atmosphere the air thins out, so much so that 90% of the air is found within 20 km of height from the ground.

The main constituents of air are nitrogen and oxygen and it is upto a height of 12 km from the Earth's surface that cloud formation and weather changes take place. Between the altitude of 10 - 50 km lies the ozone (O_3) layer which protects the Earth from harmful ultraviolet radiations of sun.

Atmosphere also is a crucial life support system. It has the following important functions.

(i) It is because of the atmosphere that the radiations from the sun do not straight way reach the surface of the Earth. Thus the atmosphere prevents the Earth from getting too hot.

(ii) Nitrogen and oxygen in the atmosphere are in correct proportion due to which living beings can breathe and controlled burning of fuels becomes possible.

(iii) Billions of meteors entering into Earth's atmosphere burn out due to air friction. In absence of atmosphere they will reach Earth's surface and hit it with great force.

(iv) The water vapours present in atmosphere provides for rains which is vital for agriculture.

(v) The ozone layer of atmosphere protects us from the harmful effects of ultra-voilet rays of sun-light.

(vi) Carbon dioxide though present in the atmosphere in a very small amount (0.033%) it is important for two reasons -

- Green plants absorb carbon dioxide from atmosphere in preparing their food through photosynthesis. (Details of photosynthesis in lesson 25).
- Carbon dioxide being a greenhouse gas traps infrared (heat) radiations and makes nights warmer and more comfortable.

CHECK YOUR PROGRESS 16.3

1. How do scientists study the interior of the Earth?
2. Give two important functions of carbon dioxide in atmosphere?
3. Give two important functions of atmosphere?
4. Give two important functions of oceans?

16.4 EVOLUTION OF LIFE ON EARTH

A very precise sequence of events gave rise to the life supporting systems mentioned in the previous section. Then came the first ever self multiplying organisms on the scene, the blue-green algae. These components of the biosphere then interacted with each other. They grew in complexities and modified each other's properties and composition. Finally, an equilibrium condition was obtained where every thing was in a fine balance supporting each other. All this did not happen in a day. It took more than 3.7 billion years to reach to the presennt stage of evolution of the biosphere.Let us have a broad look at the major events in the process of evolution of life on Earth.

16.4.1 Formation of primitive atmosphere

To begin with when the differentiation of Earth started, there was no atmosphere. In the process of differentiation, as the light elements rose up, the very light elements, which were present in gaseous form bubbled out of the surface of molten Earth and formed the primitive atmosphere. The primitive atmosphere was very thin and had only nitrogen, hydrogen, carbon dioxide and water vapour. It had no oxygen in the beginning.

16.4.2 Formation of primitive hydrosphere

As the outer surface of the molten Earth cooled and solidfied to form a thin crust, it was repeatedly hit and punctured by falling meteorites. Since the atmosphere at that time was very much rarefied, it could not offer any resistance to the falling meteorites and they hit the crust with great force, creating vents in it. Through these vents magma flew out, got solidified and became part of the crust. In this process some gases were also released mainly due to the hydrated minerals in the molten rocks.

These gases enriched the atmosphere. The water vapour in this primitive atmosphere got condensed and formed clouds. The clouds then came down in the from of rains. The rainwater on one hand speeded up the process of cooling of Earth on the other hand it filled up the low lying areas and formed the oceans.

16.4.3 Origin of life on Earth

As more and more gases were added to the atmosphere it became gradually denser. The clouds, as they moved, got charged and electric discharge between them resulted in thunderstorms and lightening. The lightening fused the elements of the primitive atmosphere into complex compounds. These compounds were then washed down by heavy rains and sent to oceans. In the oceans, under suitable circumstances more and more complex molecules like carbohydrates and amino acids were developed. With passing time more and more complex molecules came into existence which could utilize the energy and materials from their environment. Finally, in the oceans appeared a complex structure which could prepare its own food, using carbon dioxide from air and water from occean, in presence of sunlight. This was the blue-green algae, the first living organisms that ever originated on Earth. It had two properties markedly different from the existing materials– self growth and self propagation. These are clearly the properties of living beings.

16.4.4 Evolution of higher life forms

When the blue green algae appeared in oceans, atmosphere had only nitrogen, hydrogen, water vapours and carbon dioxide. There was no oxygen in atmosphere. And this was good, because the algae could have easily got oxidised in an oxygen rich environment. Then the possibility of life on Earth would have been wiped out . But fortunately the oxygen in air was added at a very slow pace so that the growing life forms could adjust with it.

The algae as they prepared their food through photosynthesis used carbon dioxide and evolved oxygen. But nature had a provision to remove this extra oxygen in the beginning years of evolving life. The iron dissolved in oceans consumed the oxygen exhaled by algae and got oxidised. 2000 to 3500 million year old deposits of iron stones at the bottom of oceans are evidences of this proposition. The early forms of life thus survived and developed into more advanced organisms.

During this period (2000 to 3500 million years from now) however the content of carbon dioxide in atmosphere decreased and that of oxygen increased gradually. The increasing level of oxygen accelerated the process of evolution of life in two ways.

(i) The new organisms adjusted themselves to have greater tolerence for oxygen and to utilise it for more efficient metabolic processes.

(ii) Some of the oxygen formed ozone layer to protect the living organisms from harmful ultraviolet radiations.

On the other hand reduction in the level of carbon dioxide reduced the green house effect, because of which the temperature on Earth could settle down to values more favourable for higher forms of life.

Under these conditions more advanced forms of life evolved which could survive even on land. Around 600 million years ago the environmental conditions and composition of atmosphere became almost similar to the present status. The organisms of the time also had reached a level of evolution to develop into more advanced life forms. The diverse life forms that we see around us today is a result of the evolutionary process of these 600 million years.

16.4.5 Evolution of man

Man also has his place in the story of the evolution of life. Scientists now believe that apes (like Chimpanzee and gorilla) were the ancestors of modern man. On the basis of fossil remains from various excavation sites they have developed a chain of successive stages of evolution of man.

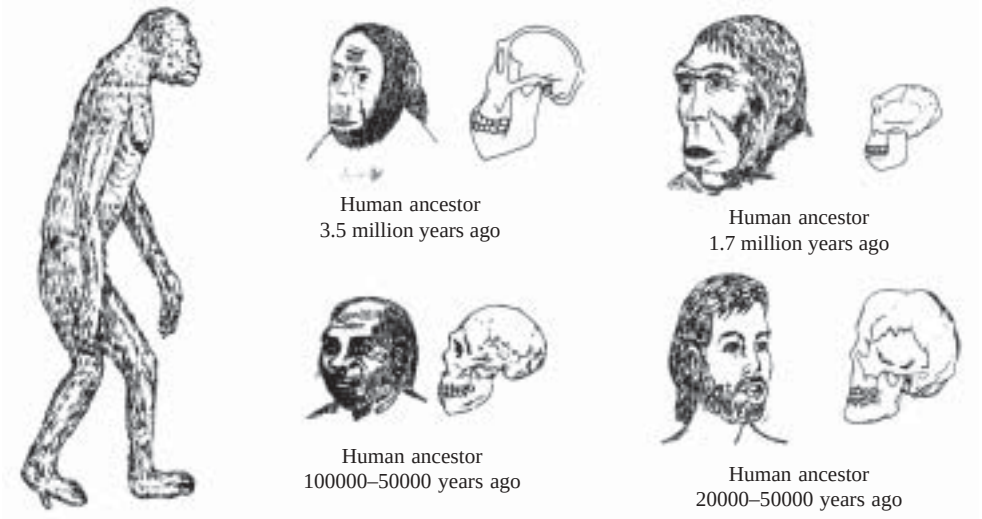


Fig. 16.4 Stages in evolution of man

CHECK YOUR PROGRESS 16.4

1. An oxygen free atmosphere was crucial for the survial of early life. Why?
2. Which evolved earlier–atmosphere or hydrosphere? Could it be otherwise?
3. What evidence do we have to believe that the oxygen evolved in early years of life was removed by some natural process. What was this process?
4. In which period of time oxygen replaced carbon dioxide from its dominant position? How do we know this?
5. What is the evidence to suggest that apes were the ancestors of man?

16.5 THE EARTH SYSTEM

The lithosphere, the hydrosphere, the atmosphere and various life forms on Earth interact with each other and support each other. So the Earth may be visualised as a system. To run

a system we need energy. On Earth all forms of energy that we use, with the exception of **nuclear energy** and **geothermal energy**, are obtained from the sun.

16.5.1 Sun, as the source of energy

Basically, the energy we receive from the sun is in the form of heat and light. We can use this energy directly in our solar cookers or solar water heaters. But, usually the energy from sun may manifest itself in various other forms on Earth. Let us consider a few examples.

1 **Wind energy :** Uneven heating of different regions of Earth's surface, creates regions of high and low pressures. Due to this, wind blows and the wind energy runs our wind mills.

2. **Hydel power :** Water evaporated by solar energy, rises up in the atmosphere. This water cools at high altitudes, forms clouds and comes down in the form of rains. The rain water as it flows down slopes may run our water-mills. It may also be collected in dams and run our power plants to generate electricity.

3. **Energy from food :** To do work we need energy. We get this energy from food. Animals get food from plants. Plants prepare their own food through photosynthesis using sunlight. So the energy that runs life on Earth is ultimately received from the sun.

4. **Energy from fossil fuels :** You have studied that fossil fuels such as coal, petroleum and natural gas are forms of **biomass** (dead remains of plants and animals) burried deep under the Earth. This biomass when alive had received its energy from the sun. So it is solar energy stored in the form of fossil fuels.

The importance of sun, as a source of energy for life on Earth, is therefore, unquestionable. The sun is a huge mass (~ 10^{30} kg) consisting of hydrogen (92%) and helium (7.8%). It is radiating out tremendously large amount of energy for the last 5 billion years and is expected to do so for the next 5 billion years. The energy that it radiates is so large that we receive 1.36 kW m^{-2} of solar power in the upper atmosphere of the Earth. However it is only 47% of this energy that reaches on the surface of the Earth.

The incredibly large amount of energy that is being released by the sun can not be produced by the simple burning of hydrogen gas. The source of the energy of sun, as suggested by German physicist, **Hans Bethe**, in 1939, is nuclear fusion of hydrogen into helium.

16.5.2 Circulation and utilization of solar energy

The flow of energy from the sun to the Earth is a unidirectional process. We receive energy from the sun, but return nothing back to it. However, the energy received from the sun may either be utilized or it may go waste and create problems for life. For example, if excessive solar energy remains trapped in atmosphere it may melt the solar ice caps, which will result in increased sea level and submergence of land.

The energy received on Earth is exchanged between atmosphere, hydrosphere, lithosphere and living organisms in various ways. Thus the energy circulates between these components of biosphere and life to keep them active.

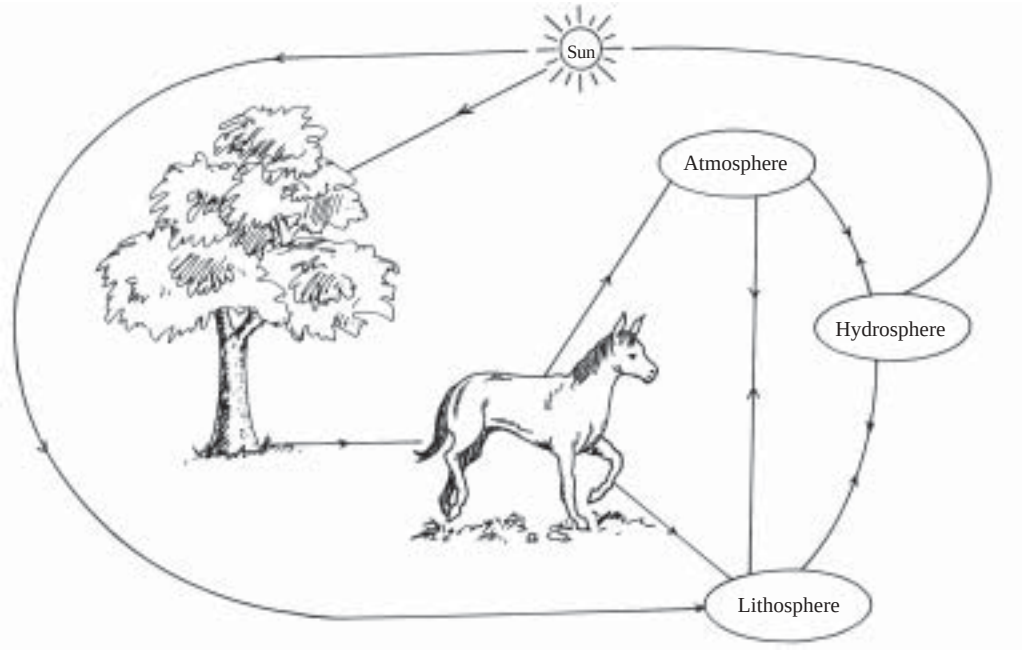


Fig. 16.5 Circulation of solar energy in the biosphere

The most effective and low cost method of utilizing solar energy is used by plants in the process of photosynthesis and hence by increasing the green cover of Earth we can think of maximum utilization of solar energy.

CHECK YOUR PROGRESS 16.5

1. Name two forms of energy which we do not receive on the Earth from the sun.
2. After a nuclear holocaust the sky some scientists say, will get covered with dense dust clouds for several months. Can you think of one consequence of this situation ?
3. The brown haze in Asian sky will result in low agricultural produce. Can you give one explanation for this ?
4. How is sun responsible for the energy we receive from a hydroelectric power plant ?
5. Name the reaction responsible for the production of energy in the sun ?

16.6 BALANCE IN NATURE

By now you might have understood that the Earth system has several interacting constituents in delicate balance. A slight disturbance in this balance may bring a big threat to the entire life. Let us consider some of the human achivities which are disturbing the balance in nature at an alarming rate.

16.6.1 Examples of threats to the balance in nature by human activities

1. In our craze for comfort and zeal for industrialization we are burning fossil fuels at a very fast rate. Thus, the carbon dioxide which was fixed for millions of years is being returned to the atmosphere in few hundred years. This is causing not only an energy crisis but also posing a threat of global warming.
2. The mindless use of chloro fluoro carbons (the chemicals we use as refrigerants and perfume sprays) are eating up our protective ozone layer creating a hole in it above Antarctica.

3. Deforestation for paper and wood is minimizing the effective use of available solar energy on Earth.
4. Creation of non-biodegradable materials like polythene is making the Earth barren and pausing threats for various life forms.

16.6.2 Our duty to protect the Earth

We must understand that the Earth is a unique planet. It is under very special circumstances that its life support systems have evolved. We must take special care to maintain the equilibrium between the various components of the Earth system so that life on this planet may flourish and progress.

CHECK YOUR PROGRESS 16.6

1. Give a consequence of deforestation.
2. Name a substance responsible for creating ozone hole.
3. What is meant by a biodegradable substance?
4. Suggest one step to maintain balance in nature.

LET US REVISE

- The Earth was formed around 4.5 billion years ago along with the other members of the solar system.
- Due to the kinetic energy of the colliding planetesimals and disintegration of radioactive elements the Earth melted and got differentiated around 3.7 billion years ago.
- Differentiation is the process of reorganization of Earth into different layers of varying density
- Radiodating techniques used by scientists revealed that the oldest rock found in Greenland is only 3.7 billion years old.
- The Earth's solid stuff differentiated into three layers (i) core (ii) mantle (ii) crust, after it melted.
- Crust of Earth along with oceans and atmosphere is the region in which living organisms are found and, therefore, they together are called biosphere.
- Biosphere has three life support systems (i) Lithosphere (ii) Hydrosphere and (iii) atmosphere
- The oxygen free atmosphere → the hydrosphere → the blue green algae → oxygen containing → atmosphere → higher life forms → *Homo sapiens* (man) evolved on Earth in this particular sequence, and seltted down to an interactive system in equilibriun.
- Man's activites are disturbing the balance of our ecosystem and posing a threat to the entire life on our unique planet.
- Let us be careful and mend our ways.

TERMINAL EXERCISES

A. Multiple choice type questions.

1. The first living organism developing on Earth was -
   (a) Bacteria (b) Virus

(c) Algae (d) Fungus

2. How much time (approximately) did it take for the formation of fossil fuel?
   (a) 2.5×10^8 years (b) 2.5×10^6 years
   (c) 2.5×10^4 years (d) 2.5×10^2 years
3. Which part of the Earth do we interact with the most?
   (a) Inner core (b) Outer core
   (c) Mantle (d) Crust
4. The first organism originated in
   (a) Ocean (b) Atmosphere
   (c) Marshy land (d) Desert
5. Which of the following is not the part of biosphare?
   (a) Lithosphere (b) Hydrosphere
   (c) Atmosphere (d) Mantle

B. Mark the following statements true or false.

1. If there were no atmosphere, the temperature of the Earth's surface would have varied over a wide range in 24 hours.
2. The oldest rock found on Earth is 4500 years old.
3. Green plants trap solar energy when they are alive and release it when they die.
4. The continents are fixed with respect to the Earth.
5. The concentration of salt in oceans remains roughly constant over a life time.

C. Fill in the blanks.

1. _____ radiations present in sun light can cause skin cancer.
2. The density of air _____ as we go up.
3. Earth was born along with other members of solar system nearly _____ years ago.
4. The temperature at the core of the Earth is about _____
5. One of the factors due to which the primitive Earth melted was radio active decay of elements like _____

D. Descriptive type questions.

1. What is meant by Pangaea ?
2. What is the age of the Earth ?
3. Up to what height do we have significant amount of water ?
4. Name two major ways by which carbon dioxide present in air is consumed.
5. When did the atmosphare reach a composition similar to what we have today ?
6. Name the four layers the Earth is differentiated into.
7. How does the atmosphere protect us from the falling meteors?
8. "Deforestation may lead to melting of polar ice caps". Explain.
9. The primitive algae were prone to oxidation, even then these survived in the oxygen exhaled. Explain how it could be possible ?
10. How were complex molecules formed from the elements present in the primitive

atmosphere?

11. Discuss why life could not evolve on planet Mars ?
12. What is meant by the term differentiation. Describe major layers of Earth with the help of a labelled diagram ?
13. State five advantages of atmosphere.
14. State the five advantages of oceans?
15. What made Earth a unique planet of solar system ? Explain.
16. List some activites of man which are disturbing balance of the life support systems of the Earth.

ANSWERS TO CHECK YOUR PROGRESS

16.1

1. Venus and Earth
2. Because it is very cold
3. So that nutrients may be transported to different parts of the organism
4. The belt containing Venus at its inner edge and Mars on the outer edge.
5. Very high range of temperature variation and low gravity to hold the atmosphere.

16.2

1. Iron
2 10km under the sea floor and 35-65 km under the land
3. Around 3.7 billion years ago from now
4. Right mass and right size ensures right gravitational field to hold atmosphere
5. because of very high pressure.

16.3

1. Studying the Earth quakes, volcanos and formation of mountains.
2. (i) green plants prepare their food using CO_2
   (ii) being green house gas it maintains night temperature to a comfortable value.
3. (i) Regulate global temperature
   (ii) Mineral and food resource
4. Provide oxygen for respiration and CO_2 for photosynthesis.

16.4

1. Because the very first organism blue-green alga was prone to oxidation.
2. Atmosphere evolved before hydrosphere. Had it been in reverse order the lighter water molecules could have escaped out of Earth. No life was then possible without water.
3. The red iron stones at the sea-beds ageing 2 billion years are evidence. Oxidation of iron dissolved in water removed the oxygen from the atmosphere.
4. Around 600 million years ago. Because that is the minimum age of the red iron stones found at sea beds.

5. The fossil remains of man-like creatures suggest a definite evolutionary trend.

16.5

1. Nuclear and geothermal energy
2. A global winter
3. Lesser light from sun reaches the Earth slowing down the process of photosynthesis.
4. Solar energy evoporates water which rises to high altitudes, forms clouds, comes down in the form of rains. It is the potential energy of this water collected in dams which runs turbines of our power plants and generates electricity.
5. Nuclear fusion.

16.6

1. Decrease in the effective use of available solar energy
2. Chloro fluoro carbons
3. A substance which can be broken up into simpler substances by some germs.
4. Grow more trees.

GLOSSARY

Algae : Plants without true stems, roots and leaves found in water or ground.

Atmosphere : A blanket of gases surrounding the Earth.

Core : The innermost portion of the Earth.

Crust : The thin, rocky outer layer of the Earth.

Convection current : A process of transfer of heat in liquids and gases where in hot and light fluid rises up and gets cooled at higher place and heavy cool fluid sinks down.

Erosion : The weathering away of Earth's surface by water, ice or wind.

Evolution : The process where by species of living things gradually change to adapt to their environment.

Geologist : A scientist who studies the Earth, its history and structure.

Global warming : Gradual rise in the average temperature of Earth.

Magma : Hot, molten rock formed beneath the Earth's crust.

Mantle : The layer of the Earth that lies between crust and core.

Organism : Any living being.

Photosynthesis : The process by which green plants use sun light as an energy source to turn CO_2 and H_2O into sugars they need for their food.

Pressure : Amount of force acting on unit area.

Volcano : An opening in Earth's crust through which magma erupts.