UNIT 14 ECOSYSTEM

Structure

14.1 INTRODUCTION

As far as we know, our earth is the only planet where life exists, though scientists are constantly searching for signs of life on other heavenly bodies. You have already learnt in the previous block, how life came into existence on this planet. You have also studied, that several hundred million years ago, living conditions on the earth were quite different from what they are today and so were the earlier living organisms. The present variety of animals and plants has evolved out of the old ones just as the present living conditions on the earth have evolved over a period of millions of years. In addition to sunlight, air, soil, water, the earth has got the right pressure and temperature that enables life to exist, evolve, and diversify. Actually there exists a very delicate balance in nature between the earth's environment and the living organisms. If this balance is disturbed then the life that exists today is likely to be affected or even destroyed. Flash floods and soil erosion are some of the adverse effects of this imbalance. Therefore, we must understand that how living and non-living things exist in harmony with nature and what are the processes that maintain this balance. In this unit you will learn how life system is sustained on this planet.

Objectives

After studying this unit you would be able to:

- describe how all forms of life are dependent directly or indirectly, on their environment, as well as on one another,
- explain how essential needs for the existence of life, such as energy, nutrition and water are continuously made available by certain processes going on in nature,
- discuss the interdependence of life, and how its sustaining processes are delicately balanced in nature.

14.2 ECOLOGY AND ENVIRONMENT

Today, we hear people from different walks of life, using the terms ecology and environment. Politicians, leaders, town planners, students and architects speak of 'environmental issues' and 'ecological concerns'. Of course, these phrases are very common, but are they really understood by the speaker and the listener alike? Often these are interpreted in many different ways. So we need to establish some common understanding of these terms.

Ecology is a branch of biology which deals with the relationships between organisms and their 'environment'. Everything that affects an organism from outside, during its life, is

collectively known as its **Environment.** These environmental influences can be divided into two categories. The living things that affect an organism are called **biotic factors**, and those that are not alive are called **abiotic factors.** Let us understand this with the help of an example. Consider a fish in a stream, we can identify many different environmental factors that are important in its life. The temperature of the water is an important abiotic factor but it may be influenced by the presence of trees, a biotic factor, along the bank of the stream that shade the stream and prevent the sun from heating it. The kind and number of organisms that serve as food for the fish, are important biotic factors as well. The type of materials that make the bottom of the stream, and the amount of oxygen dissolved in the water are two other abiotic factors, which are related to the speed of flow of water. In brief, the environment of an organism is complex, and its various factors are interrelated.

SAQ 1

Fill in the blanks choosing appropriate words from the list given below.

a) ..... is the study of the interaction of organisms with their. .....

b) The word ..... very broadly means as anything that affects an ..... during its lifetime.

c) The environment consists of ..... and..... components.

(environment, biotic, organism, abiotic, environment, ecology)

14.3 ECOSYSTEM

The example of a fish in a stream makes it quite clear that if we want to understand the living things and their place in nature properly, we must not consider them alone, but rather as a part of an interacting system. Such an interacting system, e.g., a stream, is called ecosystem.

You must have seen a lake, a pond, a grassland or a forest at one time or another. All these are some more examples of ecosystem. Let us consider a pond as our model ecosystem (see Fig. 14.1) and examine it more closely.

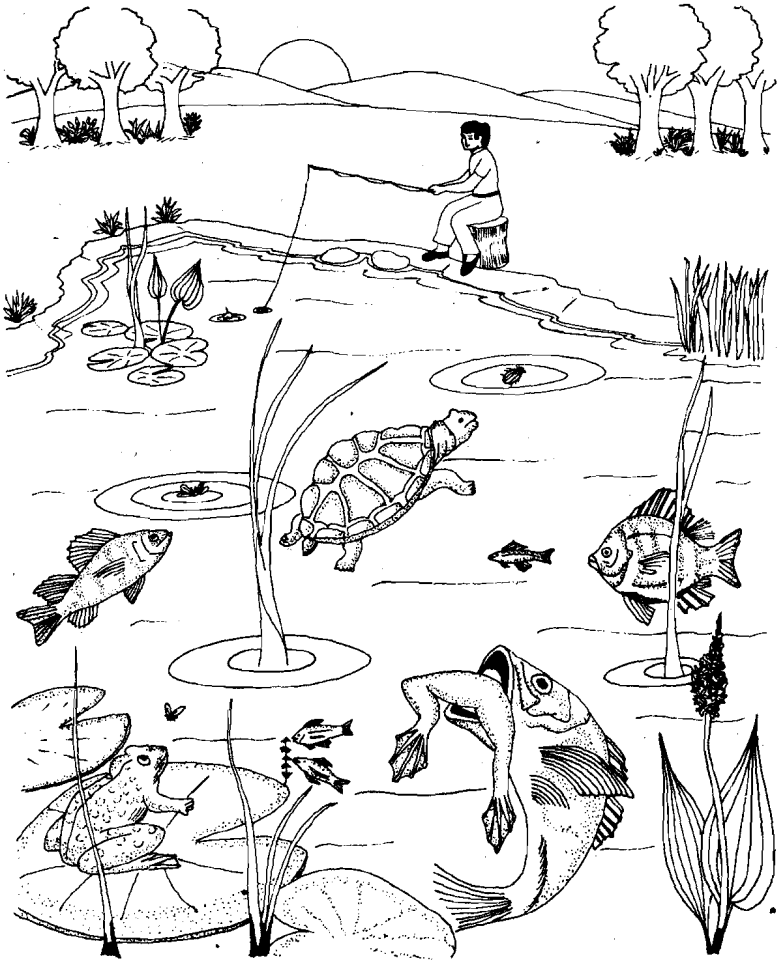


Fig. 14.1: The pond ecosystem showing biotic and abiotic components.

As already mentioned earlier, it is made up of basically two types of components: living and non-living. The living components include various types of plants, frogs, birds, fish, turtle, insects and numerous kinds of microscopic life forms called microbes. The water, the dissolved gases such as oxygen, and carbon dioxide, the minerals, soil, and stones constitute the non-living components. The various components of the pond interact with each other. In fact, the pond is a small world in itself. Here, living beings are born, they live, breathe, feed, excrete, move, grow, mate, reproduce, become food for each other and die within the pond itself. It is rightly said that the pond has a dynamic existence. It is not the same today, as it was yesterday. Now let us look more closely at the biotic components in an ecosystem, and their role.

14.3.1 Individuals in an Ecosystem, and their Ecological Role

Within an ecosystem, the organisms can be classified under three broad categories, namely, **producers, consumers** and **decomposers.** Let us see what is their position in the ecosystem.

Sun is the ultimate source of energy for nearly all life on the earth. Solar energy enters life mainly through green plants, and also through some kinds of bacteria and algae which are called **producers.** During photosynthesis, green plants use the energy of sunlight to convert two simple, low energy substances, carbon dioxide and water, into more complex substances, such as carbohydrates which we may call food. Photosynthesis produces oxygen as a by-product. To carry on photosynthesis and make food, green plants need not only sunlight, water, and carbon dioxide, but also small amounts of some minerals such as calcium, potassium and magnesium, dissolved in the water around the floating plants, or in the soil water around plant roots.

Photosynthesis:

Carbon dioxide + water + solar energy + minerals → food + oxygen

In the adjacent equation where you see arrow read it as 'produces'.

Food made during photosynthesis may later be used for energy by the plant itself, or by an organism that consumes the plant. In an organism food is used up, with the release of its stored energy, by the process of respiration. Respiration requires oxygen, and releases three products: energy (part of it is used for doing work, and the rest is not used and is given out as heat energy), carbon dioxide, and water – the starting products of photosynthesis!

Respiration:

Food + oxygen → carbon dioxide + water + energy

The arrow in the adjacent equation means produces.

Food is not only a source of energy, but also the nutrients used to build up the organisms' bodies. So we see that nutrients and energy are combined into one entity, food, during photosynthesis. This food may be taken by the other organisms from green plants.

So far we have seen that, green plants are called producers because they produce their own food. Plants live and die, they may be eaten up by animals who also eventually die. There are organisms – the **decomposers** which act on dead plants and animals and for their existence they decompose the substances which form these dead bodies. In other words, the decomposers, such as bacteria, fungi and worms, convert the material of the plants and animals back to their elementary forms.

Besides the producers and decomposers, there is another category of organisms – the **consumers.** These organisms cannot make their own food, and they depend directly or indirectly on producers, for energy and nutrients.

Consumers include **herbivores,** animals that eat plants; **carnivores,** animals that eat other animals; and **omnivores,** animals that eat both plants and animals. Deer, duck, goat, and cow are examples of herbivores. Some human beings who are vegetarian by choice, could also be considered as herbivores. Wolf, tiger, cat, dragonfly, and eagles are all carnivores; rats and most human beings are examples of omnivores.

SAQ 2

Fill the empty boxes in the crossword puzzle given below. After you have completed the crossword, classify the organisms as producers, decomposers, herbivores, carnivores, and omnivores.

Clues

Left to Right	Top to Bottom
1 Bird (5)	2 Animal (5)
2 Crop (5)	4 Weed (5)
3 Animal (6)	10 Animal (3)
4 Animal (7)	11 Plant (6)
5 Insect (11)	12 Bird (3)
6 Bird (4)	13 Insect (6)
7 Animal (4)	14 Vegetable (3)
8 Worm (9)	15 Bird (6)
9 Animal (3)	16 Animal (4)

* The numbers in bracket denote the letters in the word.

14.3.2 Food Chain

As you know from the discussion of the previous subsection (14.3.1), one of the ways in which the organisms are related is through food, that is, one organism becomes food for the other. A sequence of organisms that feed on one another constitutes a food chain (see Fig. 14.2).

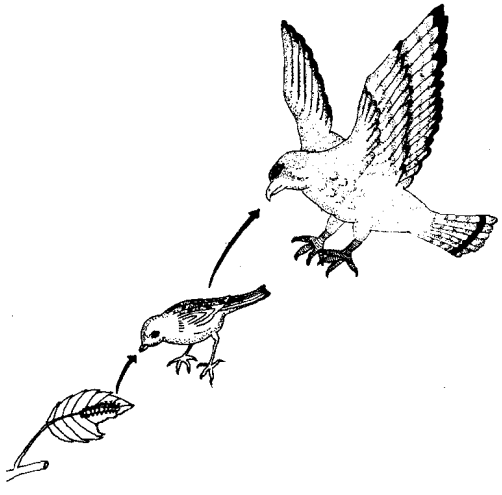


Fig. 14.2: Food Chain

The arrows in the figure show the direction of passage of nutrients and energy from the producer, a plant, to caterpillar, to the sparrow and finally to the eagle. The number of links or steps in a food chain are usually limited to four or five. You may wonder why it is so. You would find the answer to this later.

Coming back to the links or steps in a food chain, each of the link is also referred to as a **trophic level**. The trophic level to which an organism belongs, indicates how far it is away from plants in the food chain. Green plants or producers make up the first trophic level. The second trophic level contains the plant eating animals, the herbivores, and higher trophic levels are made up of carnivores. Another point, that we wish to make here is, that an organism cannot always be assigned to one specific trophic level. Take the example of man who is an omnivore, i.e., he is both a herbivore and a carnivore, so he may belong to the second and/or the third trophic level.

14.3.3 Food Web

Within an ecosystem, there are many different food chains. Some organisms may be involved in several of the food chains at the same time (see Fig. 14.3). So a number of food chains become interwoven into a food web, that may be very complex. The term food web is often used to describe more accurately, the actual feeding relationship within a given

ecosystem. In a forest, if deer become rare or get wiped out by a disease or any natural calamity, the predator, such as lion, can feed on other animals such as fox, wolf, crane etc. till the usual prey animals are available again (see Fig. 14.3). In brief, we can say that many interlocking food chains make it possible for the living beings to survive minor or major setbacks and changes in their surroundings. Thus, interlocking food chains provide stability to the ecosystem.

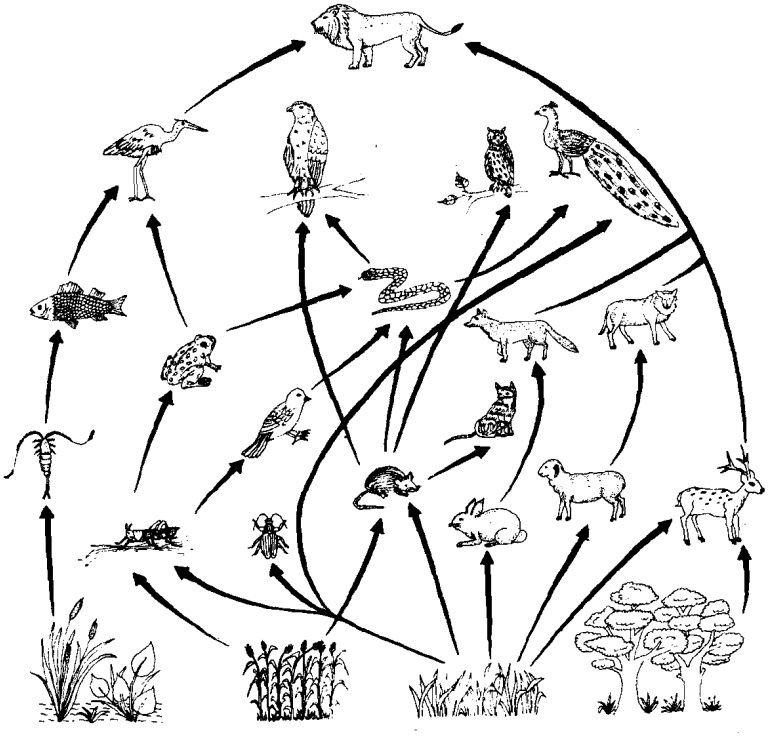


Fig. 14.3: A food web showing the main food links. Note that the starting point for each chain is a plant, and several food chains are interconnected to form a food web.

14.3.4 Energy Flow in the Ecosystem

The principal source of energy for any ecosystem is sunlight. In the earlier sub-section (14.3.1) you have studied that solar energy is converted by plants into food materials, and is stored within the body of the plant. All food materials that we or other animals consume are manufactured directly or indirectly by plants. Think of your breakfast, bread is made of a cereal that is produced from plant material, egg from hen which has fed on plant products; and milk from cow which has consumed grass or fodder derived from plants. In a nutshell, the energy that we obtain from plants either by burning wood or by eating them, represents the solar energy trapped by the plants. We are dependent on the stored resources of solar energy. When we eat meat, we obtain energy that had been stored by plants several years before and then taken up by an animal like a goat through grazing. When we cut firewood for fuel, we obtain energy accumulated and stored by trees for perhaps a century or more. When we burn coal or petroleum, we obtain solar energy stored by plant life, millions of years ago.

Now let us trace the energy flow through an ecosystem. This is represented diagramatically in Fig. 14.4.

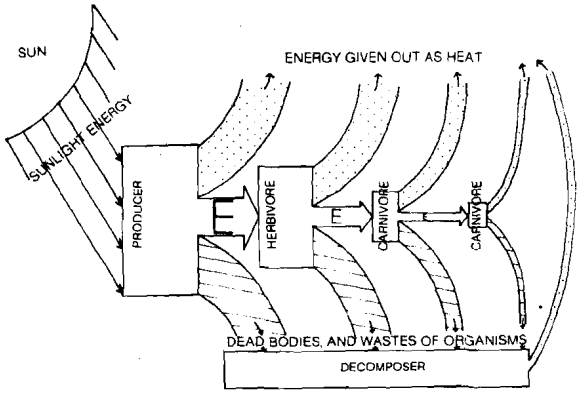


Fig. 14.4: Energy flow in an ecosystem.

Notice that the energy from the producer to the last level has decreased considerably. The energy passed on to the next trophic level is represented by letter E of three different sizes, each by its size indicates the comparative amount of energy. The arrows in the upper half of the diagram indicate the loss of energy in the form of heat given out by different organisms.

The arrows in the lower half show the energy loss via the wastes secreted and energy trapped in dead bodies of the organisms. Decomposers use these wastes and dead bodies as sources of food and derive energy from them. They also give out some unused heat energy.

Energy flowing through an ecosystem is thus first captured by the producers. From the producers the energy passes to various consumers, via food. At the end of the chain we find that very little energy is left for the last trophic level, because some energy is always lost in going from one level to the next. This loss of energy limits the number of trophic levels in the ecosystem, and so they are seldom more than five. This also clearly shows that why the steps in a food chain are limited to four or five.

SAQ 3

Place the missing links in the following food chains, from the list given below.

a) Plant → ..... → Fish → Man

b) Grass → worm → sparrow → ..... → Owl

c) ..... → rat → snake → Hawk

d) Bug → Spider → frog → .....

e) Grass → grasshopper → ..... → eagle

(rat, snake, insect, rat, wheat.)

SAQ 4

Construct a food web using the items listed below.

deer herbivorous insect
rabbit spider
plant sparrow
wolf hawk
snake

Hint: Keep the producers at the base, herbivores at the middle level, and carnivores on the top; and connect them with arrows, depending on who eats whom.

14.4 CYCLING OF MATERIALS IN ECOSYSTEM

Living organisms require four nutrients in relatively large amounts, these are carbon, oxygen, nitrogen and hydrogen. They also require phosphorus and sulphur. These elements are present in our environment in a fixed quantity, therefore they must be recycled in order to sustain life. Also these elements must move efficiently, from the living to nonliving components and vice versa. Let us understand this with the help of an example. Plants take in carbon as carbon dioxide to produce food. As the herbivores eat plants, carbon is passed on to them, which in turn is passed on to carnivores, and so on. Carbon is eventually returned to the nonliving pool in the ecosystem, through the excretory processes of the producers, the herbivores, the carnivores, and also through the activity of the decomposers. Through such cyclic processes these nutrients are used over and over again by the organisms.

This aspect of the ecosystem function is called the **cycling of materials.** In contrast to **energy flow** which **is a one way process, mineral nutrients move** more or less **in a cyclic way.**

In the following sub-sections, you would study the cycles of nitrogen, carbon and water. This would give you an idea of the complex involvement of the various living and nonliving components.

14.4.1 The Nitrogen Cycle

Nitrogen is a vital part of many essential organic compounds especially nucleic acids and proteins. It also forms a major part (79 per cent) of the atmosphere. In fact, the atmosphere is the chief reservoir of nitrogen, where it is present in the gaseous form, which unfortunately, cannot be directly used by plants and animals.

Plants actually obtain their nitrogen from nitrates and ammonium salts in the soil to build up proteins, from which animals derive some of their proteins. The amount of nitrates and ammonium salts in the soil, is limited, at a given time, and their supply would quickly exhaust, if it were not for the renewal of supply of nitrogen which goes on continuously. What are these processes which enable the cycling of nitrogen? Now, we shall discuss them briefly.

You are advised to first look at the nine basic steps of nitrogen cycle as shown in Fig. 14.5. When you see number 1 in the figure, for its explanation look up step 1 of the nitrogen cycle, described below.

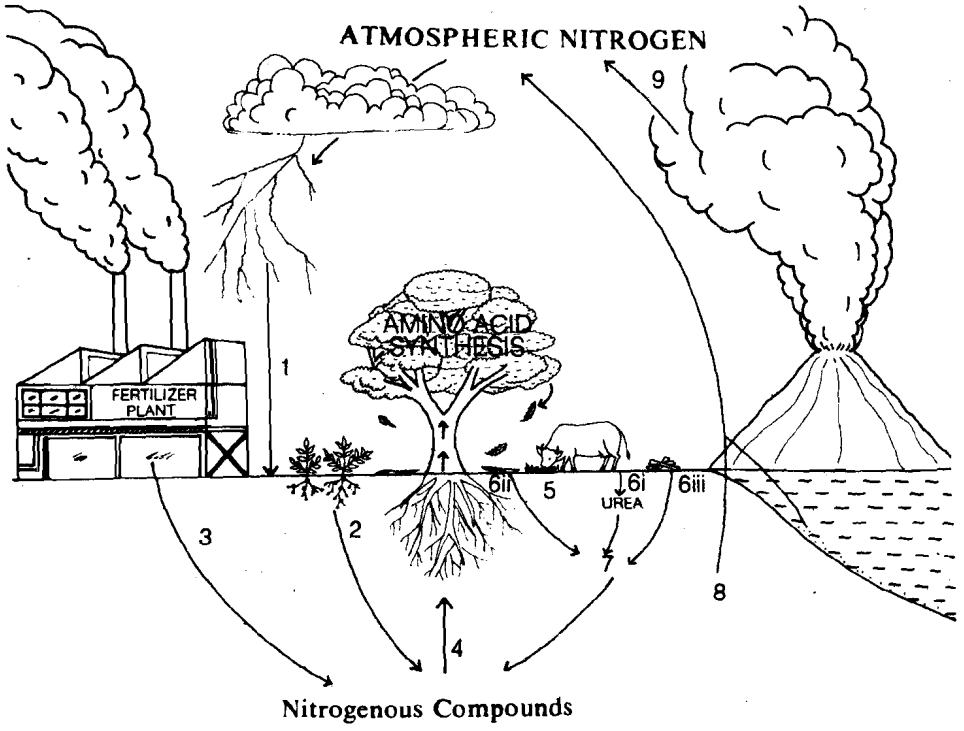


Fig. 14.5: The Nitrogen Cycle

1) During thunderstorms, some of the oxygen and nitrogen in the air are converted into oxides of nitrogen by the high temperature of lightning. The oxides of nitrogen dissolve in rain water, reach the soil and get converted into nitrates. These nitrates are taken up by plants.

2) Certain bacteria can utilise atmospheric nitrogen and build up nitrates from it. They are called the nitrogen-fixing bacteria. Some of these bacteria live freely in soil, others live in small knots or nodules on the roots (see Fig. 14.6) of certain plants. Surely, you must be familiar with plants such as beans, peas, peanuts, clover and alfa alfa etc., which have these bacteria carrying nodules on their roots. Farmers make use of some of these plants, to make fodder, and then plough the rest of the plant into the soil, to increase the nitrates in the soil.

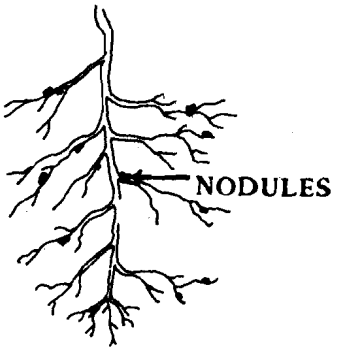


Fig. 14.6: Root nodules

3) Nitrogen fixation by bacteria, i.e., the process of putting nitrogen in a form that plants can absorb, is rather slow, compared with the rate at which plants need nitrogen. In such a situation the demand for nitrogen is fulfilled by adding nitrogen containing fertilisers to the soil.

4) Nitrogen in the form of nitrates is taken up by plants, and is converted into amino acids, which are the building blocks of proteins.

5) Nitrogen enters the food web through plants and passes on to animals which feed on them.

6) Nitrogen eventually returns to soil in the following ways: (i) During excretion, nitrogenous wastes in the form of various ammonium compounds are returned to the soil or water. (ii, iii) Nitrogen trapped in plants and animals returns to soil by death and subsequent decay of their bodies by the action of bacteria and fungi.

7) In soil, the nitrogen-containing matter are acted upon by bacteria and are converted to ammonium compounds, then eventually to nitrates.

8) Some soils, particularly the ones in bogs, estuaries, lakes and parts of the sea floor contain denitrifying bacteria which produce the opposite effect of nitrogen fixation.

They act on nitrates and release nitrogen to the atmosphere.

9) Volcanoes are one of the important sources of nitrogen. They have been emitting small quantities of nitrogen for centuries and contribute significantly to the nitrogen reservoir of the atmosphere.

Intrusion into the Nitrogen Cycle

Human intervention can disturb the nitrogen cycle. Let us see how. When we grow and harvest crops, there is loss of nitrogen from the soil, as it is utilised in the building up of plant body. Similarly, harvesting of timber results in heavy outflow of nitrogen from our forest ecosystem. You may say that we can compensate for the loss of nitrogen by adding commercial fertilisers to our fields or by large scale cultivation of nitrogen-fixing plants. Yes, you are right, **so long as** the right type of fertilisers are applied in proper quantities. Heavy addition of commercial fertilisers cause excessive build up of nitrogen in the soil and groundwater, and nutrient enrichment of rivers, lakes etc. Automobile and industrial exhausts add nitrogen oxides, especially nitrogen dioxide, at an alarming rate to the atmosphere. Nitrogen dioxide reacts with moisture in the atmosphere to form weak nitric acid, which is carried to the soil during rainfall, and ultimately to the water table. The results of nutrient enrichment of rivers, lakes etc; presence of excessive nitrogen oxides in the atmosphere; and the excessive formation and addition of nitric acid to the soil, would be studied in Unit 16 of this block.

SAQ 5

Fill in the blanks.

Nitrogen, an element required in most molecules of life, occurs as ..... in atmospheric reservoir. Plants can only take up nitrogen in the form of ..... . Nitrogen gas is fixed into useful compounds by ..... . These are found in the root nodules of plants like ..... and .... bacteria produce the opposite effect of fixation. The nitrogen in the soil is replenished by the addition of wastes and ..... that are subsequently acted upon by the. ..... .

14.4.2 The Carbon Cycle

We have seen that carbon is one of the essential elements of all organic substances and it enters the ecosystem through the process of photosynthesis. Carbon is present as carbon dioxide in the atmosphere. Carbon dioxide forms 0.03 to 0.04% of the atmosphere. The oceans also have carbon dioxide dissolved in their water. For understanding the cyclic processes related to carbon, you are advised to go through the 12 basic steps of the cycle, as indicated in Fig. 14.7. Please note numbers 1 to 12 in the figure. Each of these numbers denotes a component process of the cycle. When you see number 1 in the figure, observe what it shows and read its explanation under point 1 of the carbon cycle.

1) You have already studied that carbon dioxide enters food webs through plants (Subsection 14.3.1) by the process of photosynthesis.

2) In the same sub-section (14.3.1) you have also studied that some of the carbon dioxide captured by the plants and converted into organic molecules, is returned to the atmosphere via respiration.

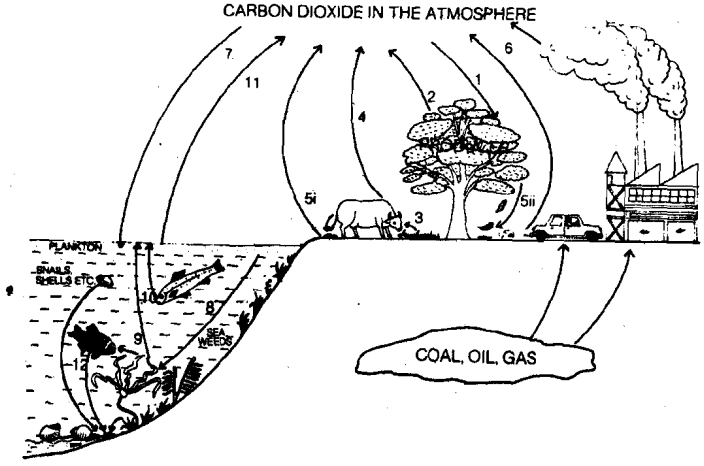


Fig. 14.7: The Carbon Cycle

3) And, some portion of the carbon is incorporated into the plant body, which is later passed on to the herbivores, etc.
4) The living beings release carbon dioxide into air during breathing.
5) (i, ii) Carbon dioxide is also returned to the atmospheric reservoir by the death and subsequent decay of the dead bodies and wastes of animals and plants.
6) Formation of fossil fuels, like coal, oil, gas, is a part of the carbon cycle, wherein carbon is trapped for millions of years. Fossil fuels are the remains of ancient plants and animals that were subjected to high temperature and pressure over millions of years. Man has been using wood, peat, coal and petroleum as sources of energy, for running transport, such as motorcars, aeroplanes etc.; for industries, for cooking food and various other purposes. While considering fossil fuels as energy packed substances, you must not forget that it is the energy of sunlight from prehistoric times that remains stored in them in chemical form.
7) Since air is in direct contact with the sea, the carbon dioxide from the air dissolves in the upper layers of water resulting in the formation of carbonates.
8) The plants that grow in sea water, do not get atmospheric carbon dioxide. Therefore, they utilise carbonates present in water as a source of carbon dioxide during photosynthesis.
9) Food produced by water plants passes through the aquatic food chain. For example, when fish feed on the water plants, carbon passes on from plants to the fish, and ultimately to the other organisms that feed on fish.
10) Some of the carbon dioxide produced by marine plants and animals during breathing gets dissolved in sea water and can be re-utilised by the plants.
11) However, some of the carbon dioxide, thus evolved, escapes to the atmosphere.
12) Organisms like snails, oysters etc., extract carbon dioxide dissolved in water and combine it with calcium to form calcium carbonate from which they construct their shells. Shells of these dead animals collect in undersea deposits and may eventually be converted to limestone.

Intrusion into the Carbon Cycle

In the carbon cycle, as long as the average amount of carbon dioxide in air and in water remains the same, a happy situation prevails. If the tendency is for it to increase, a point will come when some animals will find it intolerable for their breathing. If the tendency is for carbon dioxide to decrease, then, over a large number of years, a point will be reached when plants would not be able to photosynthesise and produce oxygen for animal life. So, we can see how important it is to maintain a balance in this cycle. In the present century, the carbon cycle has been impaired by non-judicious utilisation of fossil fuels, indiscriminate cutting of forests and changes in land use from agriculture to the cement and concrete roads and buildings, which reduces the area under plantation.

We see enormous amount of smoke emanating from some of our industries, vehicles, accidental fires, aeroplanes, and some also from kitchens. This adds carbon dioxide to the atmosphere in amounts much larger than can be tackled in natural course. Carbon dioxide input has been increasing since the beginning of Industrial Revolution some 100 years ago, and since then its concentration has increased considerably in the atmosphere. The major concern over increased carbon dioxide content, is its possible effect on the temperature of the air surrounding the earth. Excessive carbon dioxide in the atmosphere tends to trap the heat radiated by the earth. The effects of such a situation will be discussed in detail in Unit 16.

SAQ 6

Fill in the blank spaces given below:

The reservoir of carbon is carbon dioxide gas found in the ....., and dissolved in ..... . Carbon enters the producers through ....., during which they incorporate ..... in the food prepared. Carbon is released to the atmosphere as carbon dioxide during ..... . Carbon dioxide is also returned to the atmospheric reservoir by the death and ..... of the dead bodies of ..... and ..... .

14.4.3 The Water Cycle

The importance of water is obvious to everyone. Water is synonymous with life. The most common substance in the body of any organism is water. It is also the most abundant substance in our environment. An estimated amount of 1500 million cubic kilometers of

water, in one form or the other, is present in the biosphere. Ocean is the major reservoir of water which covers about seventy per cent of earth's surface. Ocean water is salty. Fresh water is mostly found in rivers and in between rocks below the surface of the earth.

The water cycle is driven by the sun's heat energy, which causes water to evaporate, while gravity draws the water back to earth after water vapour condenses. Here, we would like to point out a difference between the water cycle, and the two previous cycles. Unlike in nitrogen and carbon cycles, most of the forces that cause water to be cycled do not involve organisms, but are the normal physical processes, like evaporation, condensation etc.

In this unit, water cycle is divided into 4 basic steps. Before we proceed further, you may go through Fig. 14.8 carefully, and then read the corresponding description as you did for the study of nitrogen and carbon cycle.

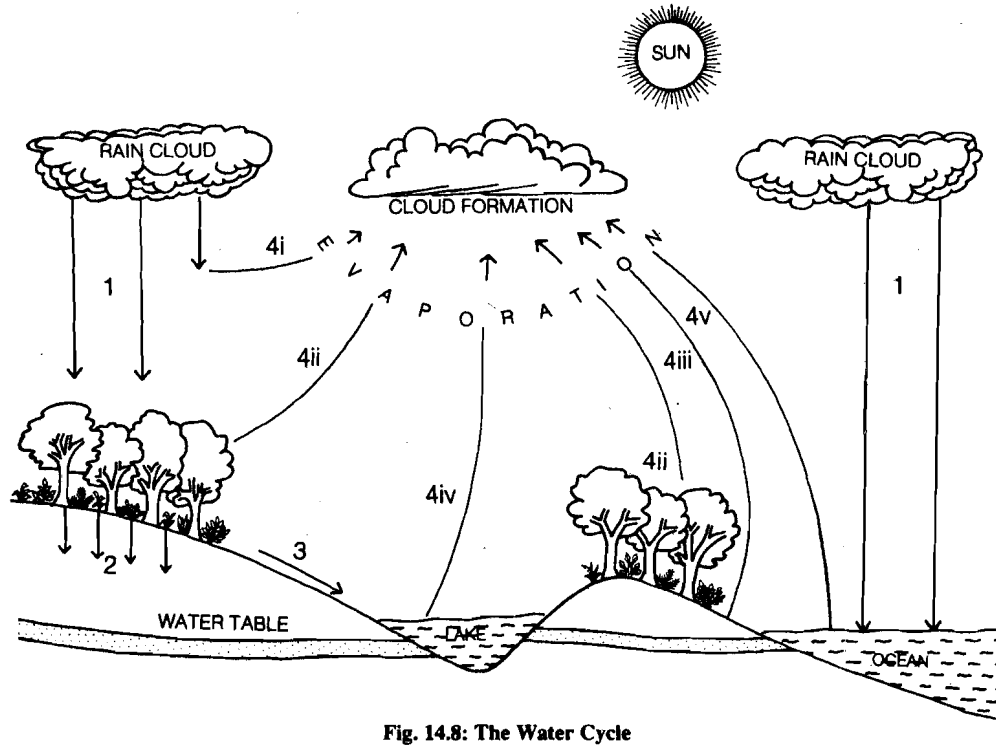


Fig. 14.8: The Water Cycle

1) All water, which is used by mankind for personal and industrial purposes, is plain or fresh water, which is derived largely from the ocean water through evaporation and precipitation.

2) As the precipitation reaches the earth, some of the water falls directly on the ground, some falls on vegetation, on buildings and on streets. A part of the water that falls on the ground, seeps through the soil, to an impervious layer of clay or rock and collects as groundwater. The rate of downward movement of water in soil is dependent on the type of soil, its slope, type of vegetation and the amount of rainfall. The underground water is utilised by human beings for domestic, agricultural or industrial purposes.

3) Some of the water falling on the ground runs down the gutters and drains to be carried off to rivers. Some surface runoff may also collect in small ditches, lakes etc.

4) So far we have been discussing the various ways in which water, in different forms, reaches the earth. Now let us understand as to how water reaches back to the atmosphere.

   i) Some amount of rain water never reaches the ground as it evaporates back into the atmosphere.

   ii) Plants also give out large amounts of water back to the atmosphere through their leaves.

   iii-v) The water remaining on the surface of the ground and on vegetation as well as the water in the surface layers of streams, lakes and oceans evaporates and goes back to the atmosphere.

   As the water vapours in the atmosphere form clouds and drift with wind, they eventually

meet cold air and condense in the same way as moisture from the air in the room condenses outside a glass of iced water.

Intrusion into the Water Cycle

Water management is one of the leading concerns of man today. The natural water cycle has not been able to compensate for the effects of human actions on water resources. The amount of water that is fit for human consumption has decreased over the years and its quality has deteriorated. To a large extent this is due to increased population, higher demands of water for personal use, agriculture and industry.

Foremost in the list of detrimental effects of human activity is deforestation, that is the indiscriminate cutting of trees and the ultimate depletion of the vegetation cover. Extensive use of paper, and of wood for construction and fuel is responsible for this. Deforestation, not only reduces the humidity in the atmosphere but also leads to a chain of other undesirable effects, for instance, the vegetation that helps to hold the soil together, when reduced considerably, is not able to hold the top soil in place. This eventually results in washing away of fertile, top soil during rainfall or by blowing winds, thus exposing harder infertile rocks. Not much water seeps down the hard soil, and the underground water reservoirs are not properly replenished. The loosely bound soil is carried along by water running on its surface, and is ultimately deposited in river beds and dams, thus choking them.

The other human activities that disrupt the water cycle are: concentration of population in big industrial towns; lack of proper sanitary facilities, and disposal of wastes. Domestic and industrial wastes are often released into the water streams, sometimes adversely affecting life in the water.

The antidote of deforestation is afforestation, i.e., plantation of new trees. For this, it is very important to know what kind of plant would be suited for a particular condition. If no attention is paid to this aspect, we may further increase the damage to our environment. *Eucalyptus* is one example in this regard. It is one of the economically important and fast growing trees. It was planted as a soil binder and wind breaker in places where there was need of water conservation. The choice of *Eucalyptus* proved disastrous as this plant is notorious for its high rate of water intake from the soil and subsequent loss to the atmosphere. Many people also call this plant an "ecological monster", as it drains the water table and prevents all other plants from growing underneath. It also makes cultivation on neighbouring lands impossible.

SAQ 7

Fill in the blanks

Water is constantly being redistributed on the earth through the ongoing ..... . It is driven by ...., and includes evaporation and precipitation. The major movement of water is from its main reservoir, the ....., to the ..... and back to ..... and ..... as precipitation.

14.5 INTERACTION IN THE EARTH ECOSYSTEM

In this comparatively smaller section, we will give you the idea, that the earth as a whole is an ecosystem. Whatever you have learnt till now is also applicable to earth on a large scale. Let us see how.

So far you have seen that the interaction of organisms with each other and with their environment is seemingly endless. As we see, the source of all energy is the sun. Solar energy, through photosynthesis, is stored in the food prepared by plants. This energy supports earth's organisms. Sunlight also powers the water cycle, that ensures supply of fresh water and continually regulates warmth and moisture over the globe. Whether it is the life on land or in water, energy captured by photosynthesis flows through the consumers, thus making animal life possible. In a far more subtle interaction, the molecules of all organisms finally reach the decomposer where the last bit of energy is extracted by them. Not only that, the vital elements such as nitrogen, carbon etc. are also freed, to be recycled back to the waiting producers for another turn of the cycle of life. In the ongoing energy flow, each participant releases its quota of unused energy in the form of heat. This energy goes back to the physical world that is the atmosphere. Thus there is an equilibrium between the physical and the biological world in terms of nutrients and energy. This state is also called natural equilibrium, a term we very often come across, when dealing with problems of ecology and environmental protection.

Every individual in modern times, must understand these basics of existence, because he or she may otherwise unknowingly make choices which would provide a set back to these processes and eventually to the life on this planet.

14.6 SUMMARY

In this unit you have studied that:

- In Ecology, we study the relationships between organisms and their environment, and anything that affects an organism during its life cycle constitutes its environment.
- An ecosystem consists of all the organisms living in an area and depending on each other in various ways and also on their environment.
- Every ecosystem requires certain nutrients, a source of energy, producer, and decomposer organisms. Most ecosystems also contain consumer organisms.
- All the organisms in an ecosystem are interrelated through feeding relationships, and they form a food web, a diagram showing what eats what. Energy and nutrients enter the living world together as producers make food. Almost all the energy entering the living world comes from sunlight, trapped during photosynthesis by the green plants. This energy is released and used for various activities by plants, consumers and decomposers. Dead bodies and animal wastes are used as energy sources by decomposers, which release the nutrients in simple forms that plants can use.
- Although the energy flow through an ecosystem is essentially one way, the nutrients may cycle indefinitely.
- Earth as a whole is an ecosystem, where the fundamental principles of existence of life hold as good as for any smaller ecosystem.

14.7 TERMINAL QUESTIONS

1) Tick the box for correct statement. Put a cross for wrong statement.
   a) Ecosystem is considered as an independent unit, and sunlight is usually its only outside energy source. ☐
   b) An ecosystem can continue to exist indefinitely, without any other organisms as long as plants are there to make food. ☐
   c) Energy moves in a cyclic way whereas nutrients move in one way only. ☐
   d) More energy is lost from an ecosystem when a carnivore eats an animal than a herbivore eats a plant. ☐
   e) Agricultural practices in the long-run disturb the natural equilibrium. ☐

2) Answer the following in the space given below:
   a) What are the factors that enabled life to exist on earth?

      .....

      .....

   b) List the nutrients that are required by the living organisms in relatively large amounts?

      .....

      .....

3) Fill in the gaps:
   a) The entry point of energy in an ecosystem is .....
   b) In a food chain, the number of trophic levels are seldom more than four and five, because at each level some of the ..... is lost, and ultimately very little of it is left for the last, fourth or fifth level.
   c) ..... is an example of organisms that occupies more than one trophic level.
   d) ..... is a group of living beings together with their environmental factors with which they interact.
   e) A food web tells us about the ..... relations, and the flow of ..... in an ecosystem.

14.8 ANSWERS

Self Assessment Questions

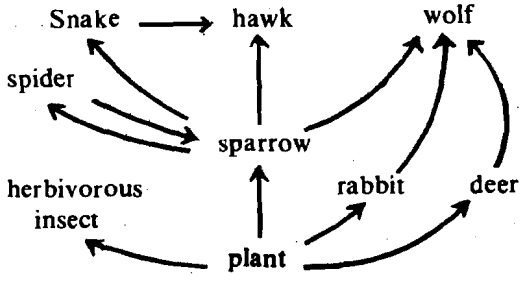
1) a) ecology, environment
   b) environment, organism
   c) biotic, abiotic

2) Left to right
   1 Crane, Carnivore
   2 Wheat, Producer
   3 Jackal, Carnivore
   4 Giraffe, Herbivore
   5 Grasshopper, Herbivore
   6 Crow, Omnivore
   7 Deer, Herbivore
   8 Earthworm, Decomposer
   9 Man, Herbivore or Omnivore

   Top to bottom
   2 Whale, Omnivore
   4 Grass, Producer
   10 Rat, Omnivore
   11 Fungus, Decomposer
   12 Hen, Omnivore
   13 Spider, Carnivore
   14 Pea, Producer
   15 Parrot, Herbivore
   16 Lion, Carnivore

3) a) insect
   b) rat
   c) wheat
   d) snake
   e) rat

4)



5) gas, nitrate, nitrogen-fixing bacteria, pea, beans, denitrifying, dead bodies, decomposers.

6) atmosphere, ocean, photosynthesis, solar energy, respiration, decay, plants, animals.

7) water cycle, solar energy, ocean, atmosphere, land, ocean.

Terminal Questions

1) a) √ b) × c) × d) √ e) √

2) a) Sunlight, air, water, soil, appropriate temperature, and pressure.
   b) Carbon, oxygen, hydrogen, and nitrogen.

3) a) producers b) energy c) man d) ecosystem e) feeding, energy