

UNIT-X

Ecology and Environment

CHAPTER

13

ORGANISMS AND POPULATIONS

Syllabus

- *Organisms and environment* : Habitat and niche, population and ecological adaptations; population interactions-mutualism, competition, predation, parasitism, population attributes-growth, birth rate and death rate, age distribution.

Chapter Analysis

List of Topics		2016		2017		2018
		D	OD	D	OD	D/OD
Organisms and its environment	<ul style="list-style-type: none">• Organism's response to different abiotic factors• Conformer and regulator• Mountain sickness and their effects and symptoms	1 Q (3 M)			1 Q (3 M)	1 Q (5 M)
Populations	<ul style="list-style-type: none">• Numerical Question on death rate of population• Age pyramids• Fitness of species proposed by Darwin• Growth models of populations• Population interactions	1 Q (5 M)	1 Q (3 M) 1 Q (5 M)	1 Q (5 M)	1 Q (5 M)	

- On the basis of above analysis, it can be concluded that this is also an important chapter from exam point of view. A long five mark question is always asked from this chapter. The important topics from which long 5 mark question asked are- Organism's response to different abiotic factor (conformer/regulator), Growth models of human population, and age pyramids. Other important topics are numerical question on death rate of population, questions on mountain sickness- their effects and symptoms and various population interactions.



TOPIC-1

Origin of Life on Earth and Various Related Evidences

Revision Notes

- **Ecology** : It is the branch of biology that deals with the inter-relationship amongst the organisms and their environment. Study of ecology is important to strike a balance between development and maintenance of natural environmental and biotic communities, use and conservation of resources, solve local, regional and global environmental problems.
- **Environment**: The sum total of all biotic and abiotic factors, substances and conditions that surround and potentially influence organisms without becoming their constituent part is called environment.

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- **Organism and its Environment** : At organism level, physiological ecology tries to understand how different organisms are adapted to their environment in terms of survival and reproduction. The variation in the intensity and duration of temperature along with annual variations in precipitation results in formation of major biomes like desert, rain forest and tundra.
- Regional and local variation within each biome lead to the formation of different kinds of habitats like tropical rain forest, deciduous forest, desert, sea coast, etc.
- The habitat includes biotic components like pathogens, parasites, predators and competitors of the organism with which they interact constantly.
- **Major Abiotic Factors**
 - (a) **Temperature** : It is the most important ecological factor to determine the bio-mass of a place. Average temperature on land varies seasonally and decreases progressively from the equator towards the poles and from plains to mountain tops. Temperature affects the kinetics of enzymes and basal metabolism along with physiological functions of the organisms. The organisms that can tolerate wide range of temperature are called **eurythermal** and those organism restricted to a narrow range of temperatures are called **stenothermal**.
 - (b) **Water** : Life on earth is unsustainable without water. Productivity and distribution of plants is heavily dependent on water. Some organisms which are tolerant to wide range of salinities are called **euryhaline** and others which are restricted to a narrow range are called **stenohaline**. Fresh water animals cannot live for long in sea water because of the osmotic problems they would face.
 - (c) **Light** : Plants produce food through photosynthesis in presence of sunlight. Some plants are adapted to low light conditions because they are overshadowed by tall canopied trees. Flowering in some plants occurs only in presence of critical day light called photoperiodism. The availability of light and land is closely linked to that of temperature as the sun is the source of both. UV component of sunlight is harmful to plants and animals.
 - (d) **Soil** : Types of soil depends upon climate, weathering process or sedimentary and how soil development occurred. Soil composition, grain size and aggregation determine the percolation and water holding capacity of the soils along with pH, mineral, composition and topography determine the vegetation in any area.
- **Responses to Abiotic Factor** : In the course of evolution, many species have evolved constant internal environment to permit all biochemical reactions and physiological functions to work with maximum efficiency to have overall fitness of species. Organisms try to maintain the constancy of its internal environment (homeostasis) inspite of varying external environment. **There are various ways to establish homeostasis** :
 - (i) **Regulate** : Certain animals have the ability to maintain a constant temperature and constant osmolarity to keep up their homeostasis E.g. All birds and mammals, very few lower vertebrates and invertebrates. Thermoregulation and osmoregulation is the source of success of these organisms in all the environmental conditions. In winter thermoregulation by means of sweating reduce the body temperature.
 - (ii) **Conform** : In most of animals and plants, their body temperature change with ambient temperature. Such animals are called conformers. For example, in aquatic animals osmotic concentration of the body fluid changes with that of the ambient water osmotic concentration. Conformers are not able to bear the energetic expenses to maintain the constant body temperature. Heat loss or heat gain is the surface phenomenon. The conformers have more surface area in comparison to their volume.
 - (iii) **Migrate** : Many animals like birds move away temporarily from stressful habitat to a more hospitable area and return when stressful condition is over. For example, Siberian birds migrate to Keoladeo National park, Bharatpur, India.
 - (iv) **Suspend** : In microorganisms like bacteria, fungi and lower plants, a thick walled spores are formed which helps them to survive unfavourable conditions. Spores germinate when conditions are favourable. In higher plants, seeds and some other vegetative reproductive structures serves to tide over periods of stress. They reduce their metabolic activity and go into a state dormancy. They germinate under favourable moisture and temperature.
 - (v) **Adaptation** is the attribute of organism's morphological, physiological and behavioural changes that enables the organisms to survive and reproduce in its habitat. For example, Kangaroo rats fulfill the water requirement by internal oxidation of fat in the absence of water. Thick cuticle in many plants also prevents loss of water. CAM plants open their stomata during night to reduce the loss of water during photosynthesis.

Adaptation of Mammals :

- (a) Mammals from colder climates have shorter ears and limbs to minimize heat loss. This is called **Allen's Rule**.
- (b) In polar seas aquatic mammals like seals have a thick layer of fat called **blubber**, below their skin that acts as an insulator and reduces loss of body heat.

Physiological and biochemical adaptations :

- (a) Altitude sickness is observed at higher altitude that includes symptoms like nausea, fatigue, heart palpitations due to less oxygen and atmospheric pressure. The person gradually get acclimatized and stop experiencing altitude sickness. This is type of physiological adaptation.
- (b) A number of marine invertebrate and fish live in temperature always less than zero and some lives deep inside ocean where pressure is very high by array of biochemical adaptations.

Behavioural adaptation :

- (a) Some organisms like desert lizard lack the physiological ability that mammals have, but deal with high temperature of their habitat by behavioural means. They bask in the sun and absorb heat when their body temperature is low, but move into shade when the ambient temperature starts increasing.

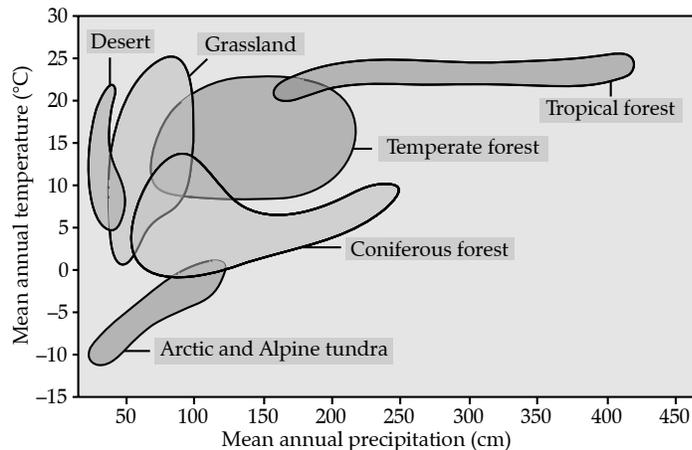
Important Diagrams:

Fig 13.1: Biome distribution with respect to annual temperature and precipitation.

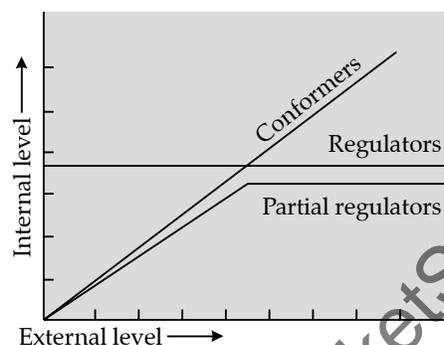


Fig 13.2: Diagrammatic representation of organismic response



Very Short Answer Type Questions

(1 mark each)

Q.1. Define Diapause. [R][CBSE SQP, 2018]

Ans. Diapause is a stage of suspended development in zooplankton species under unfavourable conditions. [CBSE Marking Scheme, 2018]

Q.2. Give an example of an organism that enters 'diapause' and why? [R][Delhi Set-I, II, III, 2014]

Ans. Many species of Zooplankton, unfavourable condition. [CBSE Marking Scheme, 2014] 1

Detailed Answer :

During unfavourable conditions, many zooplankton species in lakes and ponds are known to enter diapause, a stage of suspended development. Example - silk moth. 1

Q.3. Mention how do bears escape from stressful time in winter? [R][Delhi Set-I, Comptt. 2013]

Ans. Bears undergo hibernation to get rid of the stressful time in winter. 1

Q.4. How do seed-bearing plants tide over dry and hot weather conditions? [U][Outside Delhi Set-I, Comptt. 2013]

Ans. In higher plants, seeds and some other vegetative reproductive structures serve to tide over periods of stress. They reduce their metabolic activity and go into a state of 'dormancy'. They germinate under favourable moisture and temperature. 1

Q.5. How do snails escape from stressful time in summers? [U][Outside Delhi Set-II, Comptt. 2013]

Ans. They undergo aestivation to avoid summers. 1

Q.6. Mention any two activities of animals which get cues from diurnal and seasonal variations in light intensity. [R][Delhi Comptt. 2011]

Ans. Many plants depend on sunlight to meet their photoperiod requirements for flowering. For many animals too, light is important. They use the diurnal and seasonal variations in light

intensity and duration (photoperiod) as cues for timing their foraging, reproductive and migratory activities. 1

AIQ. 7. Very small animals are rarely found in polar regions. Give two reasons.

[U] [Foreign - 2017, Set - I, II, Foreign 2016]]

Ans. Small animals have larger surface area relative to their volume, lose heat very fast, due to small size, expend much energy to generate body heat through metabolism. 1

[CBSE Marking Scheme, 2017]



Short Answer Type Questions-I

(2 marks each)

Q. 1. Why are the plants that inhabit a desert not found in a mangrove? Give reasons.

[A] [Delhi Set-II, 2016]

Ans. Desert plants are not adapted to survive in saline / aquatic conditions. 1

Plants are conformers / stenothermal / cannot maintain constant internal environment / temperature / osmotic concentration of the body fluids affects kinetics of enzymes through basal metabolism / activity and other physiological functions of the organisms. (Any one) 1

[CBSE Marking Scheme, 2016]

Detailed Answer :

The desert plants are adapted to survive in water deficient conditions. They possess adaptations to conserve water such as thick cuticle, reduced leaf and low rate of transpiration.

The mangrove plant, on the other hand are adapted to survive in water logged and anoxic conditions. They possess prominent leaves with high rate of transpiration. Thus, the desert plants have different adaptations to survive, which cannot be found in a mangroves.

Q. 2. Heat loss or heat gain depends upon the surface area of the organism's body. Explain with the help of a suitable example.

[U] [Outside Delhi Set-II, III, Comptt., 2016]

Ans. Small animal like humming bird / shrew, have a larger surface area relative to their volume, they tend to lose heat when it is cold outside, hence spend much energy to generate body heat through metabolism. $\frac{1}{2} \times 4 = 2$

Q. 3. Shark is eurythermal while polar bear is stenothermal. What advantage does the former have and what is the constraint the latter has ?

[U] [Delhi Set-I, Comptt. 2015]

Ans. Shark : Tolerates wide range of temperature so wide spread / survives in all waters.

Polar bear : Restricted occurrence in narrow range of temperature so constraint to live in very cold icy environment. 1+1

Answering Tip

- Understand the differences between eurythermal and stenothermal with the help of examples for better understanding and retention.

AIQ. 4. Why do people suffer from altitude sickness after reaching the high altitude regions ? How does their body acclimatized after a couple of days ? [U] [Delhi Set-II, Comptt. 2015; Outside Delhi Set-I, 2015]

Ans. "Altitude sickness" is because of low atmospheric pressure at high altitude, the body does not get sufficient oxygen. $\frac{1}{2} + \frac{1}{2}$

The body compensates low oxygen availability by increasing RBCs production, decreasing the binding capacity of haemoglobin, by increasing breathing rate. $\frac{1}{2} + \frac{1}{2}$ (Any two)

[CBSE Marking Scheme, 2015]

Q. 5. How do mammals living in colder regions and seals living in polar regions able to reduce the loss of their body heat ?

[U] [Delhi Set-III, Comptt. 2015]

Ans. Mammals from colder climates generally have shorter ears and limbs which minimise heat loss (Allen's rule).

In polar region, seals have thick layer of fat (blubber) below their skin that acts as insulator and reduce loss of body heat. 1 + 1

[CBSE Marking Scheme, 2015]

Q. 6. Many fresh water animals cannot survive in marine environment. Explain.

[A] [Delhi Set-I, 2015]

Ans. Fresh water animals are not able to maintain their osmotic concentration in marine conditions. If they are transferred in marine conditions, their body will shrink due to exosmosis. Hence, they cannot survive in marine environment. 2

[CBSE Marking Scheme, 2015]

Q. 7. A moss plant is unable to complete its life cycle in a dry environment. State two reasons.

[U] [Outside Delhi Set-II, 2015]

Commonly Made Error

- Students often get confused between the term eurythermal and stenothermal.

Ans. Mosses cannot complete their life cycle in a dry environment because of the following reasons :

- (i) They need water for sexual reproduction as water acts as a medium for flagellated sperm to reach the egg and undergo fertilization.
- (ii) Since their roots are rudimentary, they cannot absorb water. Therefore, they need to grow in moist environment for their survival. 1 + 1 = 2

[CBSE Marking Scheme, 2015]

Q. 8. Why do algae and fungi shift to sexual mode of reproduction just before the onset of adverse conditions ? [R] [Delhi Set-I, II, 2014, 2011]

Ans. For survival during unfavourable conditions / Fusion of gametes helps to pool their resources for survival (hunger theory of sex) / Zygote develops a thick wall that is resistant to desiccation and damage, undergoes a period of rest before germination. 2

[CBSE Marking Scheme, 2014, 2011]

Detailed Answer :

Organisms such as fungi and algae switch to sexual mode of reproduction during adverse conditions because sexual reproduction brings variation into the individuals, some of which might help the individuals to adapt to the changed conditions and survive. This ensures the continuity of species. 2

[AI] Q. 9. Some organisms suspend their metabolic activities to survive in unfavourable conditions. Explain with the help of any four examples.

[U] [Outside Delhi Set-III, 2012, Delhi Set-I, 2012]

- Ans.** (i) The frogs hibernate during very cold season and reduce their metabolic activities.
- (ii) The kangaroo rat has the ability to concentrate its urine and can live without drinking water, thereby conserving water.
- (iii) Barnacles and molluscs, living in very cold inter-tidal zones of northern shores, show their reduce activities.
- (iv) Some animals go to summer sleep.

$\frac{1}{2} \times 4 = 2$

[CBSE Marking Scheme, 2012]

Detailed Answer :

- (i) **Polar bear** : They hibernate during winter to escape the cold weather.
- (ii) **Snails / fishes** : They go into aestivation during summer to avoid heat related problems and desiccation.
- (iii) **Seeds of higher plants / spores of bacteria / fungi** : They become dormant in unfavourable conditions and in case of *Amoeba*, cyst formation takes place.
- (iv) **Some species of zooplankton** : They undergo diapause. 2

Q. 10. Why are some organisms called as eurythermals and some others stenohalines ? [R] [Foreign 2011]

Ans. Eurythermals are the organisms which can tolerate and live in a wide range of temperature while stenohalines can tolerate only a narrow range of salinities. 1+1

Q. 11. Between amphibians and birds which are more likely to be able to cope with global warming ? Give reasons. [E & A] [Outside Delhi, 2008]

Ans. The birds are more likely to be able to cope with the global warming because they are eurythermic organisms and as such show a wide range of temperature tolerance. 2



Short Answer Type Questions-II

(3 marks each)

Q. 1. In certain seasons we sweat profusely while in some other season we shiver. Explain.

[U] [Delhi Set-II, 2016]

OR

Why do we experience shivering during winters when temperature is very low ?

[Outside Delhi Delhi I, II, III, 2011]

Ans. To regulate body temperature. 1
In summer, outside temperature is higher than body temperature, sweating causes cooling by evaporation of sweat and thus lowering the body temperature. $\frac{1}{2} + \frac{1}{2}$
In winter, outside temperature is much lower than body temperature, shivering is an (involuntary) exercise which produces heat and raises the body temperature in winter. $\frac{1}{2} + \frac{1}{2}$

[CBSE Marking Scheme, 2016]

[AI] Q. 2. Explain by taking three different examples how do certain organisms pull through the adverse conditions when unable to migrate under stressful period.

[A] [Delhi Set-I, II, III, Comptt., 2016]

Ans. **Hibernation**—winter sleep to escape cold weather e.g. bears.

Aestivation—summer sleep to avoid heat and desiccation e.g. snails / fish.

Diapause—suspended development / activity e.g. zooplanktons.

Spore formation—to tide over unfavourable conditions e.g. fungi / bacteria / lower plants.

Dormancy—By reducing metabolic activity e.g. seeds. $\frac{1}{2} \times 6 = 3$

(any three with corresponding examples)

[CBSE Marking Scheme, 2016]

Q. 3. Why are certain organisms called regulators or conformers? Explain with the help of one example of each. [R] [Outside Delhi Set-I, II, Comptt., 2016]

Ans. Regulators maintain / regulate constant body temperature irrespective of external condition. $\frac{1}{2}$

Conformers changing / varying body temperature as per external condition. $\frac{1}{2}$

Regulators : Humans maintain a constant body temperature of 37°C. In summer when temperature is more outside we sweat, when evaporates causes cooling / in winter when outside temperature is much lower than 37°C, we start shivering / a kind of exercise which produce heat and raises body temperature (**any other suitable appropriate example**). $\frac{1}{2} + \frac{1}{2} = 1$

Conformers : In aquatic animals, the osmotic concentration of body fluid changes with that of the ambient water osmotic concentration / Internal body temperature of reptiles, amphibians, fishes change with that of external temperature. (**Any other suitable appropriate example**). $\frac{1}{2} + \frac{1}{2} = 1$

[CBSE Marking Scheme, 2016]

Q. 4. (i) "Organisms may be conformers or regulators." Explain this statement and give one example of each.

(ii) Why are there more conformers than regulators in the animal world?

[R] [Outside Delhi, 2017, Set - I]

Ans. (i) Conformers : Organisms which cannot maintain a constant internal environment under varying external environmental conditions or change body temperature and osmotic concentration with change in external environment *E.g.* all plants, fishes, amphibians, reptiles. (**Any one**) $\frac{1}{2} + \frac{1}{2}$

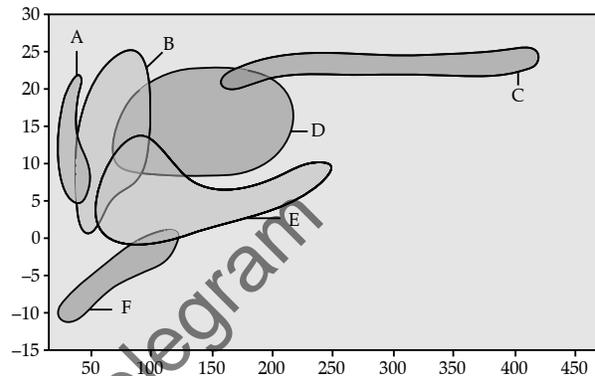
Regulators : Organisms which can maintain homeostasis (by physiological means or

behavioural means), maintain constant body temperature and osmotic concentration *E.g.* birds, mammals. $\frac{1}{2} + \frac{1}{2}$

(ii) Thermoregulation is energetically expensive for animals. 1

[CBSE Marking Scheme, 2017]

Q. 5. The graph given below shows the distribution of biomes:



a) What do the 'X' and 'Y' axes represent?

b) Identify the 'grassland' and 'coniferous forest' biomes, from the above figure.

c) Why is 'F' located at the given position in the graph?

[E & A] [Outside Delhi, 2017]

Ans. (i) 'X' axis–Mean annual precipitation (cm)

'Y' axis–Mean annual temperature (0°C)

$\frac{1}{2} \times 2 = 1$

(ii) Grassland – B

Coniferous forest – E

$\frac{1}{2} \times 2 = 1$

(iii) The mean annual temperature ranges from – 12 to 20°C (error accepted ± 2) and mean annual precipitation ranges from 10 – 125 cm, these are the optimum conditions in tundra biome. $\frac{1}{2} \times 2 = 1$

[CBSE Marking Scheme, 2017]

Q. 6. Different animals respond to changes in their surroundings in different ways. Taking one example each, explain "some animals undergo aestivation while some others hibernation". How do fungi respond to adverse climatic conditions? [A] [Outside Delhi - 2017, Set - II]

Ans. Some animals go into aestivation to avoid summer related problems (heat and desiccation) *e.g.* snails / fish.

(**Any other suitable Example**) $\frac{1}{2} + \frac{1}{2}$

Some animals go into hibernation to avoid winter related problem (extreme cold) *e.g.* bear.

(**Any other suitable Example**) $\frac{1}{2} + \frac{1}{2}$

Fungi form thick walled spores and suspend their activities to respond to adverse climatic condition. 1

[CBSE Marking Scheme, 2017]

OR

18. Aestivation is summer sleep i.e., inactivity during summer seasons, undertaken by organisms of warm climates during hot seasons. This is a type of response shown by organisms when the stressful conditions persist for a short time. Aestivation is undertaken when the stressful conditions arise due to high temperature. Organisms like snails, fishes etc. aestivate to avoid summer related problems like heat, desiccation etc.

While hibernation is inactivity during cold conditions when the organism cannot carry out its normal functions in such an extreme condition. It is known as winter sleep. Organisms seen in polar regions such as polar bears hibernate.

Fungi respond to adverse climatic conditions by forming thick walled spores, which are resistant to such conditions. Encystation / Spore formation enables them to overcome unfavourable conditions. On availability of favourable conditions, they germinate.

[Topper's Answer, 2017]

Detailed Answer :

Aestivation means summer sleep or inactivity during the summer season, undertaken by organisms of warm climates during hot seasons. This is a type of response shown by organisms when the stressful conditions persist for a short time. Organisms like snails, fishes etc. aestivate to avoid summer related problems like heat, desiccation etc.

Hibernation is inactivity during cold conditions, when the organism cannot carry out its normal functions due to extreme conditions. It is known as winter sleep. Organisms of polar regions such as polar bears hibernate.

Fungi respond to adverse climatic conditions by forming thick walled spores, which are resistant to such conditions. Encystation / spore formation enable them to overcome unfavourable conditions, on availability of favourable conditions they germinate.

Q. 7. How do kangaroo rats and desert plants adapt themselves to survive in their extreme habitat? Explain. [U] [Outside Delhi - 2017, Set - III]

Ans. Kangaroo rats : Internal fat oxidation where water is a byproduct, excretes concentrated urine.

$\frac{1}{2} + \frac{1}{2}$

Desert Plants : Thick cuticle / sunken stomata / leaves reduced to spines / deep roots / Special photosynthetic pathway / CAM (Any four) $\frac{1}{2} \times 4$

[CBSE Marking Scheme, 2017] 3

Detailed Answer :

Kangaroo rats fulfil the water requirement by internal oxidation of fat in the absence of water. Desert plants have thick cuticle to prevent loss of

water. CAM plants open their stomata during night to reduce the loss of water during photosynthesis.

[AI] Q. 8. Are humming birds and fish regulators or conformers ? Give reasons in support of your answer. [A] [Delhi Comptt. - 2017, Set - I, II]

Ans. Conformers. $\frac{1}{2}$
Heat loss or gain is a function of surface area. $\frac{1}{2}$
Since small animals have a larger surface area (relative to their volume), they tend to lose body heat very fast when it is cold outside, they have to expend much energy, to generate body heat through metabolism $\frac{1}{2} \times 4 = 2$
(cannot maintain a constant body temperature).

[CBSE Marking Scheme, 2017]

Detailed Answer :

Humming birds and fishes are conformers.

Conformers are not able to bear the energetic expenses to maintain the constant body temperature. Heat loss or gain is the surface phenomenon. The conformers have more surface area in comparison to their volume.

[AI] Q. 9. Explain with the help of suitable examples the three different ways by which organisms overcome their stressful conditions lasting for short duration. [Delhi Set-III, 2016]

OR

How do organisms cope with stressful external environmental conditions that are localized or of short duration ? [Outside Delhi Set-I, II, III, 2011]

Ans. (i) Migration : The organisms (animals) can move away temporarily from stressful habitat to a more hospitable area and return when stressful period is over.

e.g. – Humans moving from Delhi to Shimla during summer / many animals or birds undertake long distance migration to hospitable area. (Any one example)

(ii) **Spore formation** : Various kind of thick walled spores are formed which germinate on availability of suitable environment.

e.g. – bacteria / fungi / lower plants. (Any one)

(iii) **Dormancy** : Seeds or vegetative reproductive structures help to tide over stress by reducing their metabolic activity.

e.g. seeds or vegetative reproductive structures of higher plants.

(iv) **Hibernation** : It takes place during winter.

e.g. bears or any other correct relevant example.

Aestivation : It takes place during summer to avoid heat and dessication in animals.

e.g. snails / fish or any other correct relevant example.

Diapause : Under unfavourable conditions zooplanktons enter a stage of suspended metabolic activity.

E.g. zooplankton. (Any two after migration)

1 + 1 = 2

[CBSE Marking Scheme, 2016]

Detailed Answer :

Three different ways by which organisms overcome their stressful conditions are :

- (i) **Migration** : Birds like bar-headed geese temporarily move from the stressful environment to the more hospitable environment and may return when the period of stress is over. This phenomenon of moving from one place to another is commonly known as migration.
- (ii) **Hibernation (winter sleep)** : It is period of long inactivity in which organism reduces all its metabolic activities and undergo a period of long sleep *e.g.* polar bear hibernates during winter.
- (iii) **Aestivation (Summer Sleep)** : It is commonly seen in animals that live in hot and arid conditions. Frogs undergo aestivation.

Commonly Made Error

- Students get confused between technical terms like hibernation, aestivation etc.

Answering Tip

- Get familiar to technical terms like hibernation, aestivation etc. The concept should be learned carefully with example for better understanding.

Q. 10. (i) State how the constant internal environment is beneficial to organisms.

(ii) Explain any two alternatives by which organisms can overcome stressful external conditions.

[A] [Outside Delhi Set-III, 2014]

Ans. (i) (a) A relatively constant internal (within the body) environment permits all biochemical reaction and physiological function to proceed

with maximum efficiency and thus, enhance the overall 'fitness' of the species. Hence, the living system always tends to remain in a steady state with the help of a self-regulatory mechanism. Such a phenomenon, which involves the maintenance of a constant internal environments, is known as homeostasis.

(ii) (a) **Regulate** : Maintain omeostasis by ensuring constant body temperature (thermoregulation) and constant osmotic concentration (osmoregulation).

(b) **Conform** : Change the internal environment with the external environment. 2+1

Q. 11. Water is very essential for life. Write any three features both for plants and animals which enable them to survive in water scarce environment.

[U] [Delhi Set-I, 2011]

Ans. **Plants** : Ephemeral mode (complete life cycle in short period) / Deep tap roots / Deciduous leaves / Waxy cuticle / Sunken stomata / Succulence to store water / C_4 Pathway of photosynthesis. (Any three)

Animals : No sweating / uricotelic / deposition of fat in sub-epidermal layer / burrowing nature / thick skin / body covered with scales.

[CBSE Marking Scheme, 2011] 3

Q. 12. During the school trip to 'Rohtang Pass', one of your classmates suddenly developed 'altitude sickness'. But, she recovered after sometime.

(i) Mention one symptom to diagnose the sickness.

(ii) What caused the sickness ?

(iii) How could she recover by her self after sometime? [R] [Delhi Set-I, 2016]

Ans. (i) The symptom of altitude sickness include difficulty in breathing, nausea, fatigue and heart palpitations.

(ii) The sickness was caused because of lack of sufficient oxygen and comparatively low RBC count.

(iii) She got acclimatised and stopped experiencing altitude sickness because her body compensated low oxygen availability by increasing the red blood cell production.

[CBSE Marking Scheme, 2016] 1 × 3 = 3

Q. 13. When you go for a trip to any high altitude places you are advised to take it easy and rest for first two days. Comment giving reasons.

[A] [Foreign Set, 2015]

OR

Why do tribes who live in high altitude of Himalayas experience discomfort in respiration? How do they get adapted to survive in such a situation? [Outside Delhi Set, Comptt., 2015]

Ans. At high altitude, the availability of oxygen is low. Therefore, it is advised to take it easy and take rest during initial period of high altitude trip because during this period, the early rest of the body compensates the low O_2 availability by increasing RBC production and increasing the breathing rate.

? Long Answer Type Questions

(5 marks each)

Q. 1. (a) Following are the responses of different animals to various abiotic factors. Describe each one with the help of an example

- (i) Regulate
- (ii) Conform
- (iii) Migrate
- (iv) Suspend

(b) If 18 individuals in a population of 80 butterflies die in a week, calculate the death rate of population of butterflies during the period

5

[U] [Delhi/Outside Delhi, 2018]

Ans. (a) (i) **Regulate:** Maintain constant internal temperature / osmotic concentration / homeostasis.

e.g. birds / mammals.

(ii) **Conform :** Do not maintain constant internal temperature / osmotic concentration / No homeostasis.

e.g. any one example of animal other than birds and mammals.

(iii) **Migrate:** Temporary movement of organisms from the stressful habitats to hospitable areas and return when stressful period is over. example: Bar headed geese

(iv) **Suspend:** Reducing/minimising the metabolic activities during unfavourable conditions.

e.g. Polar bear / amphibian / snails / fish / any other example of animals .

(b) Death rate = $18/80 = 0.225$ therefore, death rate percentage will be = $0.225 \times 100 = 2.25\%$ butterfly death per week [4+1=5 marks]

[CBSE marking scheme]

Detailed Answer:

(a) (i) **Regulate:** Certain animals have the ability to maintain a constant temperature and constant osmolarity to keep up their homeostasis. For example, mammals have a constant body temperature (37°C) irrespective of the outside temperature. In summers, to maintain the temperature, they sweat and in winters they shiver to produce heat.

(ii) **Conform :** About 99% of animals and nearly all plants cannot maintain a constant internal environment. Their body temperature or osmotic concentration change with the surrounding conditions. They are called conformers. Hence, the internal environment of conformers changes with external environment. For example in aquatic animals, osmotic concentration of body fluids changes with that of the ambient osmotic concentration.

(iii) **Migrate:** It is the temporary movement from a stressful habitat to a more hospitable area and return when stressful condition is over. For example during winter, Keoladeo National

Park (Bharatpur, Rajasthan) hosts migratory birds coming from Siberia and other extremely cold northern regions.

(iv) **Suspend:** In bacteria, fungi and lower plants, thick walled spores are formed which help them to overcome stressful, unfavourable conditions. Spores germinate when conditions are favourable.

(b) Death rate in the population during that period is calculated as:

Death rate = Number of organism died / number of organism present initially.

= $18/80$

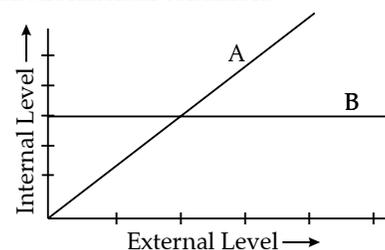
= 0.225 deaths/week

therefore, death rate percentage will be

= $0.225 \times 100 = 2.25\%$

4+1

[AI] Q. 2. (a) The graph given below represents the organisms response to temperature as an environmental condition.



(i) Which one of the two lines represents conformers and why ?

(ii) What does the other line in the graph represent and why ?

(b) Mention the different adaptations the parasites have evolved with, to be able to successfully complete their life cycles in their hosts.

[E & A] [Delhi/Outside Delhi, Comptt, Set 1, 2, 3, 2018]

Ans. (a) (i) A is a conformer 1/2

Cannot maintain homeostasis / constancy of internal environment by physiological means / their body temperature and osmotic concentration of body fluids changes with the ambient temperature. 1

(ii) Regulators 1/2

Maintain homeostasis by physiological means / capable of thermo regulation / maintain a constant body internal environment. 1

(b) Loss of unnecessary sense organs, presence of adhesive organs / suckers to cling on to the host, loss of digestive system, high reproductive capacity. (Any two) 1 + 1

[CBSE Marking Scheme, 2018]



TOPIC-2 Population and Population Interactions

Revision Notes

- **Populations** : A population is defined as a group of individuals of the same species that live in a particular geographical area at a particular time and functioning as a unit.
- A population has certain attributes that an individual organism does not have. For example, individual may have births and deaths, but a population has birth rates and death rates.
- **The birth and death rates** are referred as per capita births or deaths respectively, which increases and decreases with respect to members of the population.
- **Sex ratio** is another attributes of population. An individual may be male or female but population has sex ratio.
- A population at given time is composed of different individuals of different ages. If the age distribution is plotted for the population, the resulting structure is called age pyramids. The shape of pyramids reflects the shape of growth status of population.
- **Population size or population density (N)** is measured in terms of number.
- **Population Growth** : The size of population is not static. It keeps changing with time, depending upon food availability, predation pressure and reduced weather. The main factors that determine the population growth are :
 - (i) Natality (number of births) [B]
 - (ii) Mortality (number of deaths) [D]
 - (iii) Immigration (individuals that come into habitat) [I]
 - (iv) Emigration (individual that leaves the habitat) [E]
- **Differences between Natality Rate and Mortality Rate :**

S. No.	Natality Rate	Mortality Rate
1.	Addition of new individuals due to birth, hatching, germination or division.	Number of individuals in a population decreases with the death of the individuals.
2.	Natality shows the number of offsprings produced per unit time per unit population.	Population density and its size is decreased by death rate.

If 'N' is population density at time 't', then its density at t + 1 is

$$N_{(t+1)} = N_t + [(B + I) - (D + E)]$$

- **Growth model** : Growth of population takes place according to availability of food, habitat condition and presence of other biotic and abiotic factors. There are two main types of models :

- (i) **Exponential Growth** : This kind of growth occurs when food and space is available in sufficient amount. The population grows in an exponential or geometric fashion. If the size of population is N, the birth rate is represented as 'b' and death rate as 'd', then increase and decrease in N during unit period time 't' will be

$$dN/dt = (b - d) \times N$$

Let $(b - d) = r$.

Then $dN/dt = rN$

The r in this equation is called 'intrinsic rate of natural increase'.

- (ii) **Logistic Growth** : There is a competition between the individuals of a population for food and space. The fittest organism survives and reproduces. This type of growth initially shows a lag phase followed by phases of acceleration and de-acceleration. K indicates the carrying capacity of the population.

$$dN/dt = rN \left(\frac{K - N}{K} \right)$$

- **Population interaction** : All animals, plants and microbes in a biological community interact with each other. These interactions may be beneficial, detrimental or neutral to one species or both. Following types of interaction is seen :
 - (a) **Predation** : It is the interaction between two species members in which the members of one species capture, kill and eat up the members of other species.
 - (b) **Parasitism** : It is the relationship between two living organisms of different species in which one organism called parasite obtains its food directly from another living organism called host.
 - (c) **Amensalism** : It is the interaction between two living individuals of different species in which one organism does not allow other organism to grow or live near.

- (d) **Commensalism** : It is the relationship between two living individuals of different species in which one is benefitted, while the other is neither harmed nor benefitted.
- (e) **Proto-cooperation** : It is the interaction between two living organisms of different species in which both are mutually benefitted but they can live without each other.
- (f) **Competition** : It is the rivalry between two or more organisms for obtaining the same resources.
- (g) **Mutualism** : It is the interaction between two organisms of different species where both the partners are benefitted but cannot live separately.

IMPORTANT DIAGRAMS

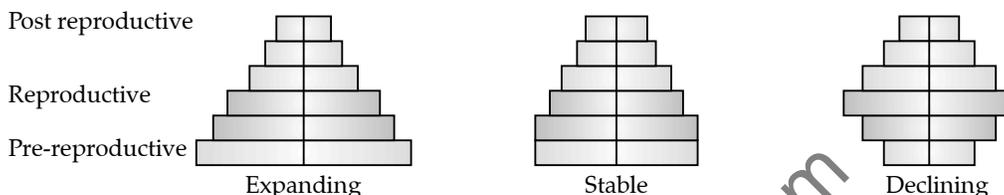


Fig 13.3: Representation of age pyramids for human population

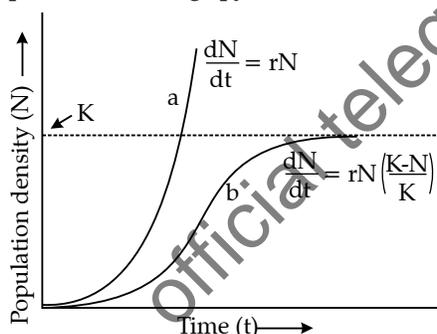


Fig 13.4: Population Growth Curve:

- (a) When responses are not limiting the growth, plot is exponential.
- (b) When responses are limiting the growth, plot is logistic. It produces (S-shaped) sigmoid curve
K is carrying capacity.

Very Short Answer Type Questions

(1 mark each)

Q. 1. Provide an instance where the population size of a species can be estimated indirectly, without actually counting them or seeing them.

[A] [Delhi Set-I, II, III, Comptt., 2016]

Ans. Tiger census in National parks and Tiger reserves was done on the basis of counting pug marks / faecal pellets. [CBSE Marking Scheme, 2016] 1

Q. 2. Name the interaction that exists between cuscuta and shoe-flower plant.

[R] [Delhi Set-I, Comptt. 2015]

Ans. Parasitism. [CBSE Marking Scheme, 2015] 1

Answering Tip

- Learn all types of population interaction with proper examples for better understanding.

Q. 3. Name the interaction that exists between sucker fish and shark.

[R] [Delhi Comptt. 2015]

Ans. Commensalism. [CBSE Marking Scheme, 2015] 1

[AI] Q. 4. Name the type of interaction that exists between barnacles and whale.

[R] [Delhi Set-III, Comptt. 2015]

OR

Name the interaction between a whale and the barnacles growing on its back.

[Outside Delhi Set-III, 2012]

Ans. Commensalism. [CBSE Marking Scheme, 2015] 1

Q. 5. State the type of interaction that exists between ticks and dogs.

[R] [Outside Delhi Set-I, Comptt. 2015]

Ans. Ecto (Parasitism). [CBSE Marking Scheme, 2015] 1

Q. 6. Name the type of interaction seen between fig and wasps.

[R] [Outside Delhi Set-II, Comptt. 2015]

Ans. Mutualism. [CBSE Marking Scheme, 2015] 1

Q. 7. Name the type of association that the genus *Glomus* exhibits with higher plants.

[R] [Outside Delhi Set-I, 2014]

Ans. *Glomus* exhibits arbuscular mycorrhizal (AM) association. [CBSE Marking Scheme, 2015] 1

Q. 8. State Gause's competitive exclusion principle.

[R] [Outside Delhi Set-I, 2014]

Ans. According to this principle, the two closely related species competing for the same but limited resources cannot co-exist continuously for a long time. Eventually the competitively inferior one will be eliminated. 1

Q. 9. Name two intermediate hosts which the human liver fluke depends on to complete its life cycle so as to facilitate parasitisation of its primary host.

[R] [Delhi Set-II, 2014]

Ans. Snail and Fish. 1

Q. 10. How are closely related species of warblers able to co-exist in a competitive environment ?

[R] [Delhi Set-III, Comptt. 2013]

Ans. They can co-exist due to behavioural differences in their foraging activities. 1

Q. 11. What does nature's carrying capacity for a species indicate ?

[U] [Foreign Set-I, 2016]

Ans. (In nature) a given habitat has enough or limited resources to support a maximum possible number and nature's carrying capacity indicates that no further growth in population is possible. 1

[CBSE Marking Scheme, 2016]

[R] Q. 12. Pollinating species of wasps shows mutualism with specific fig plants. Mention the benefits the female wasps derive from the fig trees from such an interaction.

[R] [Outside Delhi Comptt. 2011]

Ans. The female wasp uses the fruit not only as an oviposition (egg-laying) site but uses the developing seeds within the fruit for nourishing its larvae. The wasp pollinates the fig inflorescence while searching for suitable egg-laying sites. In return for the favour of pollination, the fig offers the wasp some of its developing seeds as food for the developing wasp larvae. 1

Q. 13. Name two inter specific interactions where one partner is neutral i.e. not affected.

[R] [Outside Delhi Comptt., 2013]

Ans. Amensalism and commensalism. 1

Q. 14. In a pond there were 200 frogs. 40 more frogs were born in a year. Calculate the birth rate of the population. [A] [Delhi 2016]

Ans. Birth rate = 0.2 frogs/yr or 20%. 1

Q. 15. Why are cattle and goats not seen browsing on *Calotropis* growing in the field ? [R] [Foreign 2011]

Ans. Cattle and goats are not seen browsing on *Calotropis* because *Calotropis* produces a highly poisonous chemical called cardiac glycosides. 1



Short Answer Type Questions-I

(2 marks each)

Q. 1. Draw labelled diagrams of stable and declining age pyramids of human population.

[U] [Outside Delhi Set-III, Comptt. 2015]

Ans. Diagram: Refer Topic 2/ Revision Notes/Important diagram/ Fig 13.3

[CBSE Marking Scheme, 2015] $\frac{1}{2} \times 4 = 2$

Q. 2. What is mutualism ? Mention any two examples where the organisms involved are commercially exploited in agriculture.

[R] [Outside Delhi Set-I, 2015]

Ans. Interaction between two species in which both are benefitted 1

- (i) *Rhizobium* in the roots (nodules) of legumes $\frac{1}{2}$
- (ii) Mycorrhiza / *Glomus* with the roots of higher plants. $\frac{1}{2}$ [CBSE Marking Scheme, 2015]

Commonly Made Error

- Most of the students give incomplete definitions such as, 'association' between two organisms without mentioning 'of two different species'. Some wrote 'type of association' between organisms which harm each other. Some just give examples of parasites. A few forget to mention the names of partners and the benefit available to both.

[R] Q. 3. Construct an age pyramid which reflects a stable growth status of human population.

[U] [Outside Delhi Set-III, 2014,]

Ans. Diagram: Refer Topic 2/ Revision Notes/Important diagram/ Fig 13.3 - Stable growth.

[CBSE Marking Scheme, 2014, 2011] 2

Q. 4. Differentiate between commensalism and mutualism by taking one example each from plants only. [U] [Delhi Set-I, II, III, 2014]

Ans. **Commensalism** : In this interaction, one species is benefitted and the other species is neither benefitted nor harmed.

e.g. an orchid growing as an epiphyte on the branch of a mango.

Mutualism : In this interaction, both the interacting species are benefitted.

e.g. Lichens exhibit mutualistic relationship between a fungus that absorbs water and nutrients from soil and photosynthesizing algae / cyanobacteria. [CBSE Marking Scheme, 2014] 2

Commonly Made Error

- Students get confused between various population interactions.

Answering Tip

- Learn the differences between various population interactions with examples for better retention and understanding.

AIQ. 5. Explain Verhulst – Pearl Logistic Growth of a population. [R] [Delhi Set-I, 2014]

Ans. A population growing in a habitat with limited resources show initially a lag phase, followed by phases of acceleration and deceleration, finally an asymptote when the population density reaches the carrying capacity.

$$dN / dt = rN \left(\frac{K-N}{K} \right)$$

[CBSE Marking Scheme, 2014] 2

Q. 6. Describe the mutual relationship between fig tree and wasp and comment on the phenomenon that operates in their relationship.

[U] [Outside Delhi Set-III, 2014]

Ans. Wasp helps in pollination while fig tree helps in oviposition and nourishment of larva.

The phenomenon seen here is mutualism (two organisms existing symbiotically or in mutual cooperation and benefits to each other) and Co-evolution (the evolution of fig tree and wasp in accordance with the changes in each other) and also coextinction.

[CBSE Marking Scheme, 2014, 2011] 2

Q. 7. Apart from being part of the food chain, predators play other important roles. Mention any two such roles supported by examples.

[U] [Delhi Set-I, II, 2014, 2011]

OR

Explain the role played by predators in a community. [A] [Outside Delhi Comptt. 2017, Set - I]

Ans. (i) Predators act as conduits for energy transfer across trophic levels.

(ii) They keep prey population under control.

(iii) They help in maintaining species diversity in a community by reducing intensity of competition among competing prey species.

(iv) An efficient predator may cause extinction of prey species. (Any two) 1 + 1

[CBSE Marking Scheme, 2012]

Commonly Made Error

- Majority of the students are unclear about the role of predators. Most of them write that the predators disturb the ecosystem.

Answering Tip

- Make sure, you learn the role of predators thoroughly and clearly.

Q. 8. How does Monarch butterfly defend itself from predators ? Explain.

[R] [Delhi Set-I, Comptt. 2013]

Ans. Monarch butterflies are highly distasteful to their predators. This butterfly species accumulates a chemical by feeding on a poisonous weed during its caterpillar stage. 2

Q. 9. Explain brood parasitism with the help of an example. [R] [Outside Delhi Set-II, 2012]

Ans. Koel is a parasitic bird (which has lost the instinct to make its own nest to lay eggs). It has evolved the technique of laying eggs in the nest of a crow. Its eggs bear resemblances to those of crow.

[CBSE Marking Scheme, 2012] 2

Detailed Answer :

Brood parasitism is a condition where a bird lays eggs in the nests of other bird and let the other bird incubate them. A classical example of this can be seen in koel. Koel lays egg in the nest of crow and during the period of evolution, eggs of koel have begun to resemble with the eggs of crow in colour, shape and size.

Q. 10. Why do clown fish and sea anemone pair up ? What is this relationship called ?

[R] [Outside Delhi Set-III, 2012]

Ans. Clown fish gets protection from its predators by moving around the stinging tentacles of the sea anemone. The sea anemone is neither helped nor harmed by the interaction with the fish. This relationship is called Commensalism.

[CBSE Marking Scheme, 2012] 2

Detailed Answer :

Clown fish maintains a commensalistic relation with the sea anemone. In this interaction, one species benefits and the other is neither harmed nor benefited. Sea anemone has stinging tentacles that provide protection to clown fish from predators. The anemone does not appear to derive any benefit from the clown fish.

Q. 11. Koel is clever enough to lay eggs in a crow's nest. Write the reason for this peculiar behaviour. Name the type of interaction.

[U] [Outside Delhi Set-II, Comptt. 2015]

Ans. So that the crow can incubate the Koel's eggs. Interaction – Brood parasitism.

[CBSE Marking Scheme, 2015] 1+1

Q. 12. Besides acting as 'conduits' for energy transfer across trophic levels, predators play other important roles. Justify. [U] [CBSE SQP, 2015]

Ans. Besides acting as 'conduits' of energy transfer across trophic levels, predator play other important roles like :

(i) They keep prey population under control.

(ii) Predators also help in maintaining species diversity in a community by reducing the intensity of competition among competing prey species.

[CBSE Marking Scheme, 2015] 1+1

? Short Answer Type Questions-II

(3 marks each)

Q. 1. Name and explain the type of interaction that exists in mycorrhizae and between cattle egret and cattle. [R] [Outside Delhi Set-I, 2016]

Ans. Mycorrhiza is an association between fungi and the roots of higher plants. It is an example of mutualism in which both fungi and plants are dependent on each other for nutritional needs. The fungi help the plant in the absorption of essential nutrients from the soil while the plant provides the fungi with carbohydrates.

The interaction that exists between cattle egret and cattle is known as commensalism. In this type of interaction, one species is benefitted whereas the other is neither benefitted nor harmed. The cattle egret (bird) usually forages in close proximity to the grazing cattle. As cattle moves in the grass they stir up the grass and flush out the insects which then become an easy target for the egret. In this way, the cattle is neither benefitted nor harmed but the egret is benefitted.

[CBSE Marking Scheme, 2016] 3

[AI] Q. 2. Predation is usually referred to as a detrimental association. State any three positive roles that a predator plays in an ecosystem. [A] [Outside Delhi Set-II, 2016]

Ans. Positive roles that predator plays in an ecosystem:

- Predator acts as conduits for energy transfer across trophic levels.
- Predators keep prey populations under control.
- Predators also help in maintaining ecological balance species diversity in a community, by reducing the intensity of competition among competing prey species.

[CBSE Marking Scheme, 2016] 1+1+1

OR

(i) The beneficial roles of predation are →

- Predation acts as conduits of energy transfer across trophic levels in an ecosystem.
- Predators help to keep prey populations under control. eg. prickly pear cactus caused havoc in Australia due to absence of its natural predators. By spreading into millions of hectares of rangeland. It was finally brought under control after a cactus feeding moth (predator) was introduced.
- Predators help to maintain species diversity in a community by reducing the intensity of interspecific competition among prey species. eg. more than 10 species of invertebrates became extinct within an year when a predator (Pisaster) was experimentally removed.

[Topper's Answer, 2016]

Q. 3. When do you describe the relationship between two organisms as mutualistic, competitive and parasitic? Give one example of each type.

[A] [Foreign - 2017, Set - I]

Ans. **Mutualistic** : Both the interacting organisms are benefitted from each other e.g., Lichens - Algae and fungi mutually help each other. (any other appropriate example) $\frac{1}{2} + \frac{1}{2}$

Competition : When two organisms belonging to closely related species / unrelated groups compete for the same resources that are limited, both are losers e.g. superior barnacle dominates and excludes the small barnacles / in some South American lakes visiting flamingoes and resident

fishes compete for their common food (zooplankton) in the lake / any other appropriate example. $\frac{1}{2} + \frac{1}{2}$

Parasitic : One of the two organisms is dependent on the other (host) for nutrition and support / the host is harmed and the parasite is benefitted e. g. Malarial parasite and human / Cuscuta on host plant / or any other appropriate example. $\frac{1}{2} + \frac{1}{2}$

[CBSE Marking Scheme, 2017]

Q. 4. Highlight the differences between the population interactions given below. Give an example of each. [R] [Foreign - 2017, Set - III]

- Parasitism
- Amensalism

(iii) Mutualism

Ans. Parasitism : Only one species benefits e.g., Cuscuta / Tape worm $\frac{1}{2} + \frac{1}{2}$
Amensalism : One species is harmed whereas the other is unaffected e.g., *Penicillium* growing on bacterial culture / *Trichoderma* - biological control agent and plant pathogen $\frac{1}{2} + \frac{1}{2}$

Mutualism : Both species are benefitted E. g., lichens exhibit mutualistic relationship with fungus that absorbs water and nutrients from soil and photosynthesizing algae / cyanobacteria

$\frac{1}{2} + \frac{1}{2}$

[CBSE Marking Scheme, 2017]

Q. 5. Highlight the differences and a similarity between the following population interactions, competition, predation and commensalism. [Foreign - 2017, Set - II]

Ans.

	Competition	Predation	Commensalism
Differences	Both species lose in their interaction	Only one species benefits in their interaction	One species is benefitted and the other is neither benefitted nor harmed in their interaction
Similarity	Both the interacting species live together	Both the interacting species live together	Both the interacting species live together

$\frac{1}{2} \times 6 = 3$

Q. 6. Explain parasitism and co-evolution with the help of one example of each.

[Outside Delhi Set-III, 2016]

Ans. Mode of interaction between two species in which one species (parasite) depends on the other species (host) for food and shelter / one organism is benefitted, the other is harmed. $\frac{1}{2} + \frac{1}{2} = 1$
 e.g. Human liver fluke / Malarial parasite / Cuscuta.

Co-evolution is the relationship between two interacting organisms where both organisms failed to survive in the absence of the other.

e.g. Fig and Fig wasp / Ophrys and bumble bee. 1
 (or any other suitable example) $\frac{1}{2}$

[CBSE Marking Scheme, 2016]

Detailed Answer:

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.

Co-evolution is an interaction between two living organism where both are equally benefitted and no one is harmed. For example, wasp pollinating fig inflorescence. The fig species is pollinated only by its 'partner' wasp species and no other species. The female wasp pollinates the fig inflorescence while searching for suitable egg-laying sites in fruits, whereas the fig offers the wasp some developing seeds as food for the wasp larvae.

Q. 7. (i) Explain any two defence mechanisms plants have evolved against their predators.

(ii) How does predation differ from parasitism ?

[Foreign Set-I, 2016]

Ans. Plants develop following defence mechanisms :

(i) (a) Thorns are (morphological) means of defence. 1

(b) Plants may produce / store chemicals such as nicotine, strychnine etc. for defence which inhibit digestion / disrupts reproduction / kill the predator / calotropis produces highly poisonous cardiac glycosides / plants may produce chemicals such as nicotine/ caffeine/ quinine/ strychnine/ opium are produced as defence. 1

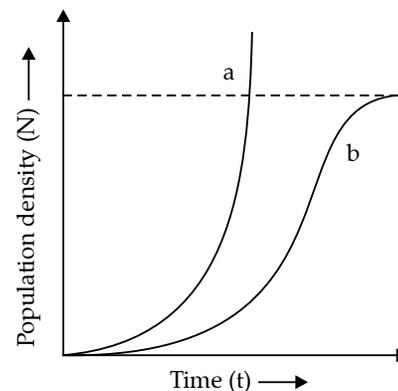
(ii)

S. No.	Parasitism	Predation
(a)	Lives and feed on the host.	Only feeds on prey.
(b)	host specific.	prudent / not prey specific.
(c)	Co-evolve with the host.	Control / check prey population.

(Any one difference) 1

[CBSE Marking Scheme, 2016]

Q. 8. Study the graph given below and answer the question that follow :



- (i) Write the status of food and space in the curves (a) and (b).
- (ii) In the absence of predators, which one of the two curves would appropriately depict the prey population ?
- (iii) Time has been shown on X-axis and there is a parallel dotted line above it. Give the significance of this dotted line. [E & A] [Delhi Set-II, 2014]

Ans. (i) a - Unlimited food and space.
b - Limited food and space.

(ii) Curve a.

(iii) Carrying capacity / a given habitat has enough resources to support maximum possible number - beyond which no further growth is possible. [CBSE Marking Scheme, 2014] 3

Q. 9. (i) Write the parasitic adaptations the parasites have evolved in accordance with their lifestyles.

(ii) Hosts and parasites tend to co-evolve. Explain.

[U] [Delhi Set-III, Comptt. 2013]

Ans. (i) Parasites have evolved the following adaptation :

(a) Loss of unnecessary sense organs.

(b) Presence of hook / adhesive organs and suckers.

(c) Loss of digestive system.

(d) High reproductive capacity.

(ii) In some cases, a parasitic species may evolve with its host taxa. Long-term co-evolution sometimes leads to a relatively stable relationship, tending to commensalism or mutualism, as it is in the evolutionary interest of the parasite that its host thrives. A parasite may evolve to become less harmful for its host or a host may evolve to cope with the unavoidable presence of a parasite, to the point that the parasite's absence causes the host harm. [CBSE Marking Scheme, 2014] 3

AIQ. 10. Name the type of interaction seen in each of the following examples :

- (i) *Ascaris* worms living in the intestine of human
- (ii) Wasp pollinating fig inflorescence
- (iii) Clown fish living among the tentacles of sea-anemone
- (iv) Mycorrhizae living on the roots of higher plants
- (v) Orchid growing on a branch of a mango tree
- (vi) Disappearance of smaller barnacles when *Balanus* dominated in the coast of Scotland.

[U] [Delhi Set-I, 2011]

Ans. (i) Parasitism
(ii) Mutualism
(iii) Commensalism
(iv) Mutualism

- (v) Commensalism
(vi) Competition

[CBSE Marking Scheme, 2011] 3

AIQ. 11. (i) Explain the birth rate and death rate in population with the help of an example.

(ii) What is age pyramid ?

[R] [Outside Delhi Comptt. 2011]

Ans. (i) In a population, the birth rate and death rate refer to per capita births and deaths, respectively.

Examples of birth rate and death rate are :

Birth rate : If in a pond, there were 20 lotus plants last year and through reproduction 8 new plants are added, taking the current population to 28, we calculate the birth rate as $8/20 = 0.4$ offspring per lotus per year.

Death rate : If 4 individuals in a laboratory population of 40 fruit flies died during a specified time interval, say a week, the death rate in the population during that period is $4/40 = 0.1$ individuals per fruit fly per week. 2

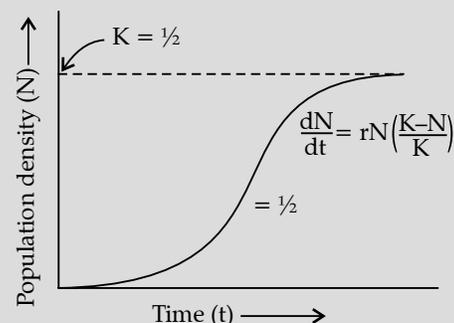
(ii) A population at any given time is composed of individuals ages. If the age distribution (per cent individuals of a given age or age group) is plotted for these population, the resulting structure is called an age pyramid. 1

Q. 12. Draw and explain a logistic curve for a population of density (N) at time (t) whose intrinsic rate of natural increase is (r) and carrying capacity is (K).

[R] [Delhi Set-I, 2010]

Ans. A population growing in a habitat with limited resources show initially a lag phase, this is followed by phases of acceleration and deceleration and finally an asymptote when the population density reaches carrying capacity (K). A plot of N in relation to time (t) result in a sigmoid curve (Verhulst - Pearl Logistic Growth).

$$\frac{dN}{dt} = rN \left(\frac{K-N}{K} \right) \quad 1$$



[CBSE Marking Scheme, 2010] $\frac{1}{2} \times 4 = 2$

Answering Tip

- Practice drawing the population curve with proper labelling.

Q. 13. (i) A parasite has to adapt to be able to live in a host. Write the various parasite adaptations?

(ii) Mention an adaptive feature exhibited in brood parasitism in Koel and Crow.

[A] [Foreign Set-II, 2016]

Ans. (i) The various parasitic adaptation enabling it to live in host are as follows :

- Loss of unnecessary sense organs.
- Adhesive organs or suckers to cling on to the host.
- Loss of digestive system.
- High reproductive capacity.
- Loss of chlorophyll and leaves. $\frac{1}{2} \times 4 = 2$

(Any four)

(ii) The eggs of the parasitic bird (Koel) resemble the host's egg (Crow) in size and colour to reduce the chances of the host bird detecting the foreign eggs and ejecting them out from the nest. 1

[CBSE Marking Scheme, 2016]

Q. 14. Co-evolution is a spectacular example of mutualism between an animal and a plant. Describe co-evolution with the help of an example.

[U] [Foreign Set-III, 2016]

Ans. Co-evolution is the mutual relationship between two interacting organisms where both the organisms are unable to survive in the absence of the other. The co-evolution of fig and wasp as a pollinator is highly linked with one another. Fig and wasp is a good example of mutualism and co-evolution between a plant species and an animal species. 1

The female wasp uses the fruit and fig for oviposition / egg laying uses seeds within the fruit (developing seeds) for nourishing its larvae. In return the wasp pollinates the fig inflorescence. The given fig species can be pollinated only by its 'partner' wasp species and no other species.

$\frac{1}{2} \times 4 = 2$

[CBSE Marking Scheme-2016]

Q. 15. Explain co-evolution with reference to parasites and their hosts. Mention any four special adaptive features evolved in parasites for their parasitic mode of life. [U] [Outside Delhi Set-II, 2015]

Ans. Co-evolution can be defined as reciprocal adaptations in two interacting organisms that brings about the evolutionary change in both of them. In terms of the relation of host and parasite, it can be explained as follows :

Parasite is an organism that is totally dependent on the host organism for its survival but in doing so, it also harms the host. The host evolved over

a long period of time to protect itself from parasite, while parasite evolved so that it can find other way to derive nutrition from the host and hence, the cycle continues.

The various parasitic adaptation enabling it to live in host are as follows :

- Loss of unnecessary sense organs.
- Adhesive organs or suckers to cling on to the host.
- Loss of digestive system.
- High reproductive capacity.
- Loss of chlorophyll and leaves.

[CBSE Marking Scheme, 2015] 3

Q. 16. What is Predation ? Explain with the help of suitable examples why is it required in a community with rich biodiversity?

[E] [Outside Delhi Set-II, Comptt. 2015]

Ans. Organism of higher trophic level (predator) feeds on organism of lower trophic level (prey) is called the predation.

Importance of predation :

- It helps in transfer of energy from one trophic level to the next.
- It keeps the prey population under control.
- It helps in biological control, helps maintain species diversity. (Any two) 2+1

[AI] Q. 17. a) In a pond there were 200 frogs. 40 more were born in the year. Calculate the birth rate of the population.

b) Population in terms of number is not always a necessary parameter to measure population density. Justify with two examples.

[E & A] [CBSE SQP, 2018]

Ans. a) Birth rate: No of individuals/ Total no. of individuals = $40/200 = 0.2$ frogs per year. 1

b) Number is not always a necessary parameter to measure population density.

Example:

1. If there are 200 *Parthenium* plants but only a single huge banyan tree with a large canopy, the population density of banyan is low relative to that of *Parthenium* which amounts to underestimating the enormous role of the Banyan in that community. In such cases, the per cent cover or biomass is a more meaningful measure of the population size.

2. In a dense laboratory culture of a microbial population in a petri dish, the total number of microbes is again not an easily adoptable measure because population is huge, counting is impossible and time-consuming. 1 + 1

[CBSE Marking Scheme, 2018]

? Long Answer Type Questions

(5 marks each)

Q. 1. (i) Name the two growth models that represent population growth and draw the respective growth curves they represent.

(ii) State the basis for the difference in the shape of these curves.

(iii) Which one of the curves represents the human population growth at present? Do you think such a curve is sustainable? Give reason in support of your answer.

[R] [Outside Delhi Set-I, 2016, KVS]

Ans. (i) The two types of growth models are as follows :

(a) Exponential growth : When the resources are unlimited, population tends to grow in an exponential pattern.

If the population size is N and the birth and death rates (not per capita) are b and d respectively, then increase or decrease of N at t (time period) is given by

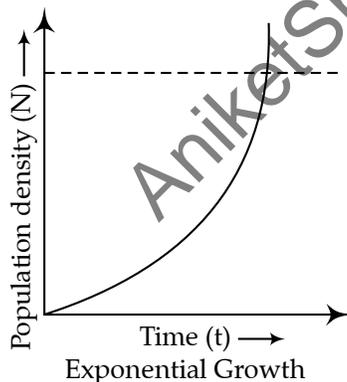
$$dN/dt = (b - d) * N$$

If $(b - d) = r$, then

$$dN/dt = rN$$

where r = Intrinsic rate of natural increase

$$\text{or } N_t = N_0 e^{rt}$$



where

N_t = Population density at time t

N_0 = Population density at time 0

r = Intrinsic rate of natural increase

e = Base of natural algorithm (2.71828) 1

(b) Logistic Growth : When the resources are limited leading to competition between individuals and survival of fittest, the population tends to grow in a logistic manner.

A population with limited resources shows initially a lag phase, followed by phases of acceleration and deceleration and finally an asymptote, when the population density reaches the carrying capacity. This type of population growth is called Verhulst-Pearl Logistic Growth.

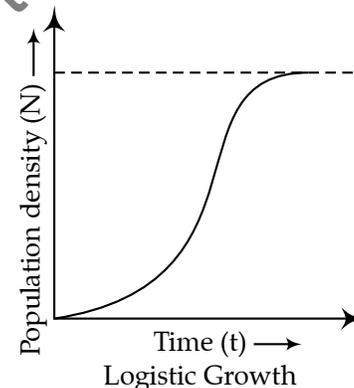
$$\frac{dN}{dt} = rN \left(\frac{K - N}{K} \right)$$

where,

N = Population density at time t

r = Intrinsic rate of natural increase

K = Carrying capacity



(ii) The difference in the shape of these curves is the amount of resources available for the given population. For exponential growth, the amount of resources is considered infinite, while, logistic growth happens when there are limited resources. 1

(iii) The human population represents the logistic growth curve as the numbers of human beings are increasing rapidly but available resources are not increasing at the same pace. Such a growth pattern is not sustainable because at one point the human population would reach a place where there would not be enough resources for everyone. For sustainable growth, we must find out ways to develop and use already present resources more intelligently. 2

OR

(a) The two growth models for population growth are —

(i) Exponential growth (ii) Verhulst Pearl Logistic growth

$$\frac{dN}{dt} = rN \quad [r = \text{Intrinsic Rate of Natural Increase}]$$

$$\frac{dN}{dt} = rN \left(\frac{K-N}{K} \right) \quad [K = \text{Carrying Capacity}]$$

J shape growth curve Sigmoid / S -shape growth curve

(b) The basis of difference in shapes of the curves is due to Resources.

- In exponential curve (Resources = food + space) are unlimited, so the population grows exponentially.
- In logistic growth after a short phase of exponential growth, Resources begin to get depleted and thus population reaches an equilibrium near the carrying capacity of the habitat.

(c) The J shaped exponential curve represents the growth of human population at present.

- Such a growth is not sustainable as the Resources (food + space) will soon get limiting and due to environmental sustenance there may be a population crash.

[Topper's Answer, 2016]

Q. 2. (i) Represent diagrammatically three kinds of age-pyramids for human populations.

(ii) How does an age pyramid for human population at given point of time helps the policy-makers in planning for future. [Delhi, Set-I, II, 2016]

Ans. (i) For Diagram: Refer Topic 2/ Revision Notes/ Important Diagram/ Fig 13.3 1+1+1=3
 (ii) Planning of health / education / transport / infra-structure / finance / food / employment can depend on the age-pyramid analysis of a population / any other relevant point.
 (Any two explanation) 1+1 = 2
 [CBSE Marking Scheme, 2016]

Detailed Answer :

- (i) Same as above
- (ii) Age pyramid for human population can help the policy makers to prepare future planning for—stress of family planning measures, help elderly people to live comfortably, planning more schools, technical institutes with digital facilities for education and more job opportunities for future.

Q. 3. (i) What is an age-pyramid ?

(ii) Name three representative kinds of age-pyramids for human population and list the characteristics for each one of them. [Delhi - 2017, Set - I, II, III]

OR

(i) What is an age-pyramid ?

(ii) Explain with the help of figures the three different types of age pyramids represented by a human population.

[Outside Delhi Set-I, 2015; Delhi Comptt. 2011]

Ans. (i) If the age distribution (per cent individuals of a given age or age group) is plotted for the population, the resulting structure is called the age pyramid. 2

(ii) **Expanding** : Pre reproductive population is greater than reproductive or post reproductive population / growing with maximum no. of individuals in pre reproductive phase and least no. in post reproductive phase.

Stable : Pre-reproductive and reproductive population are almost similar / ideal for

population / maintains balanced continuity / no. of individuals in reproductive phase is almost same, less no. of individuals in post reproductive phase.

Declining : Pre-reproductive population is less than reproductive population / less no. of individuals in pre reproductive phase than reproductive phase. $\frac{1}{2} \times 6$

OR

In lieu of the above explanation the following diagram can be considered.

Diagram: Refer Topic 2/ Revision Notes/ Important diagrams/ Fig 13.3 $2 + 3 = 5$

Q. 4. (i) What is population density ? Why are ecologists interested in measuring it ?

(ii) Write the different ways of measuring population density. Explain any two with the help of specific examples.

[R] [Outside Delhi Set-I, II Comptt., 2016, KVS]

Ans. (i) The population density is the number of individuals of a population found per unit area at a given time. **1**

Whatever ecological process we wish to investigate in a population (competition / pesticide applicable) we always evaluate in terms of any change in population size (numbers / biomass). **1**

(ii) Number of organism $\frac{1}{2}$
Biomass of organism $\frac{1}{2}$

Example : Three ways of measuring population density of a habitat

(a) Per cent cover for trees with larger canopy.

(b) Number of fishes caught per trap.

(c) Pug marks or faecal pellets for tiger census.

(Also refer, LAQ, Q6 (ii)) **1+1**

Q. 5. "Analysis of age pyramids for human population can provide important inputs for long-term planning strategies." Explain.

[U] [Delhi Set-I, 2015]

Ans. Analysis of age-pyramids for human population can provide important inputs for long-term planning, strategies :

The different age groups present in a population determines its reproductive status. Distribution of age groups highly influences the growth of the population. Each population displays following three ecological ages or age groups :

(a) Pre-reproductive

(b) Reproductive

(c) Post-reproductive.

Population having large number of young members grows rapidly, while the population bearing more number of post-reproduction members tends to be declining. There are basically three types of age-pyramids found to be present in human population. These are as follows :

Refer LAQ/ Q 3.

Therefore, through the analysis of the age-pyramids of a particular population, the distribution of resources can be done more efficiently. A better planning strategy can be adopted considering the demand of the resource, thus, long term management of resources can be done in such a way that the population can derive maximum benefit with minimum effects on nature, leading the population to flourish efficiently. **5**

[CBSE Marking Scheme, 2015]

Q. 6. (i) List the different attributes that a population has and not an individual organism.

(ii) What is population density ? Explain any three different ways the population density can be measured, with the help of an example each.

[R] [Outside Delhi Set-I, 2015]

Ans. (i) Following are the attributes that a population has but an individual organism does not have.

(a) Birth rate : Per capita births.

(b) Death rate : Per capita deaths.

(c) Sex ratio : Ratio of number of males to females in a population.

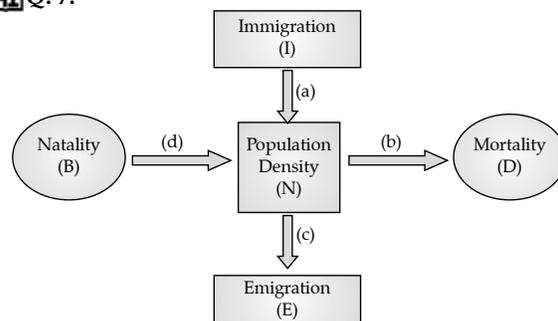
(ii) Population density : It means number of individuals present per unit area. Population density can be measured by determining the population size. The different methods to study population size are as follows :

(a) Quadrat method : It is a method that involves the use of square of particular dimensions to measure the number of organisms *e.g.* The number of parthenium plants in a given area can be measured using the quadrat method.

(b) Direct observation : It involves the counting of organisms in a given area *e.g.* In order to determine the number of bacteria growing in a petridish, their colonies are counted.

(c) Indirect method : In this method, there is no need to count the organisms individually *e.g.* number of fishes caught per trap gives the measure of their total density in a given water body. **[CBSE Marking Scheme, 2015] 5**

[R] Q. 7.



(i) Which of the above represents the increase or decrease of population ?

(ii) If N is the population density at time t, then what would be its density at time (t + 1) ? Give the formula.

- (iii) In a barn there were 30 rats. 5 more rats enter the barn and 6 out of the total rats were eaten by the cats. If 8 rats were born during the time period under consideration and 7 rats left the barn, find out the resultant population at time ($t + 1$).
- (iv) If a new habitat is just being colonized, out of the four factors affecting the population growth which factor contributes the most ?

[E & A] [CBSE, SQP, 2015]

Ans. (i) Natality (B) and Immigration (I) represents increase of population and Emigration (E) and Mortality (D) represent decrease of population.

(ii) $N_{t+1} = N_t + [(B + I) - (D + E)]$

(iii) Here $N_t = 30$; $I = 5$; $E = 7$; $D = 6$; $B = 8$

Putting the value in N_{t+1}

$$= N_t + [(B + I) - (D + E)]$$

$$N_{t+1} = 30 + [(8 + 5) - (6 + 7)]$$

$$= 30 + [13 - 13]$$

$$= 30 + 0 = 30 \text{ rats}$$

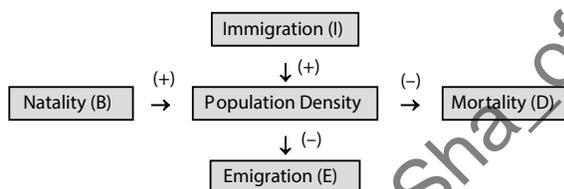
(iv) Immigration contributes the most.

[CBSE Marking Scheme, 2015] 1+1+2+1=5

Q. 8. (i) Explain the equation.

$$N_{t+1} = N_t + [(B + I) - (D + E)]$$

on the basis of the flow chart given below :



(ii) Mention the different ways by which the population density of different species can be measured. [E & A] [Delhi Comptt. 2011]

Ans. (i) In the given equation, N is the population density at time t and its density at time $t + 1$ is $N_{t+1} = N_t + [(B + I) - (D + E)]$

The above equation shows that population density increases if the number of births plus the number of immigrants ($B + I$) is more than the number of deaths plus the number of emigrants ($D + E$), otherwise it will decrease. Under normal conditions, births and deaths are the most important factors. The other

two factors are important only under special conditions. For instance, if a new habitat is just being colonized, immigration may contribute more significantly to population growth than birth rates.

(ii) Population density of a species is the number of individuals of a species per unit area or volume e.g. number of animals per square kilometer, number of trees per hectare, number of phytoplanktons per cubic liter of water.

Population density (PD) can be calculated as

$P.D. = N/S$

where, N = Number of individuals in a region.

S = Number of unit areas in a region or total unit land area of the region.

Population of an area is described on the basis of three parameters.

- (a) Number and kind of individuals of a species.
- (b) A given space or an area.
- (c) Time.

Population density reflects the success of a species in a given area. $2+3=5$

Q. 9. (i) Compare, giving reason, the J-shaped and S-shaped models of population growth, of a species.

(ii) Explain "fitness of a species" as mentioned by Darwin. [R] [Outside Delhi - 2017, Set - I, II, III]

Ans. (i)

J shaped - growth curve	S-shaped - growth curve
Resources are unlimited	Resources are limited
Growth is exponential	Logistic Growth
As resources are unlimited all individuals survive and reproduce	Fittest individual will survive and reproduce
Growth Equation : $dN/dt = rN$ (If explained)	Growth Equation : $dN/dt = rN (K-N/K)$ (If explained)

(Any three) 1 + 1 + 1

Note : Marks to be awarded only if the corresponding difference is written.

(ii) When resources are limited, competition occurs between individuals, fittest will survive, which will reproduce to leave more progeny. $\frac{1}{2} \times 4$

[CBSE Marking Scheme, 2017]

Know the Terms

- **Adaptations :** These are certain characteristics that organism develop in order to survive and reproduce better in their habitat.
- **Population :** It is defined as a group of individuals of the same species that live in a particular geographical area at a particular time and functioning as a unit.
- **Birth rate (Natality) :** It is the ratio of live births in an area to the population of an area.
- **Death rate (Mortality) :** It is the ratio of deaths in an area to the population of an area.
- **Sex ratio :** It is the number of males or females per thousand individuals.
- **Population density :** It is defined as the number of individuals of a population present per unit area at a given time.
- **Natality (B) :** It is the number of births during a given period in a population.

- **Mortality (D)** : It is the number of deaths in a population during a given period.
- **Immigration (I)** : It is the number of individuals of the same species that have come into the habitat from elsewhere during a given time period.
- **Emigration (E)** : It is the number of individuals of the population who left the habitat and gone elsewhere during a given time period.
- **Mutualism** : Both the species are benefitted (+).
- **Competition** : Both the species are harmed (-).
- **Parasitism** : One species (parasite) is benefitted and other species (host) is harmed.
- **Predation** : One species (predator) is benefitted and other species (prey) is harmed.
- **Commensalism** : One species is benefitted and the other is neither benefitted nor harmed (0).
- **Amensalism** : One species is harmed and the other is unaffected.

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