



Chapter – 13

Organisms and Populations

NCERT Back Exercises :

Ques 1: How is diapause different from hibernation?

Ans 1: Diapause is a stage of suspended development to cope with unfavourable conditions. Many species of Zooplankton and insects exhibit diapause to tide over adverse climatic conditions during their development.

Hibernation or winter sleep is a resting stage where in animals escape winters (cold) by hiding themselves in their shelters. They escape the winter season by entering a state of inactivity by slowing their metabolism. The phenomenon of hibernation is exhibited by bats, squirrels, and other rodents.

Ques 2: If a marine fish is placed in a fresh water aquarium, will the fish be able to survive? Why or why not?

Ans 2: If a marine fish is placed in a fresh water aquarium, then its chances of survival will diminish. This is because their bodies are adapted to high salt concentrations of the marine environment. In fresh water conditions, they are unable to regulate the water entering their body (through osmosis). Water enters their body due to the hypotonic environment outside. This results in the swelling up of the body, eventually leading to the death of the marine fish.

Ques 3: Define phenotypic adaptation. Give one example.

Ans 3: Phenotypic adaptation involves changes in the body of an organism in response to genetic mutation or certain environmental changes. These responsive adjustments occur in an organism in order to cope with environmental conditions present in their natural habitats. For example, desert plants have thick cuticles and sunken stomata on the surface of their leaves to prevent transpiration. Similarly, elephants have long ears that act as thermoregulators.

Ques 4: Most living organisms cannot survive at temperature above 45°C°. How are some microbes able to live in habitats with temperatures exceeding 100°C°?

Ans 4: Archaeobacteria (Thermophiles) are ancient forms of bacteria found in hot water springs and deep sea hydrothermal vents. They are able to survive in high temperatures (which far exceed 100°C) because their bodies have adapted to such environmental conditions. These organisms contain specialized thermo-resistant enzymes, which carry out metabolic functions that do not get destroyed at such high temperatures.



Ques 5: List the attributes that populations but not individuals possess.

Ans 5: A population can be defined as a group of individuals of the same species residing in a particular geographical area at a particular time and functioning as a unit. For example, all human beings living at a particular place at a particular time constitute the population of humans.

The main attributes or characteristics of a population residing in a given area are:

- (i) Birth rate (Natality): It is the ratio of live births in an area to the population of an area. It is expressed as the number of individuals added to the population with respect to the members of the population.
- (ii) Death rate (Mortality): It is the ratio of deaths in an area to the population of an area. It is expressed as the loss of individuals with respect to the members of the population.
- (iii) Sex ratio: It is the number of males or females per thousand individuals.
- (iv) Age Distribution: It is the percentage of individuals of different ages in a given population. At any given time, the population is composed of individuals that are present in various age groups. The age distribution pattern is commonly represented through age pyramids.
- (v) Population density: It is defined as the number of individuals of a population present per unit area at a given time.

Ques 6: If a population growing exponentially double in size in 3 years, what is the intrinsic rate of increase (r) of the population?

Ans 6: A population grows exponentially if sufficient amounts of food resources are available to the individual. Its exponential growth can be calculated by the following integral form of the exponential growth equation:

$$N_t = N_0 e^{rt}$$

Where,

N_t = Population density after time t

N_0 = Population density at time zero

r = Intrinsic rate of natural increase

e = Base of natural logarithms (2.71828)

From the above equation, we can calculate the intrinsic rate of increase (r) of a population.

Now, as per the Question, Present population density = x

Then,

Population density after two years = $2x$

$t = 3$ years

Substituting these values in the formula, we get:

$$\Rightarrow 2x = x e^{3r}$$

$$\Rightarrow 2 = e^{3r}$$



Applying log on both sides:

$$\Rightarrow \log 2 = 3r \log e$$

$$\Rightarrow \frac{\log 2}{3 \log e} = r$$

$$\Rightarrow \frac{\log 2}{3 \times 0.434} = r$$

$$\Rightarrow \frac{0.301}{3 \times 0.434} = r$$

$$\Rightarrow \frac{0.301}{1.302} = r$$

$$\Rightarrow 0.2311 = r$$

Hence, the intrinsic rate of increase for the above illustrated population is 0.2311.

Ques 7: Name important defence mechanisms in plants against herbivory.

Ans 7: Several plants have evolved various mechanisms both morphological and chemical to protect themselves against herbivory.

Morphological defence mechanisms:

- (i) Cactus leaves (*Opuntia*) are modified into sharp spines (thorns) to deter herbivores from feeding on them.
- (ii) Sharp thorns along with leaves are present in *Acacia* to deter herbivores.
- (iii) In some plants, the margins of their leaves are spiny or have sharp edges that prevent herbivores from feeding on them.

Chemical defence mechanisms:

- (i) All parts of *Calotropis* weeds contain toxic cardiac glycosides, which can prove to be fatal if ingested by herbivores.
- (ii) Chemical substances such as nicotine, caffeine, quinine, and opium are produced in plants as a part of self-defence.

Ques 8: An orchid plant is growing on the branch of mango tree. How do you describe this interaction between the orchid and the mango tree?

Ans 8: An orchid growing on the branch of a mango tree is an epiphyte. Epiphytes are plants growing on other plants which however, do not derive nutrition from them. Therefore, the relationship between a mango tree and an orchid is an example of commensalism, where one species gets benefited while the other remains unaffected. In the above interaction, the orchid is benefited as it gets support while the mango tree remains unaffected.



Ques 9: What is the ecological principle behind the biological control method of managing with pest insects?

Ans 9: The basis of various biological control methods is on the concept of predation. Predation is a biological interaction between the predator and the prey, whereby the predator feeds on the prey. Hence, the predators regulate the population of preys in a habitat, thereby helping in the management of pest insects.

Ques 10: Distinguish between the following:

- (i) **Hibernation and Aestivation**
- (ii) **Ectotherms and Endotherms**

Ans 10:

- (i) **Hibernation and Aestivation**

Hibernation	Aestivation
Hibernation is a state of reduced activity in some organisms to escape cold winter conditions.	Aestivation is a state of reduced activity in some organisms to escape desiccation due to heat in summers.
Bears and squirrels inhabiting cold regions are examples of animals that hibernate during winters.	Fishes and snails are examples of organisms aestivating during summers.

- (ii) **Ectotherms and Endotherms**

Ectotherms	Endotherms
Ectotherms are cold blooded animals. Their temperature varies with their surroundings.	Endotherms are warm blooded animals. They maintain a constant body temperature.
Fishes, amphibians, and reptiles are ectothermal animals.	Birds and mammals are endothermal animals.



Ques 11: Write a short note on

- (i) **Adaptations of desert plants and animals**
- (ii) **Adaptations of plants to water scarcity**
- (iii) **Behavioural adaptations in animals**
- (iv) **Importance of light to plants**
- (v) **Effect of temperature or water scarcity and the adaptations of animals.**

Ans 11:

- (i) Adaptations of desert plants and animals

(a) *Desert plants:* Some of the severe conditions typically found in a deserts are scorching heat and water scarcity. Plants that are found in deserts have suitably adapted to this as they have an extensive root system to tap the underground water. These plants possess sunken stomata on leaf surfaces and thick cuticles to decrease transpiration. A plant known as Opuntia has leaves that are completely alerted into spines where photosynthesis is performed by the green stems. These plants of deserts have specialized pathways known as CAM or the C4 pathway to manufacture food which facilitates the stomata to stay closed during the day to decrease the water loss caused through the transpiration process.

(b) *Desert animals:* Lizards, kangaroo rats, snakes are some animals found in deserts which have adapted appropriately to their habitat. For instance, the Kangaroo rat inhabiting the Arizona deserts never drinks water in its life and has the potential to concentrate its urine to conserve water. Snakes and Desert lizards have adapted in a way that they lounge in the sun early in the morning and burrow themselves in sand in the afternoons to escape the heat of the day, to prevent water loss.

- (ii) Adaptations of plants to water scarcity: Some of the severe conditions typically found in a deserts are scorching heat and water scarcity. Plants that are found in deserts have suitably adapted to this as they have an extensive root system to tap the underground water. These plants possess sunken stomata on leaf surfaces and thick cuticles to decrease transpiration. A plant known as Opuntia has leaves that are completely alerted into spines where photosynthesis is performed by the green stems. These plants of deserts have specialized pathways known as CAM or the C4 pathway to manufacture food which facilitates the stomata to stay closed during the day to decrease the water loss caused through the transpiration process.

- (iii) Behavioral adaptations in animals: Some entities that are affected by the fluctuations in temperature experience adaptations namely aestivation, hibernation, migration to escape environmental pressure to adapt to their natural habitat. These adaptations in the behavior of an entity is termed as behavioral adaptations. For instance, ectothermal and a few endothermal animals display these adaptations.



Some cold blooded animals, ectotherms such as amphibians, fish, reptiles have their temperatures varying with their surroundings as seen in Desert lizard, where they lounge in the sun in the early hours of the day and burrow themselves in sand when the temperature begins to rise in the noon. Some warm-blooded animals or endotherms such as mammals or birds escape the hot and cold weather conditions by hibernating in winters and aestivating in summers. They take shelter in burrows, caves etc to safeguard against these temperature variations.

- (iv) Importance of light to plants: The ultimate source of energy for plants is sunlight. Plants are referred to as autotrophic entities. They require light to perform photosynthesis. Light has a critical role in producing photoperiodic response that takes place in plants. These plants respond to the changes in the light intensity in different seasons to be able to meet their photoperiodic requirements for the process of flowering. Also, light has a significant role in aquatic habitats for vertical distribution of plants in the sea.
- (v) Effect of temperature or water scarcity and the adaptations of animals: One of the most important ecological factors is temperature which varies from place to place. The variation in temperature affects the distribution of animals on the planet. Eurythermals are the animals that can tolerate a range of temperatures while stenothermal animals are the ones which can withstand only a narrow range of temperature. In order to suit their natural habitats, animals also undergo adaptations. For instance, animals in cooler regions have short limbs and ears, helping to prevent heat loss from the body. Animals that are found in colder regions have thick fat layers underneath their skin, thick fur coats to prevent heat loss.

Some entities that are affected by the fluctuations in temperature experience adaptations namely aestivation, hibernation, migration to escape environmental pressure to adapt to their natural habitat. These adaptations in the behavior of an entity is termed as behavioral adaptations. Example, the Desert lizards are ectotherms, this means to say they do not possess a temperature regulatory mechanism to escape the variations in temperature. These lounge in the sun in the early hours of the day and burrow themselves in sand when the temperature begins to rise in the noon.

Another factor that expels animals to experience several adaptations to familiarize to their natural habitats is water scarcity. Lizards, kangaroo rats, snakes are some animals found in deserts which have adapted appropriately to their habitat. For instance, the Kangaroo rat inhabiting the Arizona deserts never drinks water in its life and has the potential to concentrate its urine to conserve water. Snakes and Desert lizards have adapted in a way that they lounge in the sun early in the morning and burrow themselves in sand in the afternoons to escape the heat of the day, to prevent water loss.



Ques 12 : Define decomposition and describe the processes and products of decomposition.

Ans 12: Decomposition is the process that involves the breakdown of complex organic matter or biomass from the body of dead plants and animals with the help of decomposers into inorganic raw materials such as carbon dioxide, water, and other nutrients. The various processes involved in decomposition are as follows:

- (i) Fragmentation: It is the first step in the process of decomposition. It involves the breakdown of detritus into smaller pieces by the action of detritivores such as earthworms.
- (ii) Leaching: It is a process where the water soluble nutrients go down into the soil layers and get locked as unavailable salts.
- (iii) Catabolism: It is a process in which bacteria and fungi degrade detritus through various enzymes into smaller pieces.
- (iv) Humification: The next step is humification which leads to the formation of a dark coloured colloidal substance called humus, which acts as reservoir of nutrients for plants.
- (v) Mineralization: The humus is further degraded by the action of microbes, which finally leads to the release of inorganic nutrients into the soil. This process of releasing inorganic nutrients from the humus is known as mineralization. Decomposition produces a dark coloured, nutrient-rich substance called humus. Humus finally degrades and releases inorganic raw materials such as CO_2 , water, and other nutrient in the soil.

Ques 13: Give an example for:

- (i) **An endothermic animal**
- (ii) **An ectothermic animal**
- (iii) **An organism of benthic zone**

Ans 13:

- (i) Endothermic animal: Birds such as crows, sparrows, pigeons, cranes, etc. and mammals such as bears, cows, rats, rabbits, etc. are endothermic animals.
- (ii) Ectothermic animal: Fishes such as sharks, amphibians such as frogs, and reptiles such as tortoise, snakes, and lizards are ectothermic animals.
- (iii) Organism of benthic zone: Decomposing bacteria is an example of an organism found in the benthic zone of a water body.



Ques 14: Define population and community.

Ans 14:

Population: A population can be defined as a group of individuals of the same species residing in a particular geographical area at a particular time and functioning as a unit. For example, all human beings living at a particular place at a particular time constitute the population of humans.

Community: A community is defined as a group of individuals of different species, living within a certain geographical area. Such individuals can be similar or dissimilar, but cannot reproduce with the members of other species.

Ques 15: Define the following terms and give one example for each:

- (i) **Commensalism**
- (ii) **Parasitism**
- (iii) **Camouflage**
- (iv) **Mutualism**
- (v) **Interspecific competition**

Ans 15:

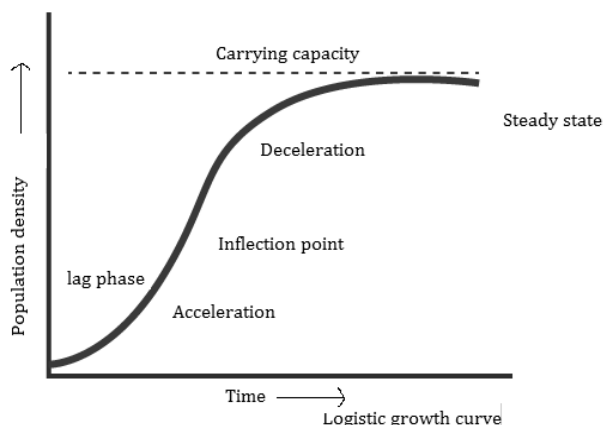
- (i) Commensalism: Commensalism is an interaction between two species in which one species gets benefited while the other remains unaffected. An orchid growing on the branches of a mango tree and barnacles attached to the body of whales are examples of commensalisms.
- (ii) Parasitism: It is an interaction between two species in which one species (usually smaller) gets positively affected, while the other species (usually larger) is negatively affected. An example of this is liver fluke. Liver fluke is a parasite that lives inside the liver of the host body and derives nutrition from it. Hence, the parasite is benefited as it derives nutrition from the host, while the host is negatively affected as the parasite reduces the host fitness, making its body weak.
- (iii) Camouflage: It is a strategy adapted by prey species to escape their predators. Organisms are cryptically coloured so that they can easily mingle in their surroundings and escape their predators. Many species of frogs and insects camouflage in their surroundings and escape their predators.
- (iv) Mutualism: It is an interaction between two species in which both species involved are benefited. For example, lichens show a mutual symbiotic relationship between fungi and blue green algae, where both are equally benefited from each other.
- (v) Interspecific competition: It is an interaction between individuals of different species where both species get negatively affected. For example, the competition between flamingos and resident fishes in South American lakes for common food resources i.e., zooplankton.



Ques 16: With the help of suitable diagram describe the logistic population growth curve.

Ans 16: The logistic population growth curve is commonly observed in yeast cells that are grown under laboratory conditions. It includes five phases: the lag phase, positive acceleration phase, exponential phase, negative acceleration phase, and stationary phase.

- (i) Lag phase: Initially, the population of the yeast cell is very small. This is because of the limited resource present in the habitat.
- (ii) Positive acceleration phase: During this phase, the yeast cell adapts to the new environment and starts increasing its population. However, at the beginning of this phase, the growth of the cell is very limited.
- (iii) Exponential phase: During this phase, the population of the yeast cell increases suddenly due to rapid growth. The population grows exponentially due to the availability of sufficient food resources, constant environment, and the absence of any interspecific competition. As a result, the curve rises steeply upwards.
- (iv) Negative acceleration phase: During this phase, the environmental resistance increases and the growth rate of the population decreases. This occurs due to an increased competition among the yeast cells for food and shelter.
- (v) Stationary phase: During this phase, the population becomes stable. The number of cells produced in a population equals the number of cells that die. Also, the population of the species is said to have reached nature's carrying-capacity in its habitat.



A Verhulst – pearl logistic curve is also known as an S-shaped growth curve.



Ques 17: Select the statement which explains best parasitism.

- (i) One organism is benefited.
- (ii) Both the organisms are benefited.
- (iii) One organism is benefited, other is not affected.
- (iv) One organism is benefited, other is affected.

Ans 17: (iv) One organism is benefited, other is affected.

Parasitism is an interaction between two species in which one species (parasite) derives benefit while the other species (host) is harmed. For example, ticks and lice (parasites) present on the human body represent this interaction where the parasites receive benefit (as they derive nourishment by feeding on the blood of humans). On the other hand, these parasites reduce host fitness and cause harm to the human body.

Ques 18: List any three important characteristics of a population and explain

Ans 18: A population can be defined as a group of individuals of the same species, residing in a particular geographical area at a particular time and functioning as a unit. For example, all human beings living at a particular place at a particular time constitute the population of humans.

Three important characteristics of a population are:

- (i) Birth rate (Natality): It is the ratio of live births in an area to the population of an area. It is expressed as the number of individuals added to the population with respect to the members of the population.
- (ii) Death rate (Mortality): It is the ratio of deaths in an area to the population of an area. It is expressed as the loss of individuals with respect to the members of the population.
- (iii) Age Distribution: It is the percentage of individuals of different ages in a given population. At any given time, a population is composed of individuals that are present in various age groups. The age distribution pattern is commonly represented through age pyramids.