

Chapter 11: Organisms and Populations

NCERT · Class 12 · Biology

Textbook exercises

Question 1

How is diapause different from hibernation?

Solution

Ans: Diapause could be a stage of suspended development to cope with unfavorable conditions. Diapause is a coping mechanism used by many species of Zooplankton and insects to survive adverse climatic conditions. Hibernation is the period of dormancy during winter months so is also called winter sleep. Their metabolism slows during the winter so they can escape the cold weather. The development of hibernation is exhibited by bats, squirrels, and other rodents.

Question 2

If a marine fish is placed in a freshwater aquarium, will the fish be able to survive? Why or why not?

Solution

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

Question 3

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

Solution

Ans: In hot water springs and deep sea hydrothermal vents, archaebacteria (thermophiles) grow. They are able to survive in high temperatures (which far exceed 100°C) because their bodies have adapted to such environmental conditions. Organisms that withstand high temperatures contain enzymes with specialized thermal-resistance in order to perform metabolic functions.

Question 4

List the attributes that populations but not individuals possess.

Solution

Ans: A population is defined as a group of individuals belonging to the same species living together in a particular geographic area at the same time. For example, all individuals living at a particular place at a particular time represent the population of humans. The most attributes or characteristics of a population residing during a given area are:

- **Birth Rate (Natality):** It is the ratio of live births per thousand people in an area. It is expressed because the range of number of individuals added to the population with respect to the members of the population.
 - **Death Rate (Mortality):** This is a measure of the percentage of deaths in an area to the total population. It is expressed as the loss of individuals with respect to the members of the population age groups. The age distribution pattern is usually represented through age pyramids.
 - **Population Density:** It is defined as the number of individuals of a population present per unit space at a given time.
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Question 5

If a population grows exponentially in size in 3 years, what is the intrinsic rate of increase (r) of the population?

Solution

Ans: If there are sufficient amounts of food resources available to an individual population, it will grow exponentially. The exponential growth equation can be expressed as the following integral form:

Where,

N 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:

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

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

Applying log on both sides:

$$\log 2 = 3r \log(e)$$

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

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

$$\Rightarrow 0.301$$

$$3 \times 0.434$$

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

$$r = 0.2311$$

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

Question 6

Name important defense mechanisms in plants against herbivory.

Solution

Ans: The presence of morphological and chemical shielding mechanisms is present in several plants in order to defend themselves against herbivores.

(1) Morphological Defense Mechanisms:

- Cactus leaves (Opuntia) are modified into sharp spines (thorns) to deter herbivores from feeding on them.
- Besides leaves, Acacia has sharp thorns to deter herbivores.
- Some plants have margins of their leaves that are spiny or have sharp edges that stop insects from eating them.

(2) Chemical Defense Mechanisms:

- A herbivore might be fatally affected if they eat any part of a Calotropis weed.
- Several chemicals are produced in plants as a part of self-defense, including nicotine, caffeine, quinine, and opium.

Question 7

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

Solution

Ans: An orchid growing on a mango tree branch is an epiphyte. Epiphytes are plants growing on other plants which however, do not derive nutrition from them. This relationship therefore exists as commensalism. There is a commensalism between a mango tree and an orchid, where one species benefits from the other while the other remains unaffected. The orchid is benefited by the above interaction because it receives support, while the mango tree remains unaffected.

Question 8

What is the ecological principle behind the biological control method of managing pest insects?

Solution

Ans: Variable biological control methods are based on a concept known as predation. In predation, the predator feeds on the prey. Hence, predators regulate the population of prey in a habitat, helping in the control of pest insects.

Question 9

Distinguish between the following:

(a) Hibernation and Aestivation,

(B) Ectotherms and Endotherms

Solution

Ans: (a)

Hibernation	Aestivation
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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,

Ans:

Ectotherm	Endotherm
Ectotherm are cold blooded animals, their temperature varies with their surrounding	Endotherms are warm blooded animals. They maintain a constant body temperature. Birds and mammals are endothermic animals.
Fishes, amphibians and reptiles are ectothermic animals.	Birds and mammals are endothermic animals.

Question 10

Write a short note on

(e) Effect of temperature or water scarcity and the adaptations of animals.

A.

Adaptations of desert plants and animals

B.

Adaptations of plants to water scarcity

C.

Behavioral adaptations in animals

D.

Importance of light to plants

Answer

Correct option: A

Solution

Ans :

(a) Adaptations of desert plants and animals:

(i) Adaptations of desert plants:

Many desert plants have been well adapted to cope with harsh conditions in the desert, including water adequate and hot. Plants have an extensive root system to tap underground water. There are thick cuticles and sunken stomata on the surface of their leaves to reduce transpiration. Opuntia is a species of plant that has spines entirely as parts of its leaves, Photosynthesis is carried out by green stems. Plants in the desert have special pathways. It is the CAM (C4 pathway) pathway that synthesizes food. To reduce water loss through transpiration, the stomata can remain closed during the day.

(ii) Adaptations of desert animals:

Desert animals such as desert kangaroo rats, lizards, snakes, etc. are well adapted to their habitat. In Arizona, kangaroo rats do not drink water. In order to conserve water, it is capable of concentrating its urine. Desert lizards and snakes bask in the sun throughout the early morning and burrow themselves in the sand during afternoons to escape the heat of the day. Desert animals have developed these adaptations to stop the loss of water.

(b) Adaptations of plants to water scarcity:

Due to water scarcity and heat, desert plants are well adapted to survive in deserts. To obtain water from underground, plants have extensive root systems. They bear thick cuticles and sunken stomata on the surface of their leaves to reduce transpiration. In Opuntia, the leaves form spines, while the green stems are responsible for photosynthesis. Desert plants have special pathways to synthesize food, called CAM (C4 pathway). It enables their stomata to remain closed during the day to reduce water loss by transpiration.

(c) Behavioral adaptations in animals:

There are some organisms that are affected by temperature changes. To cope with environmental stress, these organisms undergo adaptations such as hibernation, aestivation, migration, etc. These adaptations in behavior of an organism are referred to as behavioral adaptations. Some ectothermic animals and certain endotherms exhibit behavioral adaptations. Ectotherms are cold blooded animals such as fish, amphibians, reptiles, etc. Depending on their environment, they have different body temperatures. During the early hours of the day when the temperatures are quite low, desert lizards bask in the sun. As the temperature rises, the lizard burrows into the sand to avoid the scorching sun. Similar burrowing strategies are exhibited by other desert animals. Certain endotherms (warm-blooded animals) such as birds and mammals escape cold and hot weather conditions by hibernating during winters and aestivating during summers. They hide themselves in shelters like caves, burrows, etc. to protect against temperature variations.

(d) Importance of light to plants

Sunlight acts as the ultimate source of energy for plants. Plants are autotrophic organisms, which need light for carrying out the process of photosynthesis. Light also plays an important role in generating photoperiodic responses occurring in plants. Plants respond to changes in intensity of light during various seasons to fulfill their photoperiodic changes in intensity of light during various seasons to meet their photoperiodic requirements for flowering. Light also plays an important role in aquatic habitats for vertical distribution of plants in the sea.

(e) Effects of temperature or water scarcity and the adaptations of animals.

Temperature is the most vital ecological factor. Average temperature on the Earth varies from one place to another. These variations in temperature affect the distribution of animals on the Earth. Animals that can tolerate a wide range of temperatures can be referred to as eurythermals. Those which can tolerate a narrow range of temperature are called stenothermal animals. Animals also undergo adaptations to suit their natural habitats. For example, animals found in colder areas have shorter ears and limbs that prevent the loss of heat from their body. Also, animals found in Polar regions have thick layers of fat below their skin and thick coats of fur to prevent the loss of heat. Some organisms exhibit various behavioral changes to suit their natural habitat. These adaptations present in the behavior of an organism to escape environmental stresses are called behavioral adaptations. For example, desert

lizards are ectotherms. This means that they do not have a temperature: regulatory mechanism to escape temperature variations. These lizards bask in the sun during early hours when the temperature is quite low. As the temperature begins to increase, the lizard burrows itself inside the sand to escape the scorching sun. Similar burrowing strategy is seen in other desert animals.

Water deficiency is another factor that forces animals to undergo certain adaptations to suit their natural habitat. Animals found in deserts such as desert kangaroo rats, lizards, snakes, etc. are well adapted to stay in their habitat. The kangaroo rat found in the deserts of Arizona never drinks water in its life. It has the ability to concentrate its urine to conserve water. Desert lizards and snakes bask in the sun during early morning and burrow in the sand as the temperature rises to escape the heat of the day. Such adaptations can be used to stop the loss of water.

Question 11

List the various abiotic environmental factors.

Solution

Ans: Abiotic components are all non-living elements in an ecosystem. Temperature, soil, water, and light are all aspects to consider.

Temperature: This is the most important environmental component in terms of ecology. It changes seasonally on land and gradually diminishes from the equator to the poles, as well as from plains to mountain summits. It varies from sub-zero temperatures in polar regions to high altitudes. Eurythermal animals, such as most mammals and birds, can withstand and thrive in a wide range of temperatures, whereas stenothermal organisms, such as polar bears and amphibians, can only tolerate a small range of temperatures.

Soil: The nature and qualities of soil vary greatly depending on where you are. It is mostly determined by the following factors

- The weather
- The weathering procedure

- The process of soil growth

The soil's water holding capacity and percolation are determined by a variety of factors, including soil chemistry, grain size, and aggregation. The sort of plants that can grow in a particular habitat is determined by these qualities of soil, as well as its pH, mineral content, topography, and other factors.

Water: Water is known to have given birth to life on Earth, and it is impossible to survive without it. The pH, chemical composition, and temperature of water are all vital to aquatic creatures. They are also affected by water salinity, which ranges from less than 5 parts per thousand in inland water to 30-35 parts per thousand in the sea and 100 parts per thousand in some hypersaline lagoons. Euryhaline organisms can tolerate a large range of salinity, whereas stenohaline organisms can only tolerate a narrow range. Because of osmotic difficulties induced by high salt, many freshwater creatures cannot thrive in sea water for long periods of time, and vice versa. A range of factors, including soil chemistry, grain size, and aggregation, influence the water retention capacity and percolation of the soil. These properties of soil, as well as its pH, mineral content, topography, and other elements, affect the types of plants that can flourish in a given habitat. Stenohaline creatures can only survive a narrow range of salinity, but euryhaline species can withstand a wide range of salt. Many freshwater organisms cannot survive in sea water for lengthy periods of time due to osmotic issues caused by excessive salt levels, and vice versa.

Light: The importance of light stems from the fact that all autotrophs rely on it as a source of energy for photosynthesis, which involves the release of oxygen. Because they are obscured by towering, canopied trees, small shrubs and plants growing in forests have adapted to photosynthesis at very low light intensities. The majority of plants rely on sunshine to survive.

Many animals use diurnal and seasonal light intensity variations as cues to time their feeding, reproductive, and migratory activity. Because the sun is the source of both, the availability of light on land is directly tied to that of warmth. The environment is constantly gloomy in deep oceans (> 500m). Solar radiation's spectrum purity is also critical for life.

For marine plants living at different depths of the ocean, different components of the visible spectrum are available. UV light is harmful to many organisms. As a result, distinct species of algae, such as

green, brown, and red algae, can be found at the upper, middle, and deep layers of the sea, respectively.

Question 12

Give an example for:

- (a) An endothermic animal
- (b) An ectothermic animal
- (c) An organism of benthic zone

Solution

Ans:

(a) Endothermic Animal: Birds such as crows, sparrows, pigeons, cranes, etc. and mammals such as bears, cows, rats, rabbits, etc. are endothermic animals.

(b) Ectothermic Animals: Fishes such as sharks, amphibians such as frogs, and reptiles such as tortoises, snakes, and lizards are ectothermic animals.

(c) Organism of Benthic Zone: Decomposing bacteria is an example of an organism found in the benthic zone of a water body .

Question 13

Define Population and Community.

Solution

Ans :

- Population: A population can be thought of as a group of individuals belonging to the same species that exist in the same geographical area at the same time and function as a unit. For example, all human beings living at a particular place at a particular time constitute the population of humans.

- **Community:** A group of individuals belonging to a particular species, living in a particular geographical area. Such individuals can be similar or dissimilar, but cannot reproduce with the members of other species.

Question 14

Define the following terms and give one example for each:

(e) Interspecific competition

A.

Commensalism

B.

Parasitism

C.

Camouflage

D.

Mutualism

Answer

Correct option: A

Solution

Ans:

(a) **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.

(b) **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 benefits as it derives nutrition from the host, while the host is negatively affected as the parasite reduces the host fitness, making its body weak.

(c) Camouflage: 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.

(d) 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.

(e) Interspecific competition: It is an interaction between individuals of different species where both species get negatively affected. For example, the competition between flamingoes and resident fishes in South American lakes for common food resources i.e, zooplankton.

Question 15

With the help of a suitable diagram describe the logistic population growth curve.

Solution

Ans: Yeast cells grown under laboratory conditions commonly exhibit the logistic population growth curve. There are five phases: the lag phase, the positive acceleration phase, exponential phase, negative acceleration phase, and stationary phase.

- **Lag Phase:** Initially, the population of the yeast cell is very small. This is because of the limited resources present in the habitat.
- **Positive Acceleration Phase:** In this phase, yeast cells adapt to the new environment and start to multiply. However, at the beginning of this phase, the growth of the cell is very limited.
- **Exponential Phase:** During this phase, the population of the yeast cell increases suddenly due to rapid growth. Due to sufficient food resources, a constant environment, and the absence of interspecific competition, the population grows exponentially. As a result, the curve rises steeply upwards.
- **Negative Acceleration Phase:** During this phase, environmental resistance increases and the population growth rate decreases. This occurs because of an increased completion among the yeast cells for food and shelter.

- Stationary Phase: During this phase, the population becomes constant. A population's number of cells equals its number of cells that die. Additionally, the species is said to have reached the carrying capacity of its habitat.

Question 16

Select the statement which explains best parasitism.

A.

One organism is benefited.

B.

Both the organisms are benefited.

C.

One organism is benefited, the other is not affected.

D.

One organism is benefited, the other is affected.

Answer

Correct option: D

Solution

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

Parasitism is an interaction between two species, in which one species (parasite) benefits from the other. The other species (host) is harmed. For example, ticks and lice (parasites) can be found on the body. This means there is an interaction between parasites and the human body, from which ticks and parasites receive benefit (as they are Feeding on human blood). On the other hand, these parasites reduce host fitness and cause harm to the human body.

Question 17

List any three important characteristics of a population and explain.

Solution

Ans: A population is a collection of individuals of the same species living in a specific geographical area at a specific time and acting as a single unit. The population of people, for example, is made up of all human beings living in a specific location at a specific moment.

A population's three most significant qualities are:

(a) Birth Rate (Natality): This is the ratio of live births to total births in a given year.

It is calculated as the number of people added to the population divided by the number of people in the population.

(b) Death Rate (Mortality): This is the ratio of deaths per 100,000 people in a certain location. It's measured in terms of the number of people who have died as a result of the disease.

(c) Age Distribution: This is the proportion of people of various ages in a given population

This is the percentage of people in a population who are different ages. At any given time, a population is made up of people of varying ages. Age pyramids are a frequent representation of the age distribution pattern.
