5

ECOSYSTEM

You know that earth is perhaps the only planet in the solar system that supports life. The portion of the earth which sustains life is called biosphere. Biosphere is very huge and can not be studied as a single entity. It is divided into many distinct functional units called ecosystem. In this lesson you will study about the structure and functions of ecosystem.

OBJECTIVES

After completing this lesson, you will be able to:

- *explain the concept of ecosystem;*
- *recognize the two major components of ecosystem;*
- *describe ecosystem components by giving example of a pond;.*
- *list a few natural and human modified ecosystems;*
- *explain energy flow through food chain;*
- *differentiate between the various trophic levels- producers, consumers and decomposers;*
- *construct a food chain and represents–terrestrial and aquatic ecosystem;*
- *define food web;*
- *define ecological pyramid, pyramid of number, biomass and energy;*
- *explain ecological efficiency;*
- *explain ecosystem growth or evolution of ecosystem;*
- *explain importance of maintaining balanced ecosystem.*

5.1 ECOSYSTEM

In the previous lesson, you learnt that in nature several communities of organisms live together and interact with each other as well as with their physical environment as an ecological unit. We call it an **ecosystem**. The term 'ecosystem' was coined by A.G. Tansley in 1935. An ecosystem is a functional unit of nature encompassing complex interaction between its biotic (living) and abiotic (non-living) components. For example- a pond is a good example of ecosystem.

5.1.1 Components of an ecosystem

Components of ecosystem: They are broadly grouped into:-

(a) Abiotic and (b) Biotic components

Components of Ecosystem

- **Abiotic components**
  - **Physical factors**
    - Temperature
    - Humidity
    - Light
    - Atmospheric pressure
  - **Inorganic substances**
    - Water
    - Oxygen
    - Carbon dioxide
    - Nitrogen
  - **Organic substances**
    - Proteins
    - Carbohydrates
    - Lipids
- **Biotic components**
  - Producers (Green plants)
  - Consumers (Animals)
  - Decomposers (Microorganisms)

(a) Abiotic components (Nonliving): The abiotic component can be grouped into following three categories:-

(i) Physical factors: Sun light, temperature, rainfall, humidity and pressure. They sustain and limit the growth of organisms in an ecosystem.

(ii) Inorganic substances: Carbon dioxide, nitrogen, oxygen, phosphorus, sulphur, water, rock, soil and other minerals.

(iii) Organic compounds: Carbohydrates, proteins, lipids and humic substances. They are the building blocks of living systems and therefore, make a link between the biotic and abiotic components.

(b) Biotic components (Living)

(i) Producers: The green plants manufacture food for the entire ecosystem through the process of photosynthesis. Green plants are called autotrophs, as they absorb water and nutrients from the soil, carbon dioxide from the air, and capture solar energy for this process.

(ii) Consumers: They are called heterotrophs and they consume food synthesized by the autotrophs. Based on food preferences they can be grouped into three broad categories. **Herbivores** (e.g. cow, deer and rabbit etc.) feed directly on plants, **carnivores** are animals which eat other animals (eg. lion, cat, dog etc.) and **omnivores** organisms feeding upon both plants and animals e.g. human, pigs and sparrow.

(iii) **Decomposers:** Also called **saprotrophs.** These are mostly bacteria and fungi that feed on dead decomposed and the dead organic matter of plants and animals by secreting enzymes outside their body on the decaying matter. They play a very important role in recycling of nutrients. They are also called **detrivores or detritus feeders**.

5.1.2 Functions of ecosystem

Ecosystems are complex dynamic system. They perform certain functions. These are:-

(i) Energy flow through food chain

(ii) Nutrient cycling (biogeochemical cycles)

(iii) Ecological succession or ecosystem development

(iv) Homeostasis (or cybernetic) or feedback control mechanisms

Ponds, lakes, meadows, marshlands, grasslands, deserts and forests are examples of natural ecosystem. Many of you have seen an aquarium; a garden or a lawn etc. in your neighbourhood. These are man made ecosystem.

5.1.3 Types of ecosystems

Ecosystems are classified as follows:

(i) Natural ecosystems (ii) Man made ecosystems

(i) Natural ecosystems

(a) Totally dependent on solar radiation e.g. forests, grasslands, oceans, lakes, rivers and deserts. They provide food, fuel, fodder and medicines.

(b) Ecosystems dependent on solar radiation and energy subsidies (alternative sources) such as wind, rain and tides. e.g tropical rain forests, tidal estuaries and coral reefs.

(ii) Man made ecosystems

(a) Dependent on solar energy-e.g. Agricultural fields and aquaculture ponds.

(b) Dependent on fossil fuel e.g. urban and industrial ecosystems.

You will study the details of natural and human made ecosystems in lesson 6 and lesson 7 respectively.

INTEXT QUESTIONS 5.1

1. List the abiotic components of ecosystem.

____

2. List the biotic components of ecosystem.

3. What role do decomposers play in an ecosystem?

4. Mention two examples of (i) natural ecosystem (ii) man made ecosystem.

5.2 POND AS AN EXAMPLE OF AN ECOSYSTEM

A pond is an example of a complete, closed and an independent ecosystem. It is convenient to study its basic structure and functions. It works on solar energy and maintains its biotic community in equilibrium. If you collect a glass full of pond water or a scoop full of pond bottom mud, it consists of a mixture of plants, animals, inorganic and organic materials. Following components are found in a pond ecosystem.

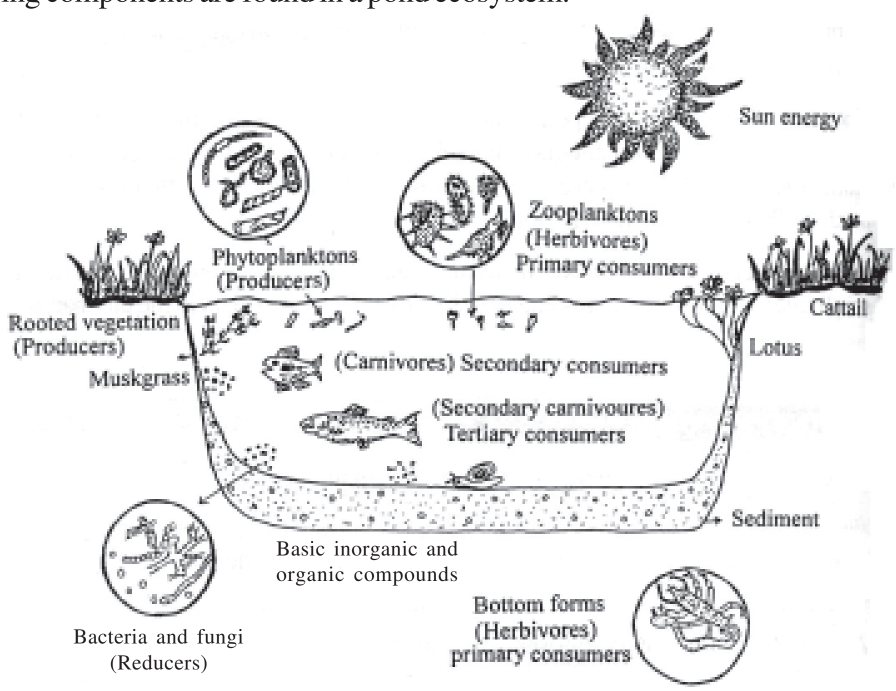


Fig. 5.1: *Pond ecosystem*

(a) Abiotic components

(i) **Light**: Solar radiation provides energy that controls the entire system. Penetration of light depends on transparency of water, amount of dissolved or suspended particles in water and the number of plankton. On the basis of extent of penetration of light a pond can be divided into **euphotic** (eu=true,photic=light), **mesophotic** and **aphotic** zones. Plenty of light is available to plants and animals in euphotic zone. No light is available in the aphotic zone.

(ii) **Inorganic substances**: These are water, carbon, nitrogen, phosphorus, calcium and a few other elements like sulphur depending on the location of the pond. The inorganic substances like O_2 and CO_2 are in dissolved state in water. All plants and animals depend on water for their food and exchange of gases- nitrogen, phosphorus, sulphur and other inorganic salts are held in reserve in bottom sediment and inside the living organisms. A very small fraction may be in the dissolved state.

(iii) **Organic compounds**: The commonly found organic matter in the pond are amino acids and humic acids and the breakdown products of dead animals and plants. They are partly dissolved in water and partly suspended in water.

(b) Biotic components

(i) **Producers or autotrophs:** synthesize food for all the heterotrophs of the pond. They can be categorized into two groups:-

(a) Floating microorganisms and plants

(b) Rooted plants

(a) Floating microorganisms (green) and plants are called **phytoplankton** ("phyto"- plants, "plankton" –floating). They are microscopic organisms. Sometimes they are so abundant in pond that they make it look green in colour e.g. *Spirogyra, Ulothrix, Cladophora,* Diatoms, *Volvox.*

(b) Rooted plants: These are arranged in concentric zones from periphery to the deeper layers. Three distinct zones of aquatic plants can be seen with increasing deapth of water in the following order:

i) **Zone of emergent vegetation:** . eg. *Typha*, Bulrushes and *Sagittaria*

ii) **Zone of rooted vegetation with floating leaves** . eg. *Nymphaea*

iii) **Zone of submergent vegetation:** eg. All pond weeds like *Hydrilla* , *Rupia*, musk grass etc.

(ii) **Consumers/Heterotrophs** are animals which feed directly or indirectly on autotrophs eg. Tadpole, snails, sunfish, bass etc.

Pond animals can be classified into the following groups

(a) **Zooplanktons** are floating animals. Cyclops, Cypris

(b) **Nektons** are the animals that can swim and navigate at will. Eg. fishes

(c) **Benthic animals** are the bottom dwellers: beetle, mites, mollusks and some crustaceans.

(iii) **Decomposers:** They are distributed through out the entire in the whole pond but in the sediment most abundant. There are bacteria and fungi. (*Rhizopus, Penicillium, Curvularia ,Cladosporium)* found at the bottom of the pond.

INTEXT QUESTIONS 5.2

1. What are phytoplanktons?

   ____

2. Where will you search for the decomposers in a pond?

   ____

3. How do nektons differ from zooplanktons?

   ____

4. From where do the fishes living at bottom of the pond get their food?

   ____

5.3 ECOSYSTEM FUNCTION–ENERGY FLOW THROUGH ECOSYSTEM

Food chains and energy flow are the functional properties of ecosystems which make them dynamic. The biotic and abiotic components of an ecosystem are linked through them.

5.3.1 Food Chain

Transfer of food energy from green plants (producers) through a series of organisms with repeated eating and being eaten is called a food chain. e.g.

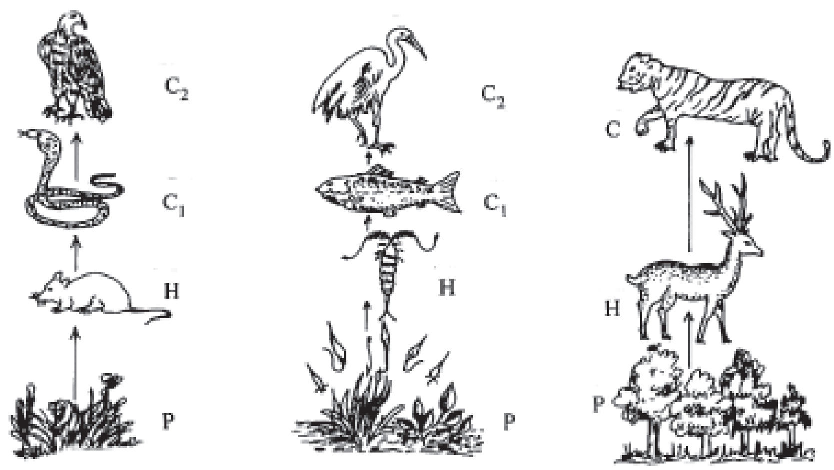
Grasses → Grasshopper → Frog → Snake → Hawk/Eagle

Each step in the food chain is called **trophic level**. In the above example grasses are 1^{st}, and eagle represents the 5^{th} trophic level.

Some more example of food chain are given in fig**.** 5.2.

During this process of transfer of energy some energy is lost into the system as heat energy and is not available to the next trophic level. Therefore, the number of steps are limited in a chain to 4 or 5. Following trophic levels can be identified in a food chain.

(1) **Autotrophs:** They are the producers of food for all other organisms of the ecosystem. They are largely green plants and convert inorganic material in the presence of solar energy by the process of photosynthesis into the chemical energy (food). The total rate at which the radiant energy is stored by the process of photosynthesis in the green plants is called **Gross Primary Production** (GPP). This is also known as total photosynthesis or total assimilation. From the gross primary productivity a part is utilized by the plants for its own metabolism. The remaining amount is stored by the plant as **Net Primary Production** (NPP) which is available to consumers.



P = Producer, H = Herbivore, C = Carnivore, C_1 = First level carnivore, C_2 = Top Carnivore

Fig. 5.2: *Some examples of food chain*

(2) **Herbivores:** The animals which eat the plants directly are called primary consumers or herbivores e.g. insects, birds, rodents and ruminants.

(3) **Carnivores:** They are secondary consumers if they feed on herbivores and tertiary consumers if they use carnivores as their food. e.g. frog, dog, cat and tiger.

(4) **Omnivores:** Animals that eat both plant and animals e.g. pig, bear and man

(5) **Decomposers:** They take care of the dead remains of organisms at each trophic level and help in recycling of the nutrients e.g. bacteria and fungi.

There are two types of food chains:

(i) **Grazing food chains:** which starts from the green plants that make food for herbivores and herbivores in turn for the carnivores.

(ii) **Detritus food chains:** start from the dead organic matter to the detrivore organisms which in turn make food for protozoan to carnivores etc.

In an ecosystem the two chains are interconnected and make y-shaped food chain. These two types of food chains are:-

(i) Producers → Herbivores → Carnivores

(ii) Producers → Detritus Feeders → Carnivores

5.3.2 Food web

Trophic levels in an ecosystem are not linear rather they are interconnected and make a food web. Thus food web is a network interconnected food chains existing in an ecosystem. One animal may be a member of several different food chains. Food webs are more realistic models of energy flow through an ecosystem (Fig. 5.3).

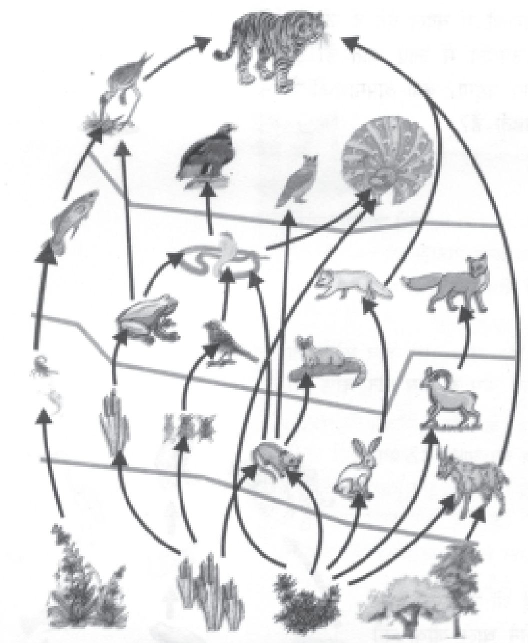


Fig. 5.3: *Simple food web*

The flow of energy in an ecosystem is always linear or one way. The quantity of energy flowing through the successive trophic levels decreases as shown by the reduced sizes of boxes in fig. 5.4. At every step in a food chain or web the energy received by the organism is used to sustain itself and the left over is passed on to the next trophic level.

NU

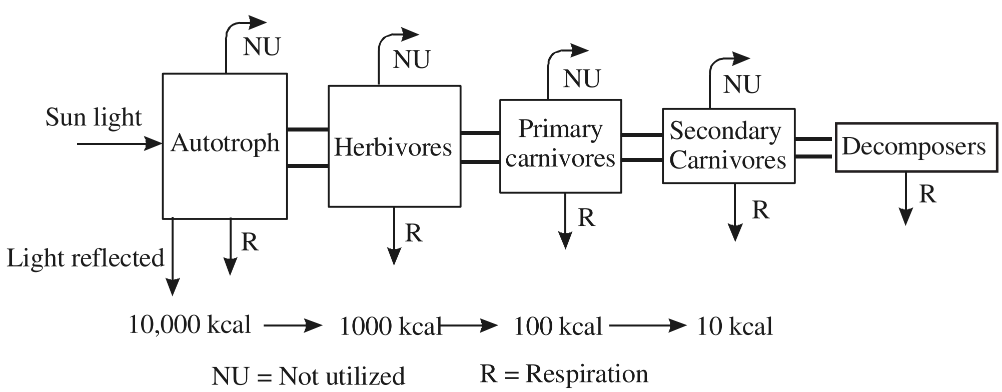


Fig. 5.4: *Model of energy flow through an ecosystem. Boxes indicate the standing crop biomass and pipes indicate the energy flowing. (NU = Not utilized, R = Respiration)*

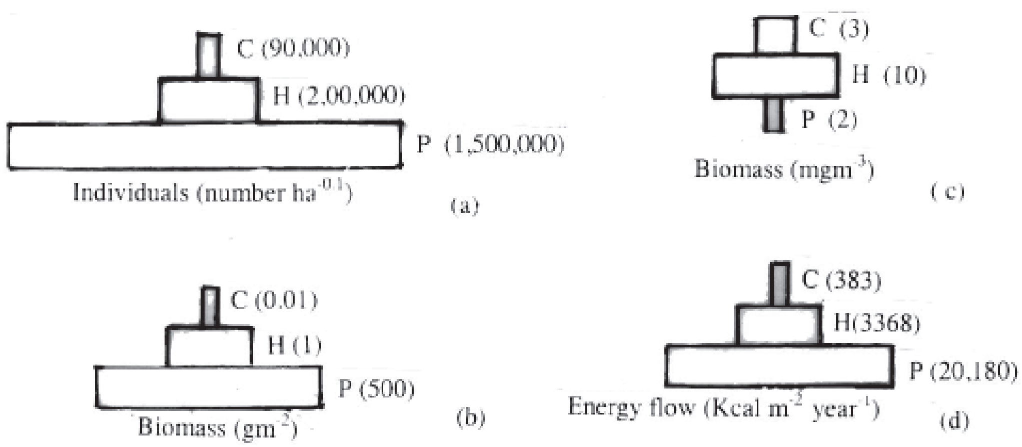
5.3.3 Ecological pyramid

Ecological pyramids are the graphic representations of trophic levels in an ecosystem. They are pyramidal in shape and they are of three types: The producers make the base of the pyramid and the subsequent tiers of the pyramid represent herbivore, carnivore and top carnivore levels.

(1) **Pyramid of number:** This represents the number of organisms at each trophic level. For example in a grassland the number of grasses is more than the number of herbivores that feed on them and the number of herbivores is more than the number of carnivores. In some instances the pyramid of number may be inverted, i.e herbivores are more than primary producers as you may observe that many caterpillars and insects feed on a single tree. (see fig. 5.5a)

(2) **Pyramid of biomass:** This represents the total standing crop biomass at each trophic level. **Standing crop biomass** is the amount of the living matter at any given time. It is expressed as gm/unit area or kilo cal/unit area. In most of the terrestrial ecosystems the pyramid of biomass is upright. However, in case of aquatic ecosystems the pyramid of biomass may be inverted e.g. in a pond phytoplankton are the main producers, they have very short life cycles and a rapid turn over rate (i.e. they are rapidly replaced by new plants). Therefore, their total biomass at any given time is less than the biomass of herbivores supported by them. (see fig. 5.5b)

(3) **Pyramid of energy:** This pyramid represents the total amount of energy at each trophic level. Energy is expressed in terms of rate such as kcal/unit area /unit time or cal/unit area/unit time.eg. in a lake autotroph energy is 20810 kcal/m/year (see fig. 5.5c). Energy pyramids are never inverted.



Pyramid of Number Grassland | Pyramid of biomass grassland | Pyramids of energy forest

***Fig. 5.5:** Ecological pyramids*

Note : P = Producer; C_1 = herbivore; C_1 = Carnivore ; C_2 = Top carnivore

INTEXT QUESTIONS 5.3

1. Draw a simple food chain.

____

2. What is a food web?

3. Give examples of an inverted pyramids

4. Which type of pyramid gives the true picture of trophic structure of an ecosystem?

5.4 ECOLOGICAL EFFICIENCY

It is clear from the trophic structure of an ecosystem that the amount of energy decreases at each subsequent trophic level. This is due to two reasons:

1. At each trophic a part of the available energy is lost in respiration or used up in metabolism.
2. A part of energy is lost at each transformation, i.e. when it moves from lower to higer trophic level as heat.

It is the ratio between the amount of energy acquired from the lower trophic level and the amount of energy transferred from higher trophic level is called **ecological efficiency**. Lindman in 1942 defined these ecological efficiencies for the 1st time and proposed 10% rule e.g. if autotrophs produce 100 cal, herbivores will be able to store 10 cal. and carnivores 1cal. However, there may be slight variations in different ecosystems and ecological efficiencies may range from 5 to 35%. Ecological efficiency (also called Lindman's efficiency) can be represented as

$$\frac{I_t \times 100}{I_t - 1} = \frac{\text{Ingestion at trophic level}_t \times 100}{\text{Ingestion at previous trophic level} - 1}$$

5.4.1 Significance of studying food chains

1. It helps in understanding the feeding relations and interactions among different organisms of an ecosystem.
2. It explain the flow of energy and circulation of materials in ecosystems.
3. It help in understanding the concept of biomagnification in ecosystems.

INTEXT QUESTIONS 5.4

1. What is the 10% rule of energy transfer in a food chain?

2. Give formula of Lindman's efficiency.

3. What is the significance of studying food chains?

5.5 BIOGEOCHEMICAL CYCLES

In ecosystems flow of energy is linear but that of nutrients is cyclical. This is because energy flows down hill i.e. it is utilized or lost as heat as it flows forward The nutrients on the other hand cycle from dead remains of organisms released back into the soil by detrivores which are absorbed again i.e. nutrient absorbed from soil by the root of green plants are passed on to herbivores and then carnivores. The nutrients locked in the dead remains of organisms and released back into the soil by detrivores and decomposers. This recycling of the nutrients is called **biogeochemical or nutrient cycle** (Bio = living, geo = rock chemical = element). There are more than 40 elements required for the various life processes by plants and animals. The entire earth or biosphere is a closed system i.e. nutrients are neither imported nor exported from the biosphere.

There are two important components of a biogeochemical cycle

(1) **Reservoir pool** - atmosphere or rock, which stores large amounts of nutrients.

(2) **Cycling pool or compartments of cycle**-They are relatively short storages of carbon in the form of plants and animals.

You shall now learn about the bio-geo chemical cycles carbon, nitrogen and water.

5.5.1 Carbon cycle

The source of all carbon is carbon dioxide present in the atmosphere. It is highly soluble in water; therefore, oceans also contain large quantities of dissolved carbon dioxide.

The global carbon cycle consists of following steps-

- **Photosynthesis**

Green plants in the presence of sunlight utilize CO_2 in the process of photosynthesis and convert the inorganic carbon into organic matter (food) and release oxygen. A part of the food made through photosynthesis is used by plants for their own metabolism and the rest is stored as their biomass which is available to various herbivores, heterotrophs, including human beings and microorganisms as food. Annually 4-9 x10^{13} kg of CO_2 is fixed by green plants of the entire biosphere. Forests acts as reservoirs of CO_2 as carbon fixed by the trees remain stored in them for long due to their long life cycles. A very large amount of CO_2 is released through forest fires.

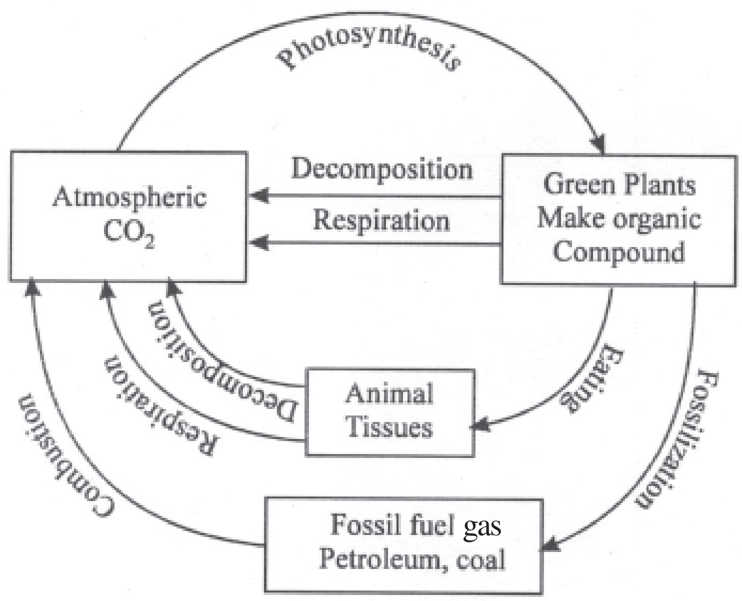


Fig. 5.6: Carbon cycle

- **Respiration**

Respiration is carried out by all living organisms. It is a metabolic process where food is oxidized to liberate energy, CO_2 and water. The energy released from respiration is used for carrying out life processes by living organism (plants, animals, decomposers etc.). Thus CO_2 is released into of the atmosphere through this process.

- **Decomposition**

All the food assimilated by animals or synthesized by plant is not metabolized by them completely. A major part is retained by them as their own biomass which becomes available to decomposers on their death. The dead organic matter is decomposed by microorganisms and CO_2 is released into the atmosphere by decomposers.

- **Combustion**

Burning of biomass releases carbon dioxide into the atmosphere.

- **Impact of human activities**

The global carbon cycle has been increasingly disturbed by human activities particularly since the beginning of industrial era. Large scale deforestation and ever growing consumption of fossil fuels by growing numbers of industries, power plants and automobiles are primarily responsible for increasing emission of carbon dioxide.

Carbon dioxide has been continuously increasing in the atmosphere due to human activities such as industrialization, urbanization and increasing use and number of automobiles. This is leading to increase concentration of CO_2 in the atmosphere, which is a major cause of global warming.

5.5.2 Nitrogen cycle

Nitrogen is an essential component of protein and required by all living organisms including human beings.

Our atmosphere contains nearly 79% of nitrogen but it can not be used directly by the majority of living organisms. Broadly like corbondioxide, nitrogen also cycles from gaseous phase to solid phase then back to gaseous phase through the activity of a wide variety of organisms. Cycling of nitrogen is vitally important for all living organisms. There are five main processes which essential for nitrogen cycle are elaborated below.

(a) **Nitrogen fixation:** This process involves conversion of gaseous nitrogen into Ammonia, a form in which it can be used by plants. Atmospheric nitrogen can be fixed by the following three methods:-

(i) **Atmospheric fixation**: Lightening, combustion and volcanic activity help in the fixation of nitrogen.

(ii) **Industrial fixation**: At high temperature (400^{o}C) and high pressure (200 atm.), molecular nitrogen is broken into atomic nitrogen which then combines with hydrogen to form ammonia.

(iii) **Bacterial fixation**: There are two types of bacteria-

(i) Symbiotic bacteria e.g. Rhizobium in the root nodules of leguminous plants.

(ii) Freeliving or symbiotic e.g. 1. *Nostoc* 2. *Azobacter* 3. Cyanobacteria can combine atmospheric or dissolved nitrogen with hydrogen to form ammonia.

(b) **Nitrification:** It is a process by which ammonia is converted into nitrates or nitrites by *Nitrosomonas* and *Nitrococcus* bacteria respectively. Another soil bacteria *Nitrobacter* can covert nitrate into nitrite.

(c) **Assimilation:** In this process nitrogen fixed by plants is converted into organic molecules such as proteins, DNA, RNA etc. These molecules make the plant and animal tissue.

(d) **Ammonification** : Living organisms produce nitrogenous waste products such as urea and uric acid. These waste products as well as dead remains of organisms are converted back into inorganic ammonia by the bacteria This process is called ammonification. Ammonifying bacteria help in this process.

(e) **Denitrification:** Conversion of nitrates back into gaseous nitrogen is called denitrification. Denitrifying bacteria live deep in soil near the water table as they like to live in oxygen free medium. Denitrification is reverse of nitrogen fixation.

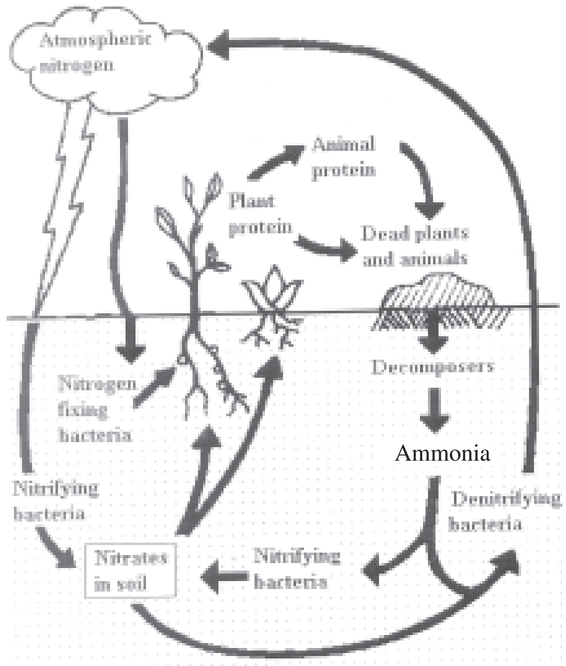


Fig. 5.7: *Nitrogen Cycle*

5.5.3 Water Cycle

Water is essential for life. No organism can survive without water. Precipitation (rain, snow, slush dew etc.) is the only source of water on the earth. Water received from the atmosphere on the earth returns back to the atmosphere as water vapour resulting from direct evaporation and through evapotranspiration the continuous movement of water in the biosphere is called water cycle (hydrological cycle). You have already studied that earth is a watery planet of the solar system, about 2/3rd of earth surface is covered with water. However a very small fraction of this is available to animals and plants.

Water is not evenly distributed throughout the surface of the earth. Almost 95 % of the total water on the earth is chemically bound to rocks and does not cycle. Out of the remaining 5%, nearly 97.3% is in the oceans and 2.1% exists as polar ice caps. Thus only 0.6% is present as fresh water in the form of atmospheric water vapours, ground and soil water.

The driving forces for water cycle are 1) solar radiation 2) gravity .

Evaporation and precipitation are two main processes involved in water cycle. These two processes alternate with each other

Water from oceans, lakes, ponds, rivers and streams evaporates by sun's heat energy. Plants also transpire huge amounts of water. Water remains in the vapour state in air and forms clouds which drift with wind. Clouds meet with the cold air in the mountainous regions above the forests and condense to form rain precipitate which comes down due to gravity.

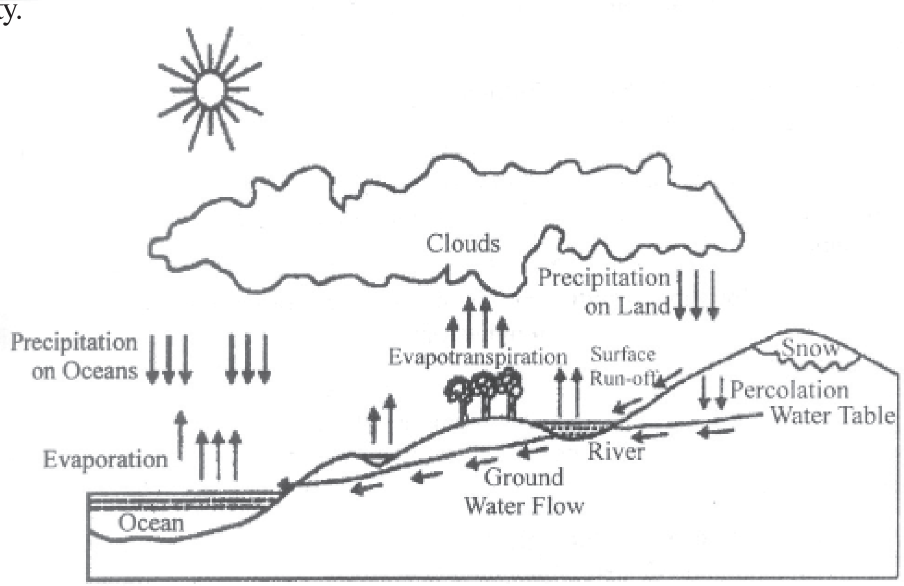


Fig. 5.8: Water Cycle

On an average 84% of the water is lost from the surface of the through oceans by evaporation. While 77% is gained by it from precipitation. Water run off from lands through rivers to oceans makes up 7% which balances the evaporation deficit of the ocean. On land, evaporation is 16% and precipitation is 23%.

5.7 HOMEOSTASIS OF ECOSYSTEM

Ecosystems are capable of maintaining their state of equilibrium. They can regulate their own species structure and functional processes. This capacity of ecosystem of self regulation is known as **homeostasis**. In ecology the term applies to the tendency for a biological systems to resist changes. For example, in a pond ecosystem if the population of zooplankton increased, they would consume large number of the phytoplankton and as a result soon zooplankton would be short supply of food for them. As the number zooplankton is reduced because of starvation, phytoplankton population start increasing. After some time the population size of zooplankton also increases and this process continues at all the trophic levels of the food chain.

Note that in a homeostatic system, negative feed back mechanism is responsible for maintaining stability in a ecosystem.

However, homeostatic capacity of ecosystems is not unlimited as well as not everything in an ecosystem is always well regulated. You will learn about the scope and limitations homeostatic mechanisms when you gain more knowledge about ecosystems. Humans are the greatest source of disturbance to ecosystems.

Large number of phytoplankton

↓

Increase population of zooplankton due to excess food available

↓

Reduction in phytoplankton

↓

Population of zooplanktons decrease
due to starvation

↓

Population of phytoplankton starts increasing due to less consumption

Fig. 5.9: *Homeostasis in ecosystem*

INTEXT QUESTIONS 5.5

1. What is a sedimentary cycle?

   ____

2. Give an example of gaseous cycle.

   ____

3. Why do forest acts as reservoir?

   ____

4. Name a symbiotic nitrogen fixing bacteria.

   ____

5. What is precipitation?

   ____

WHAT YOU HAVE LEARNT

- An ecosystem is a functionally independent unit of abiotic and biotic components of the biosphere.
- Climatic regime, inorganic substances, organic compounds, producers, macroconsumers and microconsumers are of structural components of the ecosystem.
- Functional processes an ecosystem are energy flow, food chains, nutrient cycles, ecosystem development and homeostasis.
- All the abiotic factors such as light, temperature, pressure, humidity, salinity, topography and various nutrients limit the growth and distribution of animals and plants.

- All the living organisms of an ecosystem are interdependent through food chains and food webs. Removal of any single species of the community causes ecological imbalance.
- Source of energy for all the ecosystems is solar radiations which is absorbed by autotrophs and passed on to the consumers in the form of food (organic substances). Energy flow is always down hill and unidirectional.
- Gross primary productivity (GPP) is the total amount of solar energy captured and stored in the form of organic substances by the green plants. Net primary productivity is the amount of organic substances left in the plant after its own metabolism i.e. GPP = NPP + plant respiration.
- Trophic relationships of the organisms in an ecosystem can be represented graphically in the form of ecological pyramids the base of the pyramid represents the producers and successive tiers represent subsequent higher levels.
- The nutrients move from the nonliving to the living and back to the nonliving component of the ecosystem in a more or less circular manner. These nutrient cycles are known as biogeochemical cycles.
- The main components of all the biogeochemical cycles are:-
  a) the reservoir pool that contains the major bulk of the nutrients soil or atmosphere.
  b) cycling pool which are the living organisms (producers, consumers and decomposers), soil, water and air in which it stays temporarily.

TERMINAL EXERCISE

1. Define the following terms.
   (i) Autotrophs
   (ii) Heterotrophs
   (iii) Primary carnivores
   (iv) Saprotophs
   (v) Omnivores
2. Give reasons whether the following statements are true or false.
   (i) Food chains are more stable than food webs.
   (ii) Pyramids of energy are never inverted where as pyramid of biomass may be inverted.

(iii) A detritus food chain begins with autotrophs.

(iv) Phytoplankton is the term applied to floating organisms in a pond.

(v) Aphotic is the upper zone of a pond.

3. Give reasons for the following statements:

   (i) We see more wall lizards near the tube light during summer.

   (ii) Energy pyramids are never inverted.

   (iii) We can not directly use atmospheric nitrogen.

   (iv) There is higher concentration of cabon dioxide in the aphotic zone.

   (v) Food chains have a limited number of steps

4. What is an ecosystem? Explain its structural components.

5. Define decomposers and give their role in sustaining an ecosystem.

6. Why are ecosystems dynamic in nature? Give the various functional components of an ecosystem.

7. What is an ecological pyramid? Define and differentiate between different pyramid of energy and pyramid of numbers.

8. List the various steps of nitrogen cycle in a sequence.

9. The following organisms were identified in a pond ecosystem-*Spirogyra*, *Euglena, Hydra, Daphnia*, arthropod larvae, bass and sunfish. Make a food web and identify the trophic level of each one of them.

ACTIVITIES

1) Visit a pond near your house and make the following observations:

   (a) note the colour of water

   (b) transparency (tie a white stone to a thread ,insert it into pond and measure the depth upto which you can see it)

   (c) check its pH with litmus paper

   (d) count the number of different types of plants in it (looking at the shape of the leaves)

   (e) Take a small amount of pond water in a petri dish and observe it under the binocular for different phytoplanktons and zooplanktons.

   Make sketches of these organisms that you observed.

2) Observe a park in your locality before and after the rains for one month and record your observations (count the number of different plant, insects, birds and rodents).

3) Collect a bowl full of mud from an open space near your house during rainy season and observe different types of worms in it. bernetic or homeostasis

ANSWER TO INTEXT QUESTIONS

5.1

1. Physical, inorganic and organic substance.
2. Producer, consumer and decomposers.
3. They help in decomposing dead organic material and dead plants and animals therefore they are important for recycling of nutrients.
4. (i) Pond, lake, forests, ocean (any two)
   (ii) Agriculture, aquaculture

5.2

1. Microscopic floating vegetation in an aquatic ecosystem.
2. At the bottom of pond.
3. Zooplanktons are free floating and whereas nektons can aquatic animal can surim and narrgate.
4. Bentic animals like bettle, mites, mollusks and Crustrceans formed are by these fission.

5.3

1. Grass $\rightarrow$ rat $\rightarrow$ snake $\rightarrow$ eagle $\rightarrow$ forest $\rightarrow$ deer $\rightarrow$ tiger
2. Food web – Inter connected food chains of an area form a food web.
3. Pyramid of number in case of a tree or in a pond.
4. Pyramid of energy.

5.4

1. 10% rule is i.e. related to ecological efficiency and states that the amount of energy transferred at each tropic level is only 10% of the energy of the previous tropic level.
2. $\dfrac{\text{Ingestion at tropic level t}}{\text{Ingestion at previous level}} \times 100$
3. Biomagnifications is the concentration of non-degradable pollutants in the successive tropic level in a food chain.

5.5

1. Sedimentary cycle It is a type of biogeochemical cycle where the main reservoir is lithosphere.
2. Nitrogen (N_2) and carbon
3. Forests trees have long life and therefore the carbon fixed by them cycles very slowly.
4. *Rhizobium*
5. Condensation of water vapours to form clouds.