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29

NATURAL ENVIRONMENT

The environment means everything that surrounds us—our house, garden, town, shops, hills, rivers, ocean, the air, soil, sunlight etc. and also the plants and animals around us.

All living and non-living things that occur naturally on earth constitute the **natural environment.** We also know that all living organisms are dependent on the environment for their survival. Their life is regulated by the environment and in turn they influence the environment. Thus, the environment with all its components is a vibrant and intricate entity. We need to think twice before doing anything that would disturb the delicate balance between the environment and its various components. But how do we know what affect our activities have on the environment? In order to nurture our environment we need to understand its various components and their relationship.

(Graphic to show natural environment)

OBJECTIVES

After completing this lesson, the learner will be able to:

- *define ecosystem and give examples of interdependence of aquatic and terrestrial ecosystems;*
- *establish relationship between biotic and abiotic component of an ecosystem;*
- *explain the interdependence of autotrophs, heterotrophs and saprophytes in a biotic community;*
- *explain the importance of food chain, food web, different trophic levels and energy flow in an ecosystem;*
- *highlight the importance of cycling of minerals citing the example of carbon, nitrogen and water and the role played by humans in maintaining the cycles;*
- *recognise the various services provided by the ecosystem;*
- *justify the role of adaptation in the living world;*
- *correlate the benefits of cooperation in the various types of association such as mutualism, commensalism and symbiosis.*
- *identify the factors which lead to population growth.*

29.1 ECOSYSTEM AND ITS COMPONENTS

Living organisms draw their nutrition and oxygen for survival from the environment. In the process, plants and animals interact with each other and also their physical environment. Thus, an ecosystem may be defined as **"a biological environment consisting of all organisms living in a particular area, as well as the non-living physical components of the environment with which the organisms interact".**

A.G.Tansley in 1935 put forward the concept of ecosystem. The word ecosystem is derived from the greek word "**oikos** meaning **home** and **systema** meaning **system".**

An ecosystem can either be natural or human-designed. How are these two different from each other?

All ecosystems that exist in nature are **Natural ecosystem**. They can either be terrestrial or aquatic. Grasslands and deserts constitute the terrestrial ecosystem while rivers, ponds and oceans form the aquatic ecosystem. On the other hand, **man-made or human designed ecosystem** is an artificial ecosystem e.g. gardens, aquarium, crop fields etc.

29.2 COMPONENTS OF AN ECOSYSTEM AND THEIR RELATIONSHIP

Both, non-living and living things constitute an ecosystem. Accordingly they are termed as abiotic and biotic components.

- **Abiotic:** Abiotic components are the non-living physical and chemical factors in the environment of an ecosystem.
- **Biotic:** Biotic components are the organisms which include plants, animals and micro-organisms in an ecosystem.

Table 29.1 Components of the ecosystem

Abiotic Components	Biotic Components
Sunlight	Primary producers
Temperature	Herbivores
Precipitation	Carnivores
Water or moisture	Omnivores
Soil	Detritivores etc.
Air etc.	

All of these components vary over space and time. You must have observed that plants of coastal regions, hilly areas and deserts are distinctly different from each other. Do you know why? It is because each one has different abiotic components like temperature, soil and moisture. Thus, we see that the abiotic components affect the various organisms in the environment.

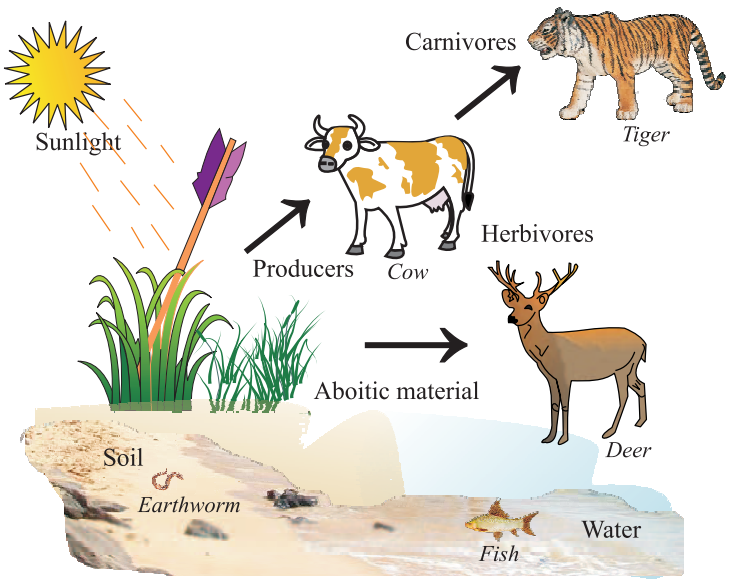


Fig. 29.1 Components of an ecosystem.

ACTIVITY 29.1

List the biotic and abiotic components shown in figure 29.1

S. No.	BIOTIC	ABIOTIC

If you have five biotic and three abiotic components correct, then your score is excellent

Four biotic and three abiotic components correct, then it is good

Anything below this, you need to revise.

These environmental factors-"biotic" and "abiotic" are important in all the ecosystems. Can you now think how all living beings are totally dependent on the abiotic components of the environment? Yes, you are right. The green plants manufacture their food with the help of sunlight, CO_2 and chlorophyll (the green pigment present in the leaves of the plants). The herbivores and carnivores including humans are dependent on the food produced by the plants. Plants, animals and other organisms release back carbon dioxide, oxygen, water and other nutrients into the environment. This not only enriches the soil but also replenishes the atmosphere. You will read about this in the subsequent section. Thus, we can say that we all eat a bit of sunlight every day.

29.3 BIOTIC COMMUNITY

Biotic community refers to populations of various kinds of organisms living together and sharing the same habitat. An ecosystem houses several biotic communities which interact with each other. For example, one can observe populations of different kinds of birds, insects and many other animals on a tree, living in the same environment, mutually sustaining and interdependent. This assembly of different organisms constitutes a biotic community. Depending on the mode of nutrition, members of a biotic community are categorised into **autotrophs, heterotrophs** and **saprotrophs.**

Autotrophs (Gr. Auto- self; trophos-feeder): You know that all plants (except for a few parasitic plants) can manufacture their own food by the process of photosynthesis, but do you know that there are certain organisms that do not utilize sunlight yet can manufacture their food by the process of chemosynthesis. Certain

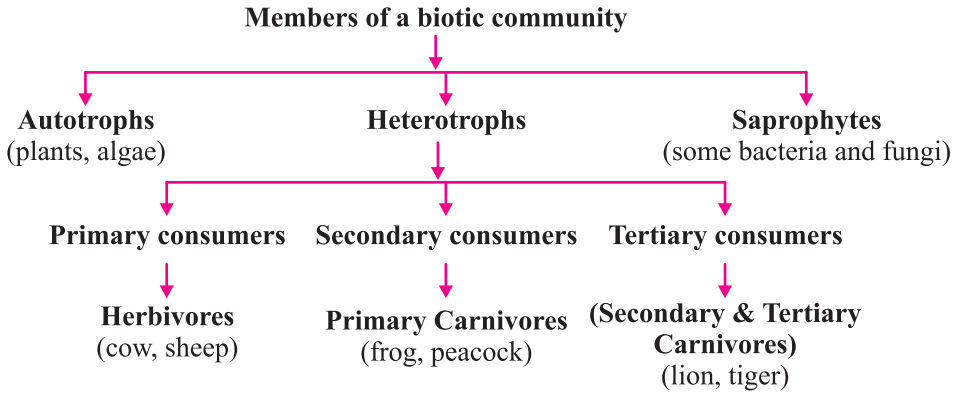
bacteria belong to this category. Since the plants provide food to all the animals directly or indirectly they are also called **producers.**

Autotrophs form the basis of any biotic system as they trap solar energy to manufacture food for all.

In terrestrial ecosystems, the autotrophs are mainly the rooted plants while in aquatic ecosystem, floating plants called phytoplankton and shallow water rooted plants called macrophytes are the examples of autotrophs.

Heterotrophs (Gr: heteros - other; trophs - feeder) are called **consumers** which feed on plants and animals. Consumers include **herbivores** (that eat plant material) and **carnivores** (which eat other animals).

Saprotrophs (Gr: sapros - rotten; trophos - feeder) also called decomposers feed on dead and decaying matter. They break down the complex organic compounds of dead plants and animals into simpler forms and return them back into the environment. **Decomposers form an important link between the living and non-living component of the ecosystem**. Some bacteria and fungi belong to this category.



You can name many more examples of primary consumers, secondary consumers and tertiary consumers. List some of them in the space provided.

Pond is a good example of an ecosystem to understand the concept of abiotic and biotic components and their relationship. A pond has three different layers: top, middle and bottom. All the three layers differ greatly from each other in terms of temperature, light conditions, oxygen content and other factors that affect the lives of the biotic components living in it. If you have taken a dip in a pond then you must have experienced that the temperature of the water at the top is different from its deeper layers.

Fig. 29.2 shows the biotic and abiotic components of an ecosystem. Water, dissolved oxygen, carbon dioxide, minerals, soil and stones are the abiotic components. A natural pond also has thousands of different species of plants and animals living together. Some are microscopic, that is, these are too small to be seen with the naked eye while some others are macroscopic. These constitute the biotic component. Greater the number of species present in the pond, the stronger and healthier it is. Here, living things are born, they live, breathe, feed, excrete, move, grow, reproduce, become food for others and die within the pond.

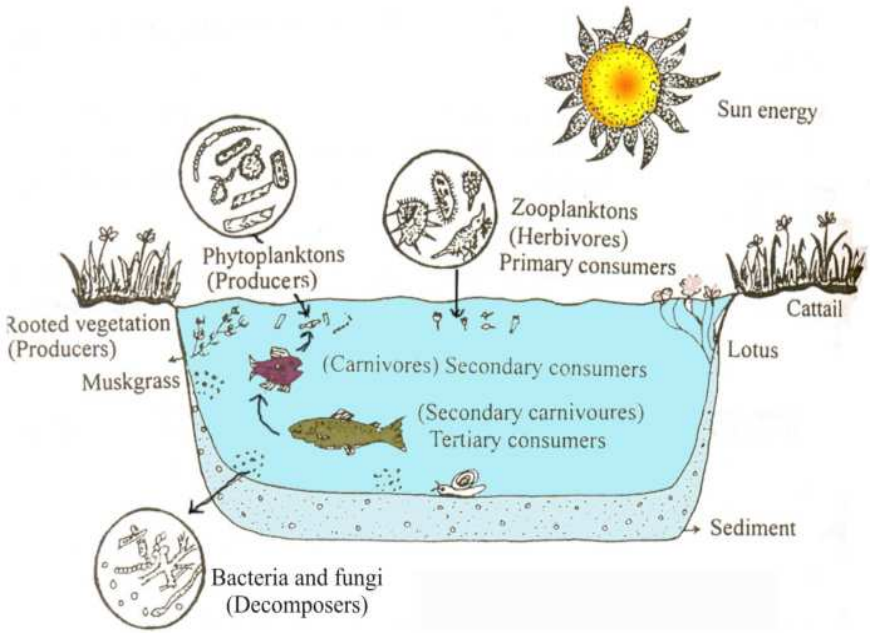


Fig. 29.2 The pond ecosystem showing the biotic and abiotic components

29.4 FOOD CHAIN AND FOOD WEB

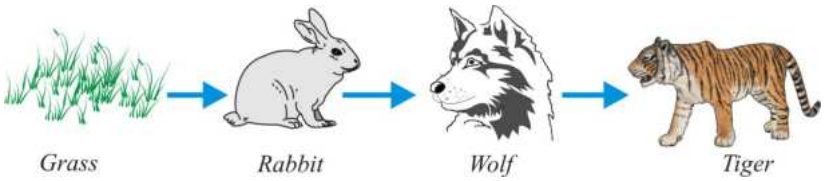
Observe figure 29.2. You can make out that organisms form a chain of 'eating' and 'being eaten'. In the fig. you can see that small fish is feeding on phytoplanktons which in turn is being eaten by a bigger fish. This constitutes the food chain. A simple food chain basically consists of producers, herbivores and carnivores. Just like the pond, a simple food chain in a terrestrial ecosystem links the trees and shrubs (producers), the giraffes (herbivores that eat trees and shrubs) and the lions (carnivores that eat the herbivores). Each link in this chain is food for the next level and is said to be at a particular trophic level (trophos means feeding). In the example, trees and shrubs are the producers and occupy trophic level I, giraffe comes at trophic level II, while lion occupies the third trophic level. As food provides energy, food chain may be defined as "**succession of organisms in an ecological community that constitutes a passing on of food energy from one organism to another as each consumes a lower member and in turn is preyed upon by a higher member of the food chain.**"

Different types of food chain can exist in an ecosystem. The examples given below will help you to understand the various food chains.

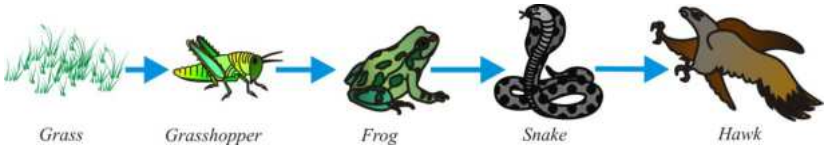
1. **Grazing food chain is** found both in aquatic as well as grassland ecosystem**.** It is the most common food chain found in the terrestrial ecosystem.

   - Food chain in a terrestrial ecosystem:

   i.

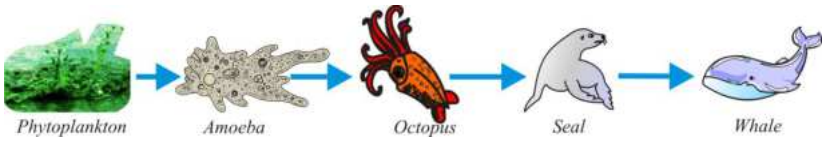


   ii.

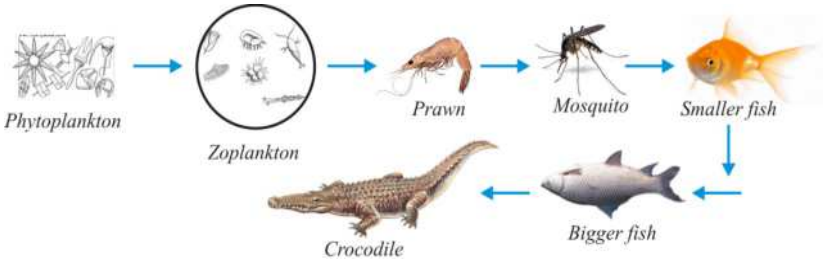


   - Food chain in an aquatic ecosystem:

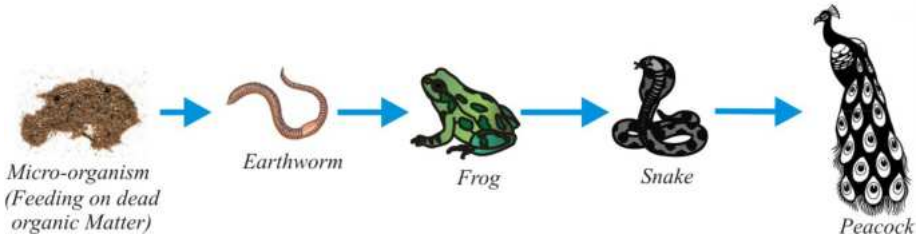
   i.



   ii.



2. **Detritus food chain:** This type of food chain starts from dead organic matter. The dead organic matter is broken down into simple nutrients by micro-organisms like fungi and bacteria. These simple nutrients and decomposers are then consumed by smaller carnivores which in turn become food for larger carnivores.



A similar detritus food chain also exist in an aquatic ecosystem

However, most animals form a part of more than one food chain and eat more than one kind of food in order to meet their food and energy requirements. These interconnected food chains form a **food web**. (figure 29.3)

Fig. 29.3 A food web

Significance of food chain and food web:

1. They help to maintain ecological balance.
2. They help in understanding the feeding relations among organisms.
3. Energy flow and nutrient cycle takes place through them.

ACTIVITY 29.2

- Go for a walk in a nearby park or field or riverside or sea beach.
- Note down the various abiotic and biotic factors.
- On a chart paper make a collage of these biotic and abiotic factors. You can draw and paste pictures of these. With the help of arrows you can show how the biotic factors are dependent on the abiotic factors.
- Mention the food chain that you have observed yourself. Which trophic level of the food chain you represent? Do you represent more than one? You can draw the food web in the space provided.

29.4. ENERGY FLOW IN AN ECOSYSTEM

We know that food provides energy and thus in a food chain, energy is passed from one link to another. This energy flow is unidirectional i.e. the energy which is transferred from one trophic level to the next does not come back (figure 29.4). When a herbivore eats, only a fraction of the energy (that it gets from the plant food) becomes new body mass; the rest of the energy is lost as heat or is used up by the herbivore to carry out its life processes (e.g., movement, digestion, respiration, reproduction). Therefore, when the herbivore is eaten by a carnivore, only a small amount of total energy is received by the carnivore. Of the energy transferred from the herbivore to the carnivore, some energy will be lost as heat or "used up" by the carnivore. The carnivore then has to eat many herbivores to get enough energy to grow. Because of the large amount of energy that is lost at each link, the amount of energy that is transferred gets lesser and lesser as we go up the food chain (figure 29.5).

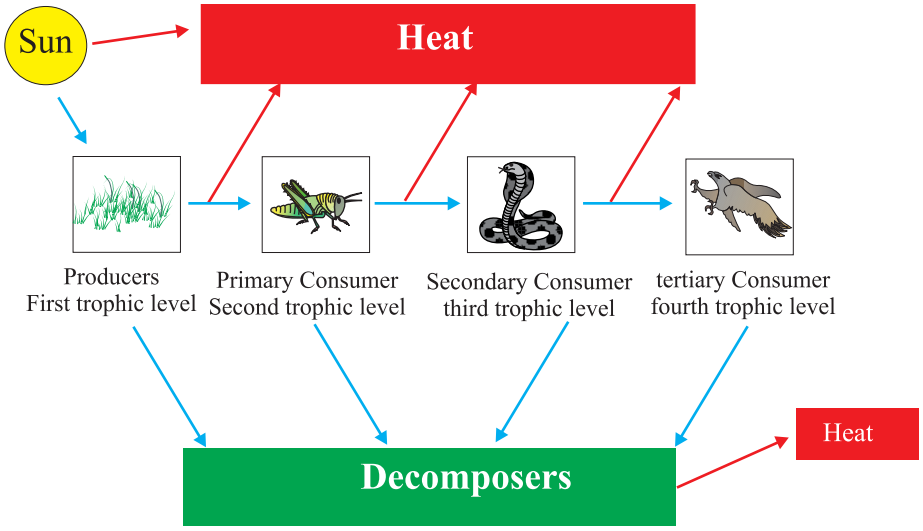


Fig. 29.4 Energy Flow

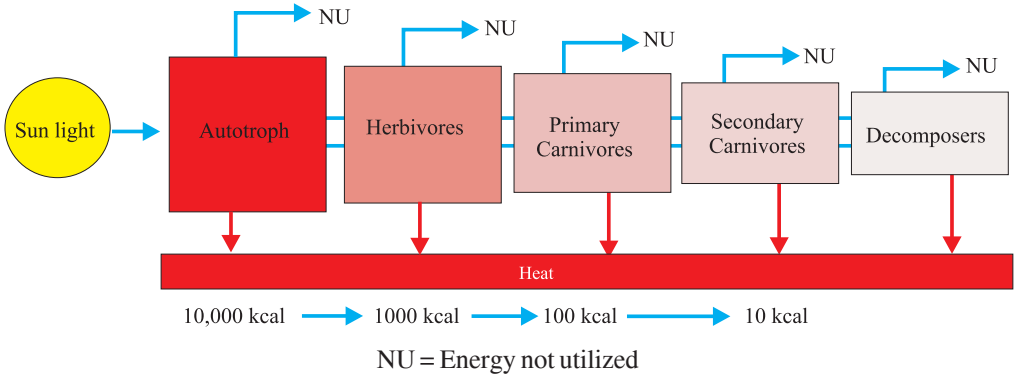


Fig. 29.5 Energy Flow at different trophic levels in an ecosystem. Boxes indicate the standing crop biomass and pipes (=) indicate the energy flowing

ACTIVITY 29.3

From the fig. 29.3, name a herbivore, collectively name the animals that are at trophic level 1, and mention the animal that gets the least energy.

INTEXT QUESTIONS 29.1

1. Sunlight forms the abiotic component of ecosystem, name one biotic component.

2. Why are plants called producers? Which trophic level do they occupy in an ecosystem?

3. Give one reason in support of the statement that "food web is a jumble of food chains".

4. Construct one food chain and one food web from the following :

   Tiger, grains, vulture, frog, snake, grass, cat, sheep, peacock, wolf, rabbit, phytoplankton, small fish, rat, large fish.

29.6 BIOGEOCHEMICAL OR NUTRIENT CYCLES

There is a constant need of nutrients by the biotic community for their survival and they take these from the environment. Nutrients in the form of oxygen, carbon dioxide, nitrogen, phosphorus, sulphur or water exists in a definite amount in the environment. The amount of these nutrients however varies in different parts of an ecosystem at a given time. But these elements are never lost and nature has its own method of replenishing them in a cyclic manner. The movement of these nutrients in a cyclic manner in the environment constitutes the biogeochemical cycles. Thus, a "**biogeochemical cycle is the cycle in which nitrogen, carbon, and other inorganic elements of the soil, atmosphere, etc. of a region are converted into the organic substances of animals or plants and released back into the environment."**

It is a cyclic pathway by which a chemical element or molecule moves through the environment unlike energy flow which is unidirectional.

Let us now study a few of the biogeochemical cycles.

A. Carbon cycle

The carbon cycle is the biogeochemical cycle by which carbon is exchanged between soil, water and atmosphere (air) of the earth. It is the most important cycle of the earth and allows for carbon to be recycled by all of its organisms (figure 29.6).

It justifies the saying "what goes around comes around"

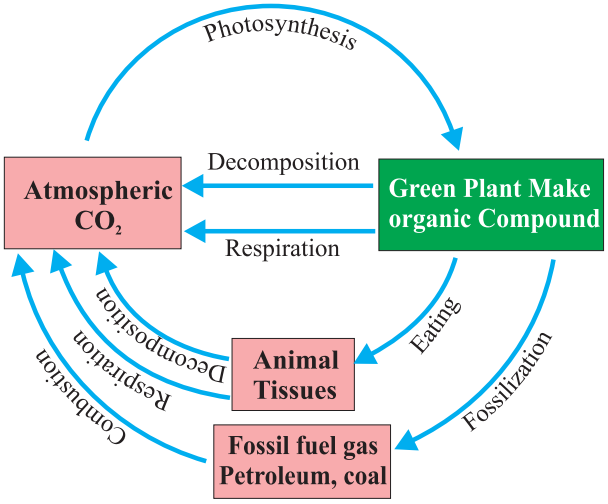


Fig. 29.6 Carbon Cycle

After studying the carbon cycle, can you think of any two ways by which human activities have been interfering with nature's carbon cycle. Write them down in the space provided below.

_____

_____

B. Nitrogen cycle

What is nitrogen cycle

Nitrogen cycle is the biogeochemical cycle that describes the transformation of nitrogen and nitrogen-containing compounds in nature. Atmospheric nitrogen is the biggest source of nitrogen. Green plants absorb nitrogen in the form of nitrates and nitrites from the soil and water. Animals get nitrogen when they feed upon plants. Nitrogen is an essential component of proteins and nucleic acids in living organisms (figure 29.7).

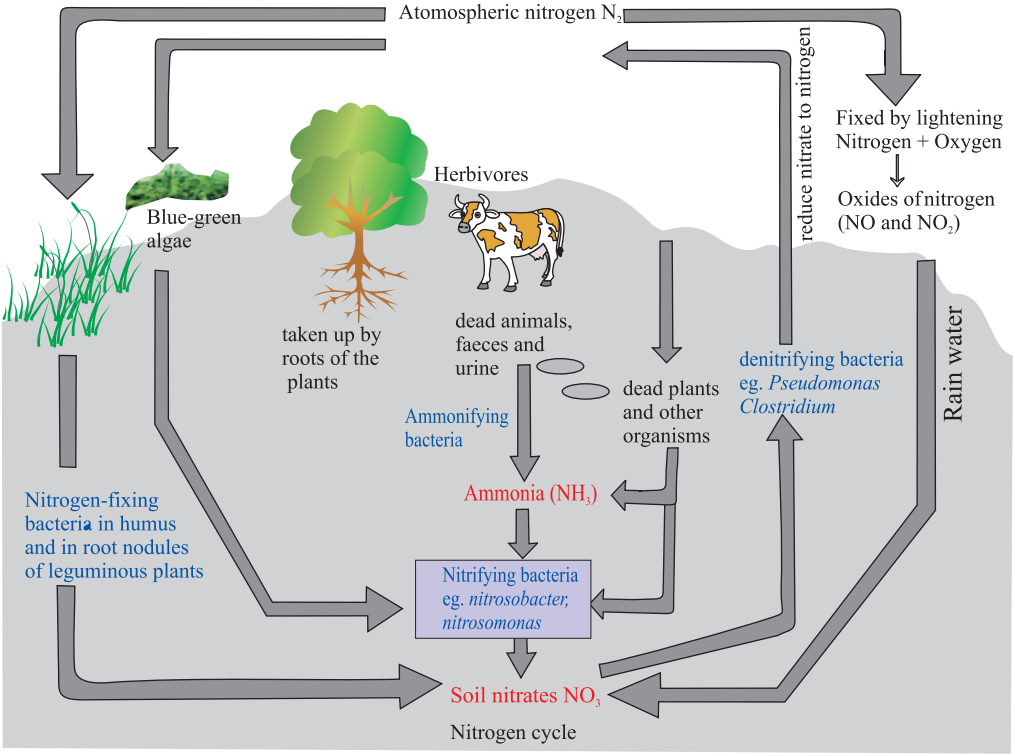


Fig. 29.7 Nitrogen Cycle

The nitrogen cycle can be studied in five steps:

i. **Nitrogen fixation**: As we can see in the figure. above, nitrogen can be fixed in two ways:

   a. Lightening during cloud formation: Nitrogen and oxygen combine with each other to form oxides of nitrogen in the atmosphere by lightening. These nitrogen oxides then dissolve in rain water and on reaching the earth's surface becomes a part of the soil and water.

   b. Free living micro-organisms present in the soil and by the symbiotic bacteria in the root nodules of certain leguminous plants: Microbes like the blue green algae and bacteria fix the atmospheric nitrogen into nitrites and nitrates. These nitrogenous compounds are then released into the soil.

ii. **Nitrogen assimilation**: Plants absorb nitrogen in the form of nitrates to prepare amino acids. This nitrogen is then taken up by the animals in the form of proteins through the food chain.

iii. **Ammonification:** The proteins in the body of the animals are broken down into simpler form like urea and ammonia. These are then removed from the body along with urine and excreta. Dead plants and animals also return nitrogen to the soil as ammonium compounds. These ammonium compounds are then converted to ammonia by ammonifying bacteria.

iv. **Nitrification**: Conversion of ammonia into nitrates is called nitrification. Nitrifying bacteria like *Nitrosobacter* and *Nitrosomonas* found in the soil convert ammonia into nitrate. Some other bacteria present in the soil convert ammonia into nitrites. Some of this nitrates and nitrites are again taken up by the plants for their nutrition

Nitrifying bacteria (*Nitrosobacter*, *Nitrosomonas*) ⟶ Convert ammonia to nitrate

v. **Denitrification:** Denitrifying bacteria like *Pseudomonas* and *Clostridium* living in the soil reduce the soil nitrites and nitrates into nitrogen which is returned back into the atmosphere.

Denitrifying bacteria (*Pseudomonas*, *Clostridium*) ⟶ Reduce nitrates and nitrites to nitrogen

Now can you think of some ways by which nature and human activities are adding nitrogen into the atmosphere? Write at least two of these in the space provided below

C. Water cycle

You all know that water is very essential for all living organisms but the earth has a limited amount of water. The water keeps going from one component of an ecosystem to another component in a cyclic manner which is called the water cycle (figure 29.8).

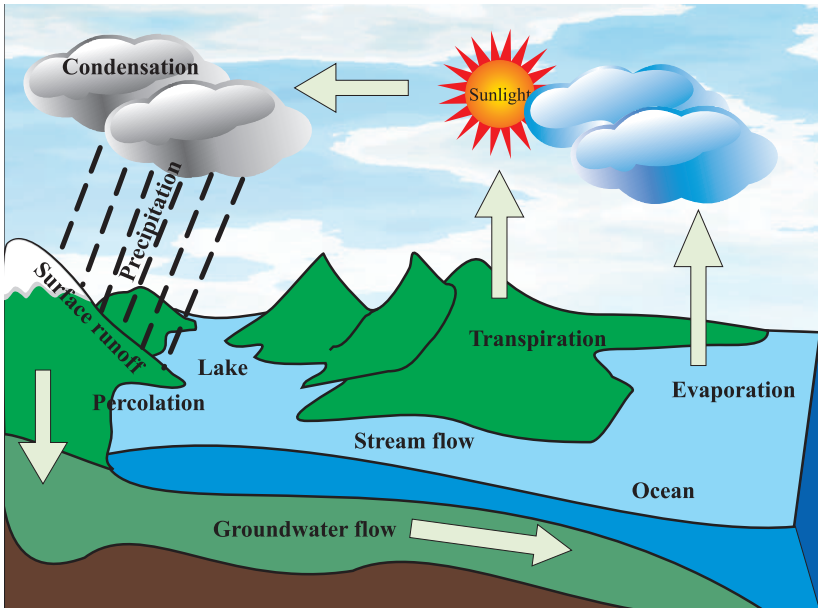


Fig. 29.8 Water Cycle

INTEXT QUESTIONS 29.2

1. Name any two ways which are responsible for adding carbon dioxide in the atmosphere.

2. Name the bacteria which live in the roots of the leguminous plants and are responsible for nitrogen fixation.

3. What is the process of conversion of free atmospheric nitrogen into nitrites and nitrates called?

4. What is the role played by denitrifying bacteria and nitrifying bacteria in the nitrogen cycle? Give the name of one denitrifying bacteria and one for nitrifying bacteria.

5. Mention any one role that you play in the (i) nitrogen cycle and (ii) carbon cycle.

6. Nitrogen is an essential component of the proteins and nucleic acids in living beings. Mention any one way by which you obtain nitrogen for your growth.

7. Mention one way in which increasing deforestation by humans is influencing the carbon cycle.

29.7 ECOSYSTEM SERVICES

Have you ever given a thought how the ecosystems are valuable to us? We gain benefit from some of the resources of our natural ecosystem free of cost e.g.

We take in oxygen (plants take in carbon dioxide) from the environment. The forests, rivers and oceans control the climate. There is also a natural check on the pests by the predators and parasites thus keeping the diseases under control.

Can you live without taking food or water? No!! Where do you get them from? Right!!! Plants and algae trap solar energy for photosynthesis and produce food for all organisms. Water, minerals, biomass fuels, wood (for fuel and for constructing houses) required for our daily needs are all provided by the

environment. Think of many more services that are provided by our environment and list them below

Ecosystem Services
1.
2.
3.
4.
5.

Although our environment provides us with so many valuable resources free of cost, the need of the hour is to appreciate its value and judiciously utilize the services so that we can leave them for our future generation.

29.8 ADAPTATIONS IN ORGANISMS

We walk with our legs, birds fly with their wings while whales swim with flippers. Why are the limbs different in them? You will say, we walk on land, birds soar in air and whales live and move in water. You are right. The limbs are adapted to the environment in which the they live. **Adaptations are special features that allow a plant or animal to live in a particular place or habitat.** Can you tell how the frog is adapted to jump on land and swim in water? Limbs help them to jump and web helps in swimming. The living things adapt themselves so that they can:

- successfully compete for food
- defend themselves from attack by other organisms
- find favourable conditions to reproduce
- respond efficiently to the change in environment.

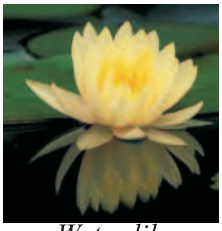
29.8.1 Aquatic adaptations in plants:

Aquatic plants are called **hydrophytes** (hydro: water; phyte: plant). For a life in water:

- Hydrophytes have reduced root system as water is easily available.
- Floating leaves have stomata only on their upper surface while the submerged ones have no stomata at all.
- The leaves are thin and narrow for example *Hydrilla*, or long, flat, ribbon shaped for example *Vallisneria*. These adaptations protect the plant body from any damage due to water currents.

- The stem may be long, slender and spongy, to prevent them from getting carried away by water current e.g. lotus
- Flat leaves on surface plants are for floatation. The broad upper surface is coated with wax which acts as water repellant, for example lotus, water lily.
- Examples: water lily, *Hydrilla*, V*allisneria, Pistia,* water hyacinth *(Eichhornia).*


Lotus


Water lily


Vallisneria


Hydrilla

***Fig. 29.9** Some Aquatic Plants*

ACTIVITY 29.4

Identify any one adaptive feature in each of these aquatic plants

Aquatic plant	Adaptive feature
	_____
	_____
	_____
	_____

29.8.2 Aquatic adaptations in animals:

The animals that live in water show the following characteristics:

1. Streamlined body (pointed at both ends) that reduces friction when the animal moves through the water.
2. Smooth, almost hairless body helps aquatic mammals move through the water with little friction.
3. Webbed feet in ducks, (formed from thin skin between the toes), work like paddles for swimming.
4. Flattened tail that serve as oar.
5. Fins of fish help to swim, steer and maintain balance. A whale has flippers for swimming.
6. Long legs and necks in cranes keep the bodies of wading birds out of the water. The long neck helps the birds to reach the water, or below it, for food.
7. Blubber of whale, a thick layer of fat or oil stored between the skin and muscles of the body, provides insulation.
8. Eyes are positioned on top of the head which allows animals to hide in water and still detect predators or prey above the water.
9. Transparent eyelids cover the eyes water of animals swimming underwater.
10. Nostrils positioned near the top of the head allow animals to come to the surface to breathe in air. Nostrils close when the animal goes under the water e.g. whales, dolphines.
11. Some fish have swim bladder which is filled with air to help maintain buoyancy.
12. Fish and aquatic invertebrates like prawns have gills for respiration.

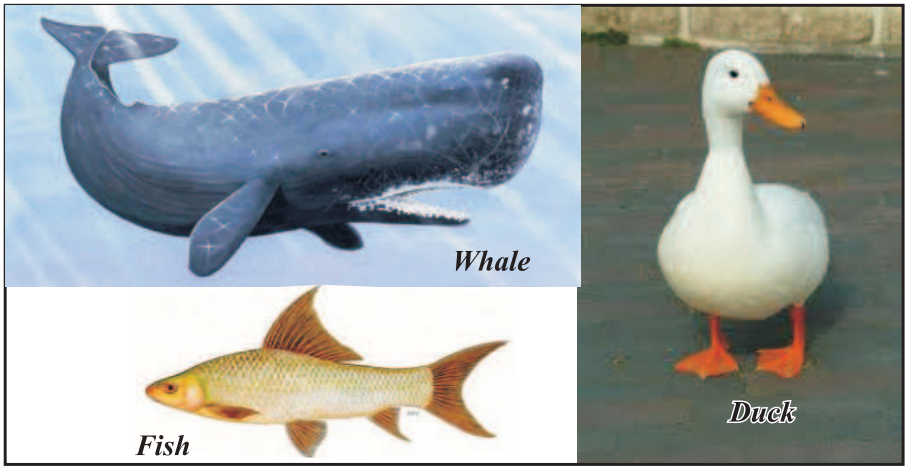


Fig. 29.10 Aquatic Animals

29.8.3 Terrestrial adaptations in plants:

Terrestrial plants include mesophytes (meso =moderate) and xerophytes (xero =scarce water).

Mesophytic adaptations:

Mesophytes are terrestrial plants which are adapted to neither a particularly dry nor particularly wet environment. Mesophytes include the majority of terrestrial plants which have the following adaptations:

- Mesophytes generally require a continuous water supply and have large, thin and broad leaves with a large number of stomata on the undersides of leaves.
- The roots of mesophytes are well developed, branched and provided with a root cap.
- The shoot system is well organised.

Fig. 29.11 Mesophytes

Xerophytic adaptations :

Xerophytes are desert plants, well adapted to high temperature and water shortages. They are adapted to store and conserve water**.** The adaptations that xerophytes may exhibit are:

- Succulent leaves and stems to store water e.g. cacti. Succulent: soft,fleshy, water storing structures.
- They have few or no leaves which reduce transpiration.
- Many desert trees and shrubs have thorns for protection from enemies.
- Fewer stomata to reduce water loss.
- Deep widespread root system caters to maximum water uptake.

Fig. 29.12 Some Xerophytes (Cacti, Casuarina etc.)

29.8.4 Adaptations in desert animals:

- Most of the desert animals avoid being out in the sun during the day. Many desert mammals, reptiles, and amphibians live in burrows to escape the

intense desert heat. They come out during the night when the temperatures are low.

- Due to constant exposure to high temperatures, desert animals need to maintain their body temperatures at an optimum level for which some of them have developed long body parts that provide greater body surface to dissipate heat.
- These animals have scaly skin, resistant to drying.
- Camels have a hump to store fat.
- A camel can drink very large amounts of water in one day or survive for a relatively long time without drinking any water. They can excrete concentrated urine when there is water scarcities and thus reduce loss of water.
- Desert animals like reptiles have minimised loss of water by excreting urine in the form of insoluble uric acid. This ensures very little wastage of water.

Fig. 29.13 Desert Animal (Camel)

9.7.5 Adaptations to survive in extreme cold and scarcity of water

- The animals which live in cold climates have very thick fur over the body to trap air and insulate it.
- They also have a layer of stored fat under the skin to give additional insulation.
- The body shape and size of many cold climate mammals is well adapted to the cold climate. They are round and bulky with short legs, ears and tail. These adaptations help to conserve heat.
- Penguins have a thick layer of densely packed feathers to reduce heat loss. Its flippers and legs are also adapted to reduce heat loss.

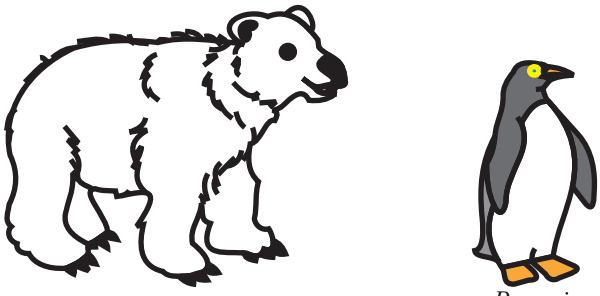


Fig. 29.14 Polar bear and penguin

29.7.6 Aerial adaptations in animals:

Aerial animals include a small number of animals that are able to fly in air. These animals come to the trees or land or water for safety or shelter. These are called **arboreal animals (which dwell on trees).** They may walk or run on land or glide in air for a short while to land on the tree or ground. Flying squirrel, flying lizard, tree frogs, lemurs and monkeys belong to this group. True aerial animals are birds and bats. These animals exhibit adaptations to balance themselves and stay in air, soaring or flying. These adaptations include:

- **Streamlined body** to steer through the air.
- **Wings** - Forelimbs are modified into wings to help them to fly.
- Birds have wings that are covered with **feathers** which trap air to keep the body warm and help the bird to fly. Bats have an extension of the skin between fingers of forelimb which help them to fly.
- **Bones**- Bones are hollow to make them light.
- **Flight muscles** - Very strong flight muscles are attached from the body to the wings.

Fig.29.15 Bat

ACTIVITY 29.5

- Visit a nearby pond or a lake and observe the various plants that you can see. Try to find their common and scientific names.
- Make a list of :
  1. Plants that were floating on the surface of the water
  2. Remain on the surface but had roots or stem in water
- Now study the adaptations that help them to float or remain on the surface of water.

	Name of the plant	Special features
1	(i) _____	(ii) _____
2	(i) _____	(ii) _____

INTEXT QUESTIONS 29.3

1. Why are leaves of water lily coated with wax on the upper surface?

_____

2. Name two tree dwellers.

3. Enumerate the adaptations of birds that enable them to fly so easily (Any two).

4. How are penguins able to survive in the extreme cold conditions?(Any two adaptations)

5. Why do the desert plants have fewer stomata?

6. Humans are not adapted for aquatic life. List any two challenges that you would face when you go for swimming in a pond/lake and the ways by which you would overcome them and become an effective swimmer.

29.9 POPULATION INTERACTION

You have learnt that all living organisms are interdependent, otherwise it would be difficult to live together in a population.

What is population?

Population is a group of similar individuals living in a particular geographical area. Populations of different species of organisms live in the same ecosystem. When organisms encounter one another in their habitats, they can influence each other in a number of ways. Some interactions are harmful to one or both of the organisms. Others are beneficial.

Such relationships can be characterised into different types depending on the interaction and the extent to which they associate.

1. Mutualism: Mutualism in an interaction between individuals belonging to two different species, that benefit both members. Lichen is a complete entity formed by the association of an alga and a fungus. The main body of the lichen is formed by fungus. The alga manufactures food for itself as well as for the fungus, while the fungus provides water, minerals and shelter to the alga.

2. Commensalism: Commensalism is an interspecific interaction where one species benefits and the other is unaffected (neither harmed nor benefitted). Commensal relationships may involve one organism using another for transportation or for housing. For example, hermit crab lives in gastropod shell to

protect their body. Sucker fish attaches itself to the under surface of shark and gets a free ride. It is thus protected from its predators and is also widely dispersed in this way.

3. Parasitism: It includes one organism living in or on the body of another living organism from which it derives nourishment and in the process harms its host. For example: tapeworm living in the intestine of man.

4. Symbiosis: A close interaction between two or more different organisms of different species living in close physical association. You are quite familiar with pollination of flowers where the flowering plants are cross pollinated by the bees which benefit by getting nectar from the plants. Plants pollinated in this manner produce less pollen than do plants that rely on the wind to transfer pollen. This is an example of symbiotic association.

This is the term that relates to parasitism, commensalism and mutualism. Literally the word symbiosis means living together. More important for us to understand is that emphasis is on the interactions that involve a close relationship between two kind of organisms.

INTEXT QUESTIONS 29.4

1. How is the sucker fish benefitted by attaching itself to the shark's body? What type of association is it?

   _____

2. If alga provides food to the fungus that lives on it, what does the fungus do for the alga?

   _____

29.10 POPULATION GROWTH

Population is an aggregate of individuals belonging to the same species.

Population of any species does not remain static. It undergoes changes. Now the question arises as to why does the population keeps changing? Let us try to find an answer to this question.

Population growth is the change in the number of individuals of any species in a population at a given time. The size of the population depends upon the density, natality (birth rate), mortality (death rate), population dispersal, age distribution, and environmental resistance that the population has to face.

29.10.1 Population growth:

The provisions for life in a geographical area where a population lives is limited. Only certain number of organisms can live comfortably in the area. When this number gets exceeded it is termed as "population growth".

Growth rate of a population is the difference between the birth rate and the death rate. When the birth rate is more than the death rate, then the population density increases.

Birth rate or natality: It is defined as the number of live births per thousand per unit time.

Mortality rate: The mortality rate of a population is the number of individuals dying per thousand per unit time.

29.10.2 Population dispersal

It is the movement of individuals or groups of living organisms by which they expand the space or range within which they live. Dispersal operates when organisms leave the space that they have previously occupied, or in which they were born and settle in new areas. It affects the size of the population. Population dispersal can be of two types:

1. **Emigration:** It is the permanent outward movement of the organisms from a given population. It decreases the size of the local population.

2. **Immigration:** It is the permanent inward movement of the organisms from outside into a given population. It increases the size of the local population.

29.10.3 Environmental resistance

It is the resistance presented by the environmental conditions to prevent the species from reproducing at maximum rate and thus limiting a species from growing out of control. Environmental resistance includes both abiotic factors like temperature, space etc. and biotic factors like natural enemies. Environment keeps a check on the rise in the population size.

The physical and biological factors that together prevent a species from reproducing at its maximum rate is called environmental resistance.

Carrying Capacity: It is the maximum population that the environment can sustain indefinitely.

29.10.4 Growth curves:

The growth of a population can be expressed in the form of a mathematical expression called the growth curve. If the number of organisms is plotted against

time, we get a curve which is called the **population growth curve.** Population growth curve has a characteristic shape.

There are two forms of growth curves, namely, **J-shaped growth curve** and **S-shaped or sigmoidal growth curve.**

29.10.5 S-shaped growth curve:

When a small number of organisms first enter a previously unoccupied area, the growth is slow at first as it adapts to new conditions and establishes itself. Reproduction in these organisms takes place after a certain period of time. This is called the **lag phase**. During this phase, both natality and mortality remain small and relatively constant. Gradually, the growth becomes rapid and the population increases rapidly. Now, the natality rate increases while the mortality remains low. This is called **growth phase.** The rapid rise in population is because of the availability of plenty of food and also because there is no competition between the biotic potential and the natural resources. But the number of organisms cannot continue to increase at a faster and faster rate because eventually something in the environment will become limiting and cause an increase in the number of deaths. For animals, food, water or resting sites may be in short supply, or predators or disease may kill many individuals. Plants may lack water, soil nutrients or sunlight. Eventually, the number of individuals entering the population will become equal to the number of individuals leaving it by death or migration and the population size becomes stable. This part of the population growth curve is called **stable phase** where the natality rate and mortality rate are approximately equal. The graph so obtained is S-shaped and is called the **sigmoid curve**.

29.10.6 J-shaped growth curve:

The J-shaped growth curve describes a situation in which the population growth continues in an exponential form until the environmental resistance becomes effective. As the environmental resistance becomes effective, there is a stiff competition for survival and the growth rate stops abruptly. There is a sudden increase in mortality (population crash).

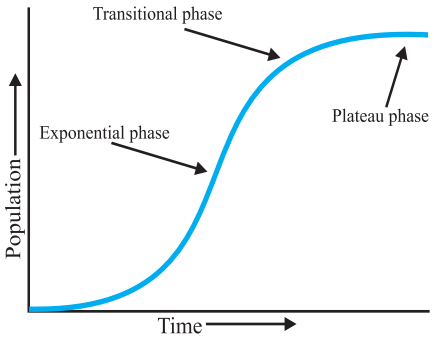


Fig. 29.16 S-shaped curve

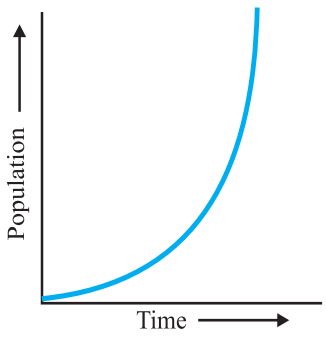


Fig. 29.17 J-shaped curve

INTEXT QUESTIONS 29.5

1. When does the population density increase?

_____

2. What is the difference between Emigration and Immigration?

_____

3. What is lag phase?

_____

WHAT YOU HAVE LEARNT

- An ecosystem is a functionally independent unit of biotic and abiotic components of an ecosystem.
- Physical and chemical factors, plants, animals and micro-organisms are the structural component of an ecosystem.
- Biotic community is the living together and sharing of the same habitat by different organisms which are classified as autotrophs, heterotrophs and saprophytes on the basis of their mode of nutrition.
- All the living organisms are interdependent through food chains and food webs. An ecological imbalance is caused if any single species of the community is removed.
- Source of energy for all the ecosystems is solar radiation which is absorbed by autotrophs and passed on to the consumers in the form of food (organic substances).
- The energy flow in an ecosystem is unidirectional and the amount of energy that is transferred from one trophic level to another gets lesser and lesser as we go farther along the food chain.
- The nutrients move from the non-living to the living and back to the non-living component of the ecosystem in a more or less circular manner. These nutrient cycles are known as biogeochemical cycles.
- Biosphere, geosphere, hydrosphere, and atmosphere are the main components of the biogeochemical cycles.
- Adaptations are special features that allow a plant or an animal to live in a particular habitat.

- Population of different species of organisms have evolved certain features that help them to live together in close association.
- On the basis of the interaction and the extent to which the organisms associate with each other, the association can be called as mutualism, commensalism or symbiosis.
- Population does not remain static.
- Population growth is the change in the number of individuals of any species in a population at a given time.
- Size of the population depends upon the natality, mortality, immigration and emigration.
- Environmental resistance prevents a species from reproducing at its maximum rate.
- Population growth curves are either J-shaped or S-shaped.

TERMINAL EXERCISES

1. What is an ecosystem? Name the various components of an ecosystem.
2. Is detritus a biotic component or is it an abiotic component of an ecosystem?
3. What is the function of *Nitrosomonas* in nitrogen cycle?
4. With the help of suitable examples differentiate between the detritus and grazing food chain.
5. What is the significance of food chain and food web?
6. Why does the energy decrease as we go along the food chain from producers to tertiary consumers?
7. What will happen if all the animals are removed from a pond?
8. Why is the number of trophic level restricted to four or five in a food chain?
9. What is the difference between energy flow and biogeochemical cycle in an ecosystem?
10. How are camels able to survive in extreme heat?
11. Why do polar bear have thick fur over their body?
12. Compare the S-shaped pattern of population growth with the J-shaped pattern of population growth.

13. What is population dispersal? What are the two types of population dispersal?

14. What is the main cause of population explosion?

15. Do you think population remains static? Support your answer with suitable explanation.

16. Try to complete the table given below

	Feature	How is the feature advantageous to the organism?	Name of the plant/animal if is found
1.	Nostrils positioned near the top of the head of animals		
2.		To store water	Cacti
3.	Loss of water by excreting uric acid in water		
4.	Hollow bone		Birds
5.		Trap air to keep the body warm and help the bird to fly	Birds
6.	Presence of flippers and legs		
7.	Thin, bread leaves with a large number of stomata on the underside of leaves		
8.		Acts as a water repellent and allows them to remain afloat on the surface of water	Water lily

17. Extensive poaching and hunting has reduced the tiger population in Asia to a dangerous level.
    (a) What are they hunted for (2 points)
    (b) Draw a food web with tiger as the top level carnivore (At least 2 food chain to be shown)
    (c) What effect will removal of the tiger have on (i) the herbivore (ii) producer?
    (You can answer this question by making a food chain)

ANSWER TO INTEXT QUESTIONS

29.1

1. Plants, animals and microorganisms (any one).

2. They produce the food for all the animals either directly or indirectly; first trophic level
3. Animals eat more than one kind of food in order to meet their food and energy requirements
4. Refer to text

29.2

1. Factories, vehicles, burning wood, living organisms (respiration) (any two)
2. *Rhizobium*
3. Ammonification
4. Denitrifying bacteria reduces nitrate to nitrogen.
   - Nitrifying bacteria converts ammonia to nitrate.
   - Example: denitrifying bacteria – *Pseudomonas, Clostridium* (any one)
   - Nitrifying bacteria *Nitrosobactor, Nitrosomonas*
5. (i) Release/excrete N_2 as nitrogen compounds in the urine/excreta) (ii) Release CO_2 to the atmosphere
6. As food/as vegetables/meat (Any other)
7. Lead to increase in the level of atmospheric carbon dioxide

29.3

1. Wax acts as a water repellent.
2. Flying squirrel/flying lizard/ tree frogs/lemurs/monkeys (any two)
3. Streamlined body, hollow bones, strong flight muscles, wings covered with feathers, forelimbs modified into wings.
4. Presence of thick layer of densely packed feathers, flippers and legs are adapted to reduce heat loss.
5. To reduce water loss.
6. Challenges: Keeping afloat, breathing, eyes getting affected (Any two)

   How to overcome: Try to move hands and feet so as to swim/keep the nose above water to breathe air; wear water mask (any two)

29.4

1. It is protected from its predators; can be widely dispersed. Commensalism

2. Fungus provides water, shelter and minerals to the alga.

29.5

1. When birth rate is more than the death rate.
2. Emigration

   (i) It is the permanent outward movement of the organisms from a given population.

   (ii) Decrease the size of the population.

   Immigration

   (i) It is the permanent inward movement of the organisms from outside into a given population.

   (ii) Increases the size of the local population.
3. When the individuals enter a previously unoccupied area, the growth is slow at first as it adapts to the new conditions and establishes itself.