



CHAPTER – 18

Natural Resources

The earth is the only planet known to have life on it. A large variety of plants and animals exist today on the earth, ranging from protozoa to humans in the animal world, and from algae to trees in the plant kingdom. Life could originate and flourish on the earth because it has the necessary resources essential for the living. The heat and light from the sun is the main source of energy that plays an important role in the maintenance of life on the earth.

18.1 What are the resources on the earth?

We all know that it is the crust of the earth that is habitable. The thickness of the crust varies from 35 to 60 km from the deepest of the oceans to the highest mountains. The solid part of the oceans to crust is called lithosphere. The oceans, rivers and other water bodies on the surface of the earth together comprise the hydrosphere. The gaseous part is known as the atmosphere. It is the air that covers the entire earth like a blanket. The light and heat received from the sun is the main source of energy. Living things are found where these resources exist. The habitable part of the earth where the atmosphere, the hydrosphere and lithosphere interact and make life possible is known as the biosphere.

Biosphere has two types of components, biotic and abiotic. Living things constitute the biotic components. The air, the water and the soil form the non-living or abiotic components of the biosphere. Both the types of components provide resources to meet the basic requirements of life forms. However, the energy required for sustaining life is ultimately obtained from the sun. It is used in the synthesis of food. Most life forms require an ambient temperature, water and food.

The two components affect each other. For example, if it does not rain and the temperature is very high, plants dry up. Animals including us find it very difficult to live in such an environment.

In desert areas there is sand all around. It rains very little, water is hence scarce. Days are very hot while nights are cool. Because of such abiotic conditions there is very little vegetation and a few species of animals can live. Can you name one?

Thus we find that biotic components depend on abiotic components. However, abiotic components are also affected by biotic components. For example, if there are more trees in a place then air contains more moisture at the place and temperature remains low. Also dust particles are less in air. Have you ever noticed this effect? Why we encourage planting of trees on the roadside.

It is noticed that fertility of soil is destroyed by the affect of water, temperature and air in a place where there is less or no plants at all.

Thus, dependence of biotic and abiotic components of the biosphere on each other cannot be ignored as soon as it is being ignored environmental problems start.

18.2 Air, the breath of life.

Air is a mixture of gases that forms a transparent envelope or atmosphere around the earth. Air is dense below near the surface of earth. It becomes progressively rarefied with height. The height to which air or atmosphere extends is about 500 km. It does not escape into space, being held to earth by gravity.

Life and burning of things are not possible without air. We cannot see air like soil and water but we can feel it while breathing. We can see the plants moving, dust and papers being blown by the wind. These show the effects of air.

We can live without food for some days but it is impossible to remain alive without air even for some moments. Hold your breath for sometime. You will start feeling uncomfortable by not taking in air. Hence, air is called the breaths of the life as life cannot exist without it. Even the composition of air is the result of life on earth. Venus and Mars are two planets having air or atmosphere around them. There is no life on these planets. The major component of the atmosphere is found to be carbon dioxide which constitutes 95-97% of the atmosphere.

18.2.1 What is the composition of air?

The main gases present in the air are Nitrogen and oxygen. In addition to these gases carbon dioxide and some inert gases like helium, argon, krypton, Xenon etc are also present in very small quantities. Water in the form of vapour is also present in these gases.

The main composition of air is given in table below:

Gases	Total % of Air	% according to the volume in air.
Oxygen	99%	20.9478.04
Nitrogen		
Carbon dioxide	1%	0.030.930.05
Argon		
Other gases and water vapour		

Besides these gases some dust particles and other gases like oxides of nitrogen and sulphur, carbon monoxide etc are also found in the air the amount of which is more in the industrial areas and less in the area with more plants.

The main components of air remain largely stable as the consumption of various components is counterbalanced by their regeneration. For example, eukaryotic and many prokaryotic cells used up oxygen to break down glucose molecules during respiration for obtaining energy required for their activities. Carbon dioxide is produced in the process. Oxygen is also consumed in the combination of fuels, forest, fires and many other processes. Carbon dioxide is the common product. However, the concentration of carbon dioxide does not increase nor that of oxygen decrease. It is because carbon dioxide is fixed in two ways: (i) green plants convert carbon dioxide into glucose in the presence of sunlight (photosynthesis), giving out oxygen and (ii) many marine animals use dissolved carbon dioxide in sea water as carbonates to make their shells.

18.2.2 Role of air in moderating temperature:

The air which forms the atmosphere covering the Earth like a blanket is a bad conductor of heat. It prevents the sudden increase in temperature during the daylight hours. And during the night, it slows down the escape of heat into outer space. Because of it, the average temperature of the Earth remains fairly steady during the day and even during the course of the year. The moon, which is at nearly the same distance from the sun as that of earth, has no atmosphere. Its temperature rises very high to about 110°C during the day and cools to -190°C during the night.

Activity 18.1

- * Take :
 - (i) a beaker full of water,
 - (ii) a beaker full of sand or soil,
 - (iii) a corked glass bottle with a thermometer fitted through the cork.
- * Measure the temperature
- * Keep the three in bright sunlight for three hours.
- * Again note the temperature.
- * Place the three in shade for three hours and take the temperature.

Find out:

- a) Is the temperature reading the same in beakers (i) and (ii)
- b) Based on the above data, which would become hot faster – the land or the sea;
- c) Is the temperature reading of air in shade the same as the temperature of sand or water in shade? What is the reason for this?
- d) Is the temperature of air in the closed bottle the same as the temperature taken in open air? What is the reason for this?

Result : Sand or soil heats up quickly in sunlight. It also cools down quickly. Water is very slow to get heated. It is also very slow to cool down. Temperature of air in closed glass bottle rises slowly. It remains higher than the outside air even in shade.

18.2.3 Movement of Air: Wind**Activity 18.2**

- * Fix a candle in a beaker or wide-mouthed bottle and light it.
- * Light an incense stick and take it to the mouth of the above bottle.
- * Observe which way the smoke flows when the incense stick is kept near the edge of the mouth.
- * Which way does the smoke flow when the incense stick is kept a little above the candle?
- * Which way does the smoke flow the incense stick is kept in other regions:

The patterns of the smoke show us the direction in which hot and cold air move. When incense stick is kept near the edge, smoke from incense stick will move towards the flame. This also occurs when it is halfway towards the flame. However, when the incense stick is kept above the flame, the smoke rises up. In all cases smoke flows towards the area of low pressure.

From the above activity you have just performed, you can understand that movement of winds occurs from the area of high pressure to the area of low pressure. Such

movement of air resulting in diverse atmospheric phenomena is caused by the uneven heating of the atmosphere in different regions of the earth. Various other factors like the rotation of earth and the presence of mountain ranges in the paths of the winds also influence the movement of winds.

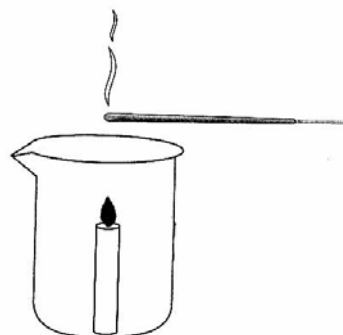


Fig. 18.1: Air currents caused by uneven heating of air

18.1.3 Rain

When water bodies are heated during the day, a great amount of water evaporates and goes into the air. Some amounts of water vapour also get into the atmosphere because of various biological activities (transpiration by plants). When air is heated, it rises up carrying the water vapour with it. As the air rises, it expands and cools, that causes the water vapour in the air to condense to form tiny droplets. Dust particles and other suspended particles in the air act on the nucleus for these drops to form around, that in turn facilitate the process of condensation of water. Once the water droplets are formed, they grow bigger due to condensation of water droplets. When the drops have grown big and heavy, they fall down in the form of rain. Sometimes, when the temperature of air is low, precipitation may occur in the form of snow or hail.

Patterns of rain fall are determined by the prevailing wind patterns. In large parts of India, rains are brought by south-west or north-east monsoons.

18.1.4 Air pollution.

An increase in the content of the harmful substances in air is called **air pollution**. Air pollution can severely affects plants and animals. In human, it can cause many health problems like respiratory problems, renal problems, high blood pressure, problems in nervous system etc.

Industrial growth in the present day has polluted air to a greater extent by releasing SO_2 , CO_2 , CO , oxides of nitrogen and sulphur etc. For example, the burning of coal and oil to generate electric power, run factories and fuel automobile engines creates oxides of nitrogen and sulphur. Inhalation of these gases is dangerous. SO_2 dissolve in and acidify the rain by forming sulphuric acid. This cause acid rain. Acid rain severely affects the growth of plants, Salmon reproduction and fish yield and it also eats into the surface of the

buildings, eroding the stone and brick woods. The combustion of fossil fuels also increases the amount of suspended particles (unburned carbon, hydrocarbons) in air.

18.2 Water:

Water is by far the most important substance necessary for life. Water is present everywhere. The earth's surface is covered for more than 70 percent of its area by water in the form of sea, lakes and rivers. Most of the water of our utilization on the earth comes from rivers, lakes, ponds and even underground wells. Fresh water forms only 2.5 percent of water and major part of this fresh water is frozen in glacial ice. However, the availability of fresh water varies from a place to a place.

Water is one of the most unusual natural compounds found on earth and it is also one of the most important. All the physiological processes take place in the medium of water. All the reactions that take place within our body and within the cells occur between the substances dissolved in water. Substances are also transported from one part of the body to the other in the dissolved form. Hence, organisms need to maintain the level of water within their bodies to stay alive.

18.2.1 Water pollution:

Water pollution adversely changes the quality of water. It disturbs the balance of ecosystem and it causes health hazards to human and animals. Water becomes polluted by the presence or addition of inorganic, organic or biological substances.

Fertilizers and pesticides used in the farm and field get dissolved in water and some percentages of these substances are washed into the water bodies. Effluents from urban and rural sewage, factories etc. are also dumped into rivers or lakes.

Some substances dissolved in water could be poisonous that can cause many diseases like cholera. Enrichment of water by nutrients (especially phosphates and nitrate) results in eutrophication of lakes and water bodies. This results in excessive growth of harmful blue green algae and depletion of dissolved oxygen present in the lake. Such reduction in the amount of dissolved oxygen adversely affects aquatic organisms. Aquatic organisms can sustain a certain range of temperature in the water body. Their breeding processes may be adversely affected if there is any change of temperature.

18.3 Soil

Soil is derived from the Latin word solum meaning 'the floor' or the ground surface. The soil is the weathered (or broken particles) surface of the earth's crusts which is mixed with organic material and in which microorganisms live and plants grow. Thickness of the soil on the earth's crust ranges from a few millimeters to 3-4 meters. Terrestrial plants depend upon the soil for their nutrients, water supply, and anchorage.

18.3.1 Formation of Soil

Soil formation is a slow process and it may take thousands of years to form a thick soil layer. Soils are formed by the disintegration and decomposition of rocks due to weathering (action of rain-water, running streams, wind, alternate high and low temperature etc) and action of soil organisms like bacteria, fungi, protozoa, earthworm etc. and

also interaction of various chemical substances present the soil. Although soils are normally formed from underlying rocks in a particular region, these may be transported to long distances by agencies like rivers, glaciers, strong winds, etc.

Physically the soil is a mixture of mineral particles of varying sizes – coarse and fine – of different degrees, some angular and rounded, with certain amount of decaying organic matter in it.

The spaces between the soil particles may be occupied by air and water. Water has minerals dissolved in it. Soil water is of different types: capillary water, hygroscopic water and gravitational water. Plants can absorb only capillary water. Soil air differs from atmospheric air as it is interrupted by the soil particles and has higher moisture content. Carbon dioxide content of the soil air is usually higher and oxygen content is lower than in the atmospheric air. The amount of air in the soil largely depends on the amount of water in the soil. Proper aeration (ventilation) of soil is necessary for plants roots and soil microorganisms and humus formation, nitrification etc.

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Humus constitutes the most important part of the soil. It consists of partially decayed organic matters. It makes the soil porous, thereby increasing the water-holding capacity. It is rich in nutrients that promote plant growth. Being black, humus absorbs heat to warm up the soil. The nutrient contents of a soil, the amount of humus present in it and depth of the soil are some of the factors that determines which plant can thrive on that soil. The quality of the topsoil is an important factor that decides biodiversity in that area.

Soils may be classified into different types depending upon size of the particles that a particular type of soil is composed of. Soils may be classified into the following types:

- (1) **Sandy soil:** It contains a large proportion of sand and small amount of clay and slit. It remains dry most of the time as it is well aerated and porous. It cannot hold much water. This soil is light.
- (2) **Clay Soil:** This soil contains more of clay and very small amount of slit and humus. It has a great capacity for retaining water. It is heavy and easily becomes compact and cracks when it dries up.
- (3) **Loamy Soil:** It contains more of slit, a small amount of clay and sand. It is the best soil for plant growth and is most suitable for agricultural crops because all the important physical conditions are satisfied. This soil has good capacity for water holding and is porous to allow aeration of roots.

18.3.2 Soil Erosion:

The soil erosion is a process of removal of fertile surface of the soil layer by various factors. The movement of soil takes place from one place to another place in soil erosion due to flood, rainwater or winds.

Soil erosion can be understood in performing the following activity.

Activity: 18.3

Let us take two identical trays and fill them with soil. Plant mustard or green gram or paddy in one of the trays and water both the trays regularly for a few days till the first tray is covered by plant growth. Now, tilt both the trays and fix them in that position. Make sure that both the trays are tilted at the same angle. Pour equal amount of water gently on both trays such that the water flows out of the tray. And study amount of soil that is carried out of the trays. Is the amount the same in both the trays?

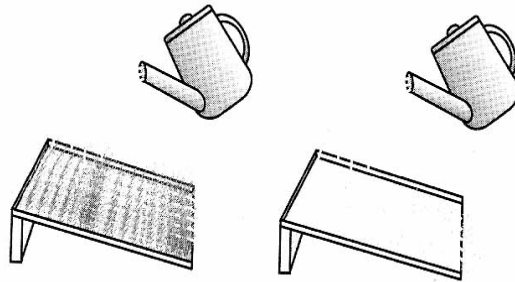


Fig.18.2: Effect of flowing water on the top soil

Now pour equal amounts of water on both the trays from a height. Pour three or four times the amount that you poured earlier. And study the amount of soil that is carried out of the trays now. Is the amount the same in both trays? Is the amount of soil that is carried out more or less or equal to the amount washed out earlier?

The plant roots have a very important role in preventing soil erosion. The large scale deforestation not only destroys biodiversity but also cause soil erosion. If there is no vegetation on the topsoil, it is likely to remove the surface layer of the soil quickly. Such process is accelerated in hilly and mountainous regions. The process of soil erosion is very difficult to reverse. Vegetative cover on the ground facilitates percolation of water into the deeper layer.

18.3.3 Soil Pollution

Soil pollution is the removal of useful components from the soil and addition of other substances that not only can adversely affect the fertility of the soil but also kill the organisms that live in it. Soil pollution is caused by solid wastes like polythene plastics etc and chemicals like pesticides and fertilizers used in farming. Industries are also one of the major factors in soil pollution. Soil pollution can destroy the soil structure by killing soil organisms that are responsible for recycling of nutrients in the soil. It can also kill the earthworms that are instrumental in making the soil rich humus.

18.4 Biogeochemical Cycles

The life on the earth depends upon the availability of energy and circulation of certain chemical substances such as Carbon (C), nitrogen (N), oxygen (O), potassium (K), Sulphur (S), Phosphorus (P) etc. These substances act as nutrients. There is a non-stop

transfer and circulation of these nutrients through soil, water, air and living organisms. *This flow of nutrients from the non-livings to livings, back to the non-livings in a cyclic form is known as **biogeochemical cycle**.* Cycling of such nutrients is required for the working of any type of ecosystem and ecological balance on the earth.

18.4.1 Water Cycle

Water is the most abundant compound present in all living organisms. It is made up of two elements, hydrogen and oxygen. Living organisms contain about 75% of water in their body. In order to perform various life processes, living organism require water. Water from the oceans evaporates to become water vapour. These vapours get cooled and slowly condense into water droplets at the low temperatures. These droplets come down as rain and snow on the land and ultimately get collected again in the ocean passing through rivers. This circulation of water is known as water cycle.

All the water comes down as rain and snow do not go to ocean. Some water get absorbed by the soil and some of these underground water are brought to the surface of the earth through well and tube-wells.

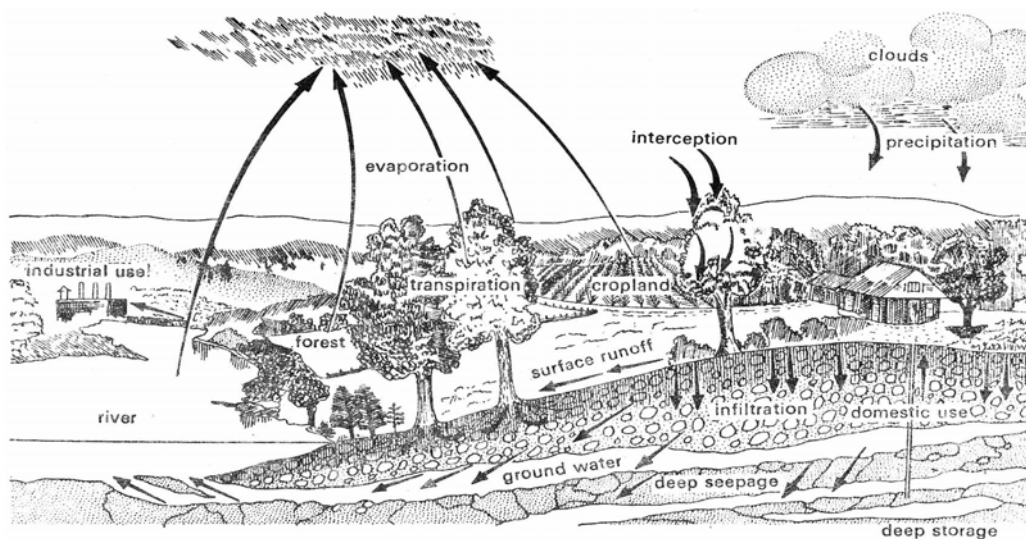


Fig. 18.3: Water Cycle in nature

18.4.2 Oxygen Cycle

Oxygen is the second most abundant element forming about 21% of the constituents of the air. It is available in free molecular form as oxygen gas (O_2). Oxygen occurs as a component of water (H_2O) and carbon dioxide (CO_2) in combined form. It remains dissolved in water and helps in the survival of animal and plants living in under water (aquatic).

Oxygen is taken from air for respiration by all living beings. Then convert it into carbon dioxide and water during respiration and release the products into atmosphere. Micro

organisms like decomposers also require oxygen during decomposition. Oxygen is also used up during burning of fossil fuels like wood, coal etc, releasing carbon dioxide and water. These carbon dioxide and water released during the above processes are used by plants during the process of photosynthesis to form carbohydrates releasing oxygen gas into the atmosphere. Thus, oxygen cycle is completed in nature. Oxygen cycle maintains the oxygen contents of the atmosphere at a constant level.

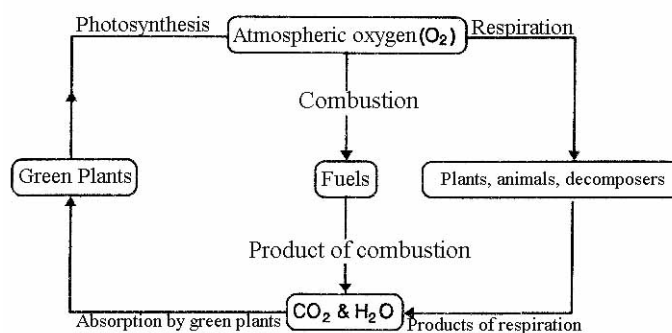


Fig. 18.5: Oxygen Cycle

18.4.2.1 Depletion of ozone layer: Ozone hole:

Ozone (O₃) is an isotope of oxygen containing three atoms of oxygen. It is poisonous and we are lucky that it is not stable nearer to the surface of the earth. It is found in the stratosphere. The presence of this layer containing ozone is essential necessity for life on the earth. It absorbs harmful ultraviolet rays of the sun, preventing it from reaching earth surface. These ultraviolet rays can damage many forms of life if they reach the earth's surface.

Over the past few decades, it is discovered that this ozone layer is getting depleted. It is because of man made pollutants which react with ozone molecules and resulting in the reduction of ozone layer. Some major pollutants responsible for depletion of ozone are Chloroflouro carbons (CFCs), nitrogen oxides, hydrocarbons and oxides of chlorine and bromine. Recently, a hole in the ozone layer is found above the Antarctica. Consequences may be very serious if it is not checked now. Many countries have started working on it to stop further depletion in ozone layer.

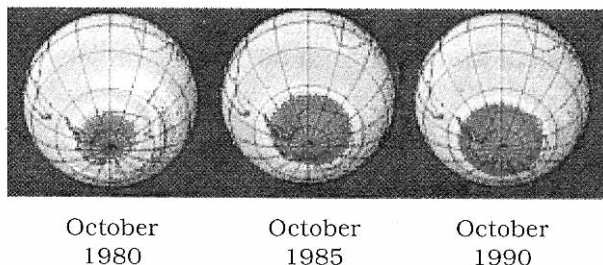
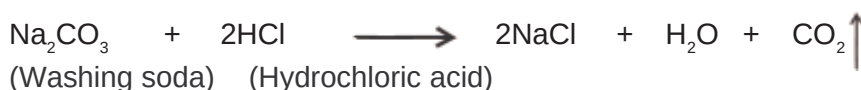
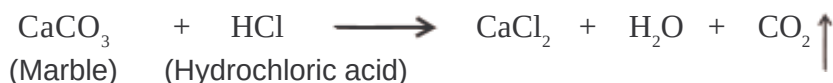


Fig. 18.6: Satellite picture showing the hole (black colour) in the ozone layer over Antarctica

18.4.3 Carbon Cycle:

Carbon is a basic component of all organic compounds. It is also a building material of all living organisms. It can exist in different forms as carbohydrates, nucleic acids, proteins, fats. It is transferred from organisms to organisms through food chain systems. Gaseous carbon is mainly occurring in the atmosphere (the concentration of carbon is about 0.03 – 0.04) and they are mostly dissolved in the ocean. Movement of carbon takes place in cycle from reservoir i.e. atmosphere to producers and then to consumers.

Carbon cycle involves a constant supply of carbon dioxide into the air. This is accomplished by the plants and animals, as they release carbon in the form of carbon dioxide during respiration. Carbon is also released by bacteria, fungi and decomposers, acting on the animal wastes. The burning of coal, wood etc. also releases carbon to the air. Limestones also release carbon due to weathering. Hydrochloric acid (HCl) reacts with marble (calcium carbonate), washing soda (sodium carbonate) etc to produce carbon dioxide.



Further, there is continual exchange of CO_2 between the atmosphere and water. If there is any deficit in concentration of CO_2 either in air or in sea, the movement of it takes place towards the air or sea. Carbon cycle occurs in the following way.

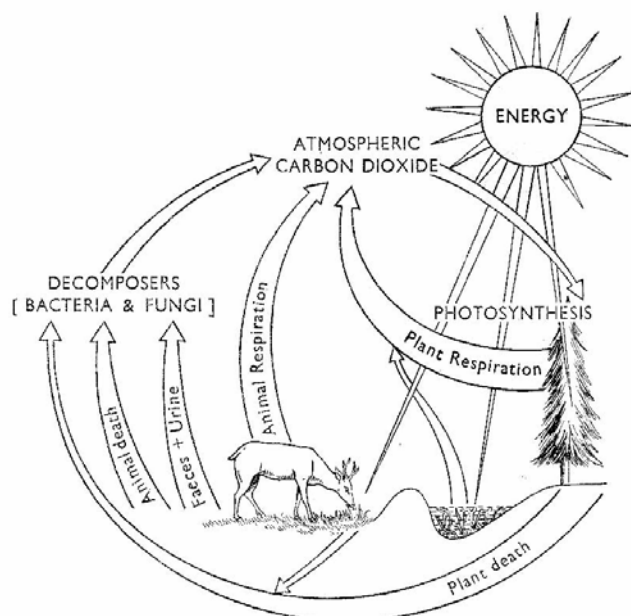


Fig. 18.7: Carbon Cycle

18.4.3.1 Greenhouse effect:

The carbon dioxide of the atmosphere keeps the earth warm. Such warming of earth is known as green house effect. Without it, the earth would be a frozen wasteland. Earth absorbs some short wavelengths or ultraviolet radiation coming from sun penetrating the atmosphere. This absorbed energy is also radiated back to space. The atmosphere has some gases that trap the outgoing radiation, resulting in warming the earth. Such gases are known as greenhouse gases. Some prominent

examples of green house gases are water vapour, carbon dioxide, methane, ozone, nitrous oxide, CFC(Chloroflouro carbons) and halons.

The increase in the quantity of the greenhouse gases in the atmosphere can reinforce the greenhouse effect and leads to the global warming, which is rise in average global temperature to a level which affects the life-forms on the earth surface. Global warming can give a dangerous impact on the earth. It may lead to melting of polar ice caps and ultimately rise in the sea level. The sea water will inundate the coastal area and massive human and economic dislocation in low-lying areas around the world.

18.4.4 Nitrogen cycle

Nitrogen is the most abundant component of the atmosphere. Nitrogen gas makes up 78% of the atmosphere. It is present in all organisms. It is also a part of many molecules essential to life like nucleic acids (DNA and RNA), proteins and some vitamins.

There is a regular cycle of nitrogen through the air, soil, plants and animals. Soil nitrogen is not exhaustible. Free nitrogen of the air is brought down into the soil as products of nitrates and nitrites of some salts through fixation and assimilation by bacteria of particular kind. These are known as 'nitrogen fixing' bacteria which are may be free living or commonly found in the roots of legumes plants in a special structure known as root nodules. Physical processes like lightning also convert this nitrogen into nitrites and nitrates. During lightning, high temperature and pressure are created in the air and convert nitrogen to its oxides. These oxides dissolve in water to give nitric and nitrous acid and fall on land along with rain. These are then utilized by various life-forms. Plants absorbed these nitrates and convert into ammonia and then into amino-acids. Plant proteins are subsequently consumed by herbivorous animals. Proteins and other nitrogenous compounds go to the soil after the death and decay of animals and plants. These compounds are again converted into nitrates by ammonification (process of formation of ammonia) and nitrification (process of conversion of ammonia into nitrates). Nitrates are absorbed by plants again. Finally there are some other bacteria like decomposers which reduce nitrates back into nitrogen or to ammonia or to some other oxides. This process is known as denitrification. Free nitrogen returns to atmosphere and oxides are absorbed by plants again. Thus, there is a nitrogen cycle.

Some organisms involved in nitrogen cycles are

1. *Rhizobium*, found in root nodules, *Azotobacter* in soil, blue green algae are responsible for nitrogen fixation.
2. Putrefying bacteria and fungi are responsible for ammonification.
3. Nitrifying bacteria like *Nitrosomonas* and *Nitrobacter* for nitrification.
4. *Pseudomonas*, denitrifying bacteria, responsible for denitrification.

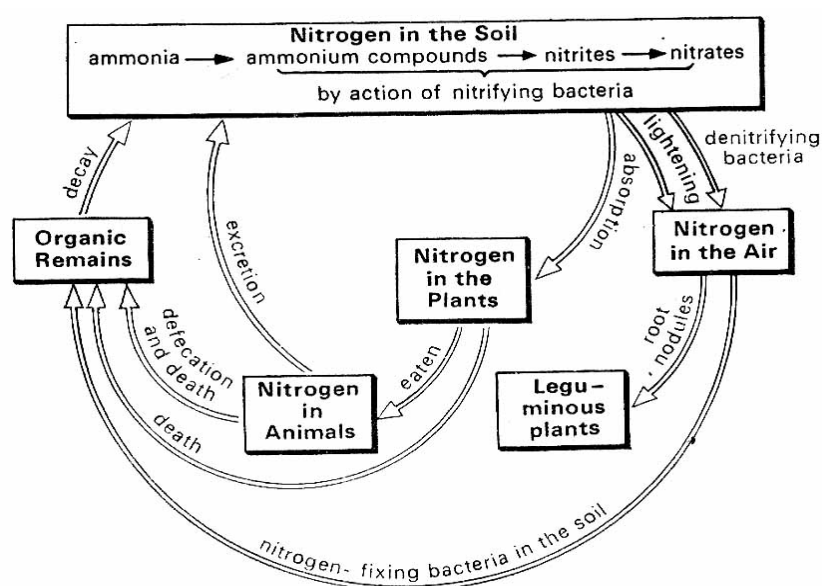


Fig.18.4: Nitrogen Cycle

POINTS TO REMEMBER

- * Life on earth depends on natural resources like water, air, soil and sun energy.
- * Winds are caused by uneven heating of air over the land and water-bodies.
- * Evaporation of water from water bodies and subsequent condensation gives us rain.
- * Biogeochemical cycle is the flow of nutrients from the non-livings to livings and back to the non-livings in a cyclic form.
Biogeochemical cycle maintain the balance between the various components of the biosphere.
- * Pollution of water, air and soil affect the quality of life and harm the biodiversity.
- * Some greenhouse gases like water vapour, carbon dioxide, CFCs etc. causes greenhouse effect resulting in global warming.
- * We need to conserve our natural resources and use them in a sustainable manner.

EXERCISES

- (1) *Why is the atmosphere essential for life?*
- (2) *Why is water essential for life?*
- (3) *What are biogeochemical cycles? Explain the pathway of any one.*
- (4) *Define nitrogen fixation? Name some bacteria involved in it.*
- (5) *What is green house effect?*
- (6) *What is global warming? How is it caused?*
- (7) *How is depletion in ozone layer caused?*
- (8) *Give diagrammatical representation of nitrogen cycle.*
- (9) *Give diagrammatical representation of carbon cycle.*
- (10) *How does oxygen content of the atmosphere maintained?*
- (11) *Write on the importance of water cycle in the environment.*