- As the anther develops, the group of cells below the epidermis, become large with visible nucleus and dense cytoplasm. These cells are called **archesporial cells.**
- Multiple Divisions (mitosis) in these cells give rise to sporogenous tissue.
- When the anther is young a group of compactly arranged homogenous cells called sporogenous tissue occupies the center of each microsporangium.
- Later sporogenous cells get differentiated into **microspore mother cells** or pollen mother cell or potential pollen during the formation of wall of pollen sac.
- Each **microspore mother cell** divides to form four **haploid microspores** or pollen grains by **meiotic division** or **reduction division**. This process is known as **microsporogenesis.**
- During this period, spherical bodies are formed inside the tapetal cells before their disintegration. are known as **Ubisch-body**. Ubisch body is made up of a **complex substance** called **sporopollenin**. After the formation of ubisch body, the tapetum layer degenerates.
- Ubisch bodies participate in the formation of exine of the microspores inside the pollen sacs.
- At the initial stage all **four microspores** are attached together with the help of **callose layer.** This group of microspores is called **tetrad.** After some time, this callose layer gets dissolved by callase enzyme, which is secreted by tapetum and microspores gets separated from each other
- As the anther mature and dehydrate, the microspores dissociate from each other and developed into pollen grains.
- Inside each microsporangium several thousands of pollen grains are formed that are released with the dehiscence of anther

SPOT LIGHT

- Pollen tablets are used as food supplement because pollen grains of many plants are rich in nutrients.
- Pollen consumption has been claimed to increase the performance of athletes and race horses.
- Pollen grains of some plants present in air that, cause allergy (pollen allergy) are called 'aero allergens'. E.g. *Chenopodium, Parthenium* (came in India as a contaminant along with imported wheat)
- These aero allergens may lead to cause chronic respiratory disorders i.e. asthma, bronchitis etc.
- **Pollen viability -** It is capability of pollen to get mature and then fertilize and after fertilization, it is the ability to develop into seed and fruit.
  - Pollen viability depends on the prevailing temperature and humidity.
  - Pollen viability of rice and wheat – **30 minutes.**
  - Pollen viability of Rosaceae, Leguminoseae and Solanaceae **–few months.**
- It is possible to store pollen grains of a large number of species for years in liquid nitrogen (–196°C).

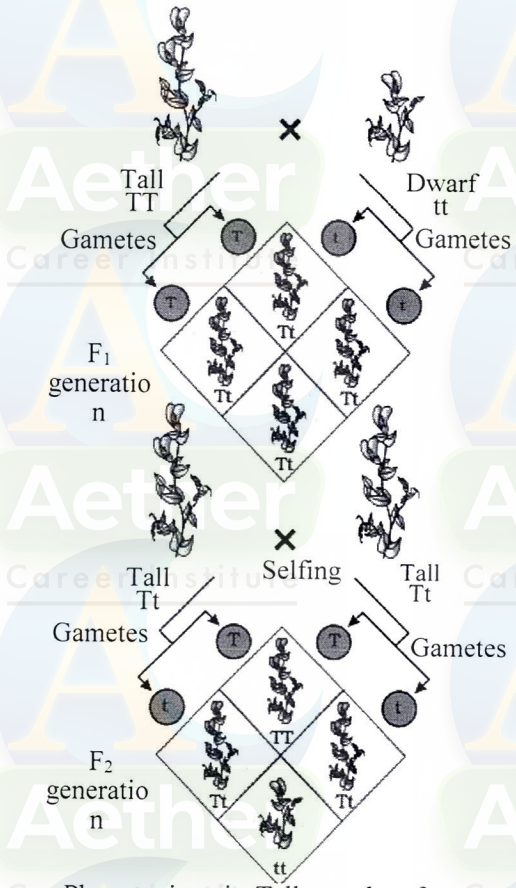
[C] STRUCTURE OF POLLEN GRAIN

A pollen grain tetrad

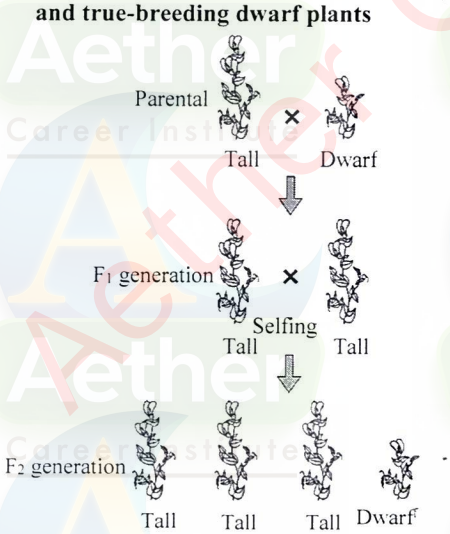
- Pollen grains are generally spherical measuring about 25-50 micrometres in diameter. **Pollen grains represent the male gametophyte,** it is also termed as **immature male gametophyte.**
- Pollen grains are surrounded by **two distinct layers.**
  (1) Outer layer (Exine) (2) Inner layer (Intine)

(1) Outer layer (Exine)

- The **outer layer** (wall) is **thick, rigid** and **ornamented**, called **exine.**
- This layer is formed by **sporopollenin.**
- Sporopollenin is **highly resistant, non-biodegradable organic material.**



A Punnett square used to understand a typical monohybrid cross conducted by Mendel between true-breeding tall plants and true-breeding dwarf plants



Diagrammatic representation of monohybrid cross

RESULTS OF MONOHYBRID CROSS

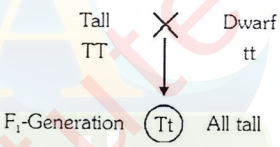
1st Conclusion (Postulate of paired factors):

(a) According to Mendel, each genetic character is controlled by a pair of unit factor.

(b) In this pair, one factor comes from male parent and other from female parent.

2nd Conclusion (Postulate of Dominance):

(a) This conclusion is based on F_1 - generation. When two different unit factors are present in single individual, only one unit factor is able to express itself and is known as dominant unit factor.



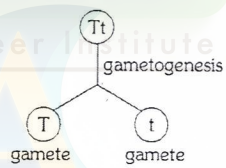
(b) Another unit factor that fails to express in F_1 generation is the recessive factor.

- The law of dominance is used to explain the expression of only one of the parental characters in a monohybrid cross in the F_1 generation and the expression of both in the F_2 generation. It also explains the proportion of 3 : 1 obtained at the F_2
- There are two exceptions of law of dominance. [A] Incomplete dominance, [B] Co-dominance,

Law of dominance = 1st Conclusion + 2nd Conclusion.

3rd Conclusion (Law of segregation):

- This law is the based on the fact that the alleles do not show any blending and that both the characters are recovered as such in F_2 generation though one of these is not seen at the F_1 stage
- During gamete formation, the unit factors of a pair segregate randomly and transfer inside different gametes. Each gamete receives only one factor of a pair; so gametes are pure for a particular trait. It is known as **law of purity of gametes or segregation.**



- There is no exception of Law of segregation. The segregation is essential during the meiotic division in all sexually reproducing organisms. (Nondisjunction could be exception of this law).
- This law is based on the basis of F_2 generation.

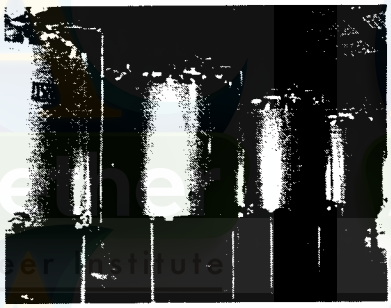


Fig. : Fermenters

(a) Fermented Beverages

(i) ***Saccharomyces cerevisiae*** commonly called **Brewer's yeast** is Yeast species used in alcoholic fermentation:

(ii) Malted cereals, molasses and fruit juices produce ethanol by fermentation, Molasses are most common substrate for ethanol production.

(iii) Depending on the type of the raw material used for fermentation and the type of processing (with or without distillation) different types of alcoholic drinks are obtained.

(iv) **Wine** and **beer** are produced without distillation (Low alcohol concentration).

Table: Alcoholic beverages with substrates and their concentration

	Alcohol	Substrate used	Concentration of alcohol
1	Beer	Barley malt	3-6%
2	Wine	Fruit juices	9-12%
3	Whisky	Fermented cereals	50%
4	Brandy	Fruit juices	60-70%
5	Rum	Molasses	40%
6	Gin	Rye malt	40%
7	Vodka	Potato	60-80%

(v) **Whisky, brandy** and **rum** are produced by distillation of fermented broth (high alcohol concentration).

(vi) The concentration of alcohol in beverages that are naturally fermented is usually less. But this is high in distilled alcohols.

Fermentation Plant

(b) Antibiotics : Antibiotics are chemical substances, which are produced by some microbes and kill or retard the growth of other (disease-causing) microbes. (Greek. Anti-against, bio-life)

- Antibiotic means **against life,** (in the context of disease causing organisms), whereas with reference to human beings, they are **'pro life'** and not against.
- Antibiotics are regarded as one of the most significant discoveries of the twentieth century and have greatly contributed towards the welfare of the human society.
- The first antibiotic **Penicillin** was discovered by **Alexander Fleming.** While working on *Staphylococci* bacteria, he observed a mould growing in one of his unwashed culture plates around which *Staphylococci* could not grow. He found that the chemical was produced by fungi and named it **Penicillin** after the mould *Penicillium notatum*.
- However, its full potential as an effective antibiotic was established by **Ernest Chain** and **Howard Florey.** This antibiotic was extensively used to treat American soldiers wounded in World War II. **Fleming, Chain** and **Florey** were awarded the **Nobel prize** in 1945, for this discovery.
- Antibiotics have greatly improved our capacity to treat deadly diseases such as **plague, whooping cough** (kali khansi), **diphtheria** (gal ghotu) and **leprosy** [kusth rog], which used to kill millions all over the globe. Bulk of antibiotics are obtained from three groups of microorganisms i.e., **Bacteria** ***(Bacillus)***, **Actinomycetes** ***(Streptomyces)*** and **Fungi** ***(Penicillium, Aspergillus)***.

(c) Chemicals, Enzymes and Other Bioactive Molecules

- **Bioactive molecules** are those molecules which are functional in living system or can interact with their components. Microbes are used for commercial and industrial production of certain chemicals (bioactive molecules) like organic acids, alcohols, enzymes, cyclosporin A and statins.

(i) Organic acids : Certain microbes have ability to convert carbohydrate into organic acids.

- In fact, it is these changes in population density that give us some idea of what is happening to the population – whether it is flourishing or declining. Whatever might be the ultimate reasons, the density of a population in a given habitat during a given period, fluctuates due to changes in four basic processes, two of which **(natality and immigration) contribute to an increase in population density and two (mortality and emigration) to a decrease.**
- The main factors that determine the population growth are-

(a) Natality **(b) Mortality**
(c) Immigration **(d) Emigration**

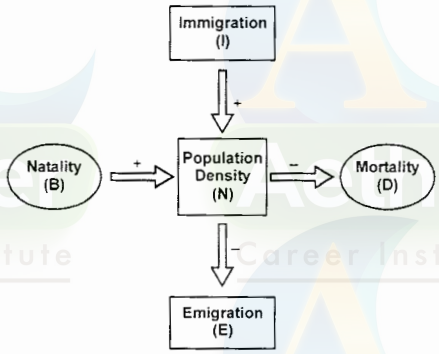
(a) **Natality:** It is the increase in number of individuals in a population under given environmental conditions.

(b) **Mortality:** It is the loss of individuals due to death in a population under given environmental conditions.

(c) **Immigration:** Increase in population due to entry of individuals into habitat from elsewhere during given period of time.

(d) **Emigration:** The number of individuals of population who left the habitat and gone elsewhere during given time period.

- Population size is determined by available resources like nutrients, water etc. at a given time.



- So if **'N'** is population density at time **'t'** then at time **t + 1**. it's density is:

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

- You can see from the above equation that population density will increase 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). Under normal conditions, births and deaths are the most important factors influencing population density, the other two factors assuming importance only under special conditions. For instance, if a new habitat is just being colonised, immigration may contribute more significantly to population growth than birth rates.

NCERT PLUS

- **Biotic Potential and Environmental Resistance**
- **Biotic Potential:** The inherent maximum capacity of an organism to reproduce or increase in number.
- Biotic Potential (symbol **'r'**) can be realised only when environmental conditions are most favorable. So that natality rate is maximum and mortality rate is minimum. In this condition population size increase at maximum rate.
- **Environmental Resistance:** The environmental control on population size, on its biotic potential.
- Nature keeps a check on expression of biotic potential. With increase in population size, the environmental resistance (against population) increase.
- Environmental resistance represents the **limiting effect of abiotic** (water, space) and **biotic factors (food, competition),** which do not allow organisms to attain their biotic potential and keep the population size at much lower level.

The population growth forms/Growth model (Characteristic pattern of growth in unit time)
It is of two types.

(a) **J-shaped or Exponential or Geometric Growth Form:**

- Ideally, when resources in the habitat are unlimited, each species has the ability to realise fully its innate potential to grow in number.
- Then the population grows in an exponential or geometric fashion.
- If in a population of size **N**, the birth rates (not total number but *per capita* births) are represented as ***b*** and death rates (again, *per capita* death rates) as ***d***, then the increase or decrease in N during a unit time period **t**(dN/dt) will be

$$dN/dt = (b - d) \times N$$
Let (b–d) = r, then
$$dN/dt = rN$$

(III) Life History Variations: [*NCERT. Pg. No.196*]

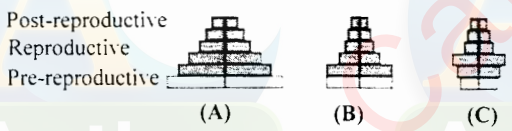
- Populations evolve to maximise their reproductive fitness, also called **Darwinian fitness (high r value)**, in the habitat in which they live.
- Under a particular set of selection pressures, organisms evolve towards the most efficient reproductive strategy.
- Some organisms breed only once in their lifetime (Pacific salmon fish, bamboo) while others breed many times during their lifetime (most birds and mammals).
- Some produce a large number of small-sized offspring (Oysters, pelagic fishes) while others produce a small number of large-sized offspring (birds, mammals).
- Ecologists suggest that life history traits of organisms have evolved in relation to the constraints imposed by the abiotic and biotic components of the habitat in which they live.

Practice Section-01

Q.1 The number of individuals of the same species that have come into the habitat from elsewhere during the time period under consideration is known as
(1) Immigration (2) Emigration
(3) Influx (4) Efflux

Q.2 If in a pond there were 40 lotus plants last year and through reproduction 8 new plants are added, taking the current population to 48, calculate the birth rate
(1) 0.4 (2) 0.2
(3) 0.8 (4) None of these

Q.3 Observe the age pyramids given in the diagram and mark the option with correct labelling



(1) A-expanding, B-stable, C-declining
(2) A-stable, B-expanding, C-declining
(3) A-expanding, B-declining, C-stable
(4) A-declining, B-stable, C-expanding

Q.4 In nature, a given habitat has enough resources to support a maximum possible number, beyond which no further growth is possible, this is known as
(1) Reproductive potential
(2) Carrying capacity
(3) Growth potential
(4) Carrying potential

Q.5 Darwinian fitness is fitness pertaining to
(1) Evolution (2) Adaption
(3) Reproduction (4) Competition

Q.6 During any ecological investigation in a population, the evaluation is in the terms of
(1) Increase in the population size
(2) Decrease in the population size
(3) Any change in the population size
(4) Constancy in the population size

Q.7 In a laboratory there were 40 fruitflies last week and during experiment 4 fruitflies died in a week. Calculate the death rate.
(1) 0.1 individual per fruitfly per year
(2) 0.36 individual per fruitfly per week
(3) 0.4 individual per fruitfly per week
(4) 0.1 individual per fruitfly per week

Q.8 Population density is designated as
(1) 'D' (2) 'P' (3) 'N' (4) 'd'

Q.9 $N_t = N_o\, e^{rt}$ is an equation of
(1) Logistic growth
(2) Verhulst - Pearl Logistic Growth
(3) Exponential growth
(4) Both (1) & (2)

Q.10 The most appropriate measure of population density is generally
(1) Number (2) Biomass
(3) Percent cover (4) All of the above

Q.11 In the models that describe population growth, *r* stands for
(1) Population density
(2) A time interval
(3) Total number of individuals in the population
(4) Growth rate

Q.12 According to Darwin, species breed once in life have:
(1) High *r* values
(2) Low *r* values
(3) Low or high *r* values
(4) Intermediate *r* values

- The **prickly pear cactus** introduced into **Australia** in the early 1920's caused havoc by spreading rapidly into millions of hectares of rangeland. Finally, the invasive cactus was brought under control only after a **cactus feeding predator (a moth - *Cactoblastis cactorum*)** from its natural habitat was introduced into the country.
- **Biological control methods** are adopted in agricultural. **Pest control** are based on the ability of the predator to regulate prey population.
- Predators also help in **maintaining species diversity in community**, by reducing the intensity of competition among competing prey species. In the rocky intertidal communities of the **American Pacific Coast** the **starfish *Pisaster*** is an important predator. In a field experiment, when all the starfish were removed from an enclosed intertidal area, more than 10 species of invertebrates became extinct within a year because of interspecific competition.
- If a predator is too efficient and overexploits its prey, then the prey might become extinct and following it, the predator will also become extinct due to lack of food. This is reason why **predators in nature are 'prudent'.**

SPOT LIGHT

Camouflage:

(i) In some animals, the capacity to blend with surroundings or camouflage is a common adaptation. Some shows adaptation on their bodies, which make it difficult to distinguish them from shadows and branches, or from their surrounding.

(ii) Prey species have evolved various defences to lessen the impact of predation. Some species of **insects and frogs** are **cryptically-coloured** (camouflaged) to avoid being detected easily by the predator. Some are poisonous and therefore avoided by the predators. The **Monarch butterfly** is highly distasteful to its predator birds because of a special chemical presents in its body. The butterfly acquires this chemical during its caterpillar stage by feeding on poisonous weed (***Asclepias*).**

- For **plants, herbivores are predators**. About 25% of all insects are **phytophagous** (feeding on plant parts and plant sap). Plants have specific adaptations or morphological and chemical defence against herbivores.
- **Spines in *Acacia*, Cactus** –are most common morphological means of defence.
- Many plant produce and store chemicals that can make herbivore sick or inhibits feeding or digestion disrupts digestion reproduction or even kill.
- The weed ***Calotropis*** growing in abandoned fields, produces highly poisonous **cardiac glycosides** and that is why you never see any cattle or goats browsing on this plant.
- A wide variety of chemical substances that we extract from plants on a commercial scale **(nicotine, caffeine, quinine, strychnine, opium, etc....,)** are produced by them actually as defences against grazers and browsers.

(B) Amensalism (– / 0):

Amensal = (–) Inhibitor = (0)

- In this interaction one species is inhibited by toxic secretion of another species. Inhibitor is neither benefitted nor harmed.

Type of Amensalism:

(i) Antibiosis (ii) Allelopathy

(C) Competition (–, –) **:** Interaction in which the fitness of one species is significantly lowered in the presence of another species.

- According to **Darwin**, the struggle for existence and survival of the fittest in nature, shown that **interspecific competition is a potent force in organic evolution.**
- Competition is best defined as a **process in which the fitness of one species** (measured in term of its 'r' the intrinsic rate of natural increase) **is significantly lowered in the presence of another species.**
- **Totally unrelated species could also compete for the same resource.** For instance, in some **shallow South America lakes** visiting **flamingoes** and **resident fishes** compete for their **common food, the zooplankton** in the lake.
- It is generally believed that competition occur when closely related species compete for the same resources that are limiting, but this is not entirely true.

Q.33 Given below are two statements: **[NEET-2024]**

Statement I: Gause's competitive exclusion principle states that two closely related species competing for different resources cannot exist indefinitely.

Statement II: According to Gause's principle, during competition, the inferior will be eliminated. This may be true if resources are limiting.

In the light of the above statements, choose the correct answer from the options given below :

(1) Both Statement I and Statement II are true.

(2) Both Statement I and Statement II are false.

(3) Statement I is true but Statement II is false.

(4) Statement I is false but Statement II is true.

Q.34 When will the population density increases, under special conditions ? **[Re-NEET-2024]**

When the number of :

(1) Deaths exceeds number of births and also number of emigrants equals number of immigrants.

(2) Births plus number of immigrants equals number of deaths plus number of emigrants.

(3) Births plus number of emigrants is more than the number of deaths plus number of immigrants.

(4) Births plus number of immigrants is more than the sum of number of deaths and number of emigrants.

Q.35 Match List-I with List-II : **[Re-NEET-2024]**

	List-I		List-II
A.	Predator	I.	*Ophrys*
B.	Mutualism	II.	*Pisaster*
C.	Parasitism	III.	Female wasp and fig
D.	Sexual deceit	IV.	*Plasmodium*

Choose the correct answer from the options given below :

(1) A-III, B-II, C-I, D-IV

(2) A-IV, B-I, C-II, D-III

(3) A-II, B-III, C-I, D-IV

(4) A-II, B-III, C-IV, D-I

Q.36 Match List-I with List-II : **[Re-NEET-2024]**

	List-I		List-II
A.	Migratory flamingoes and resident fish in South American lakes	I.	Interference competition
B.	Abingdon tortoise became extinct after introduction of goats in their habitat	II.	Competitive
C.	Chathamalus expands its distributional range in the absence of *Balanus*.	III.	Resource Partitioning
D.	Five closely related species of Warblers feeding in different locations on same tree	IV.	Interspecific competition

Choose the correct answer from the options given below : **[Re-NEET-2024]**

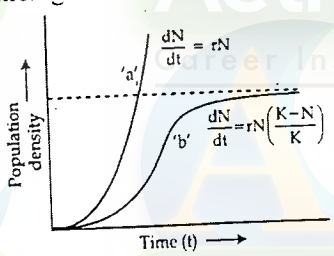
(1) A-I, B-IV, C-III, D-II

(2) A-IV, B-I, C-II, D-III

(3) A-III, B-I, C-II, D-IV

(4) A-II, B-IV, C-III, D-I

Q.37 What do 'a' and 'b' represent in the following population growth curve ? **[Re-NEET-2024]**



(1) 'a' represents exponential growth when responses are not limiting the growth; and 'b' represents logistic growth when responses are linting the growth.

(2) 'a' represents logistic growth when responses are not limiting the growth; 'b' represents exponential growth when responses are linting the growth.

(3) 'a' represents carrying capacity and 'b' shows logistic growth when responses are linting the growth.

(4) 'a' represents exponential growth when responses are not limiting the growth and 'b' shown carrying capacity.

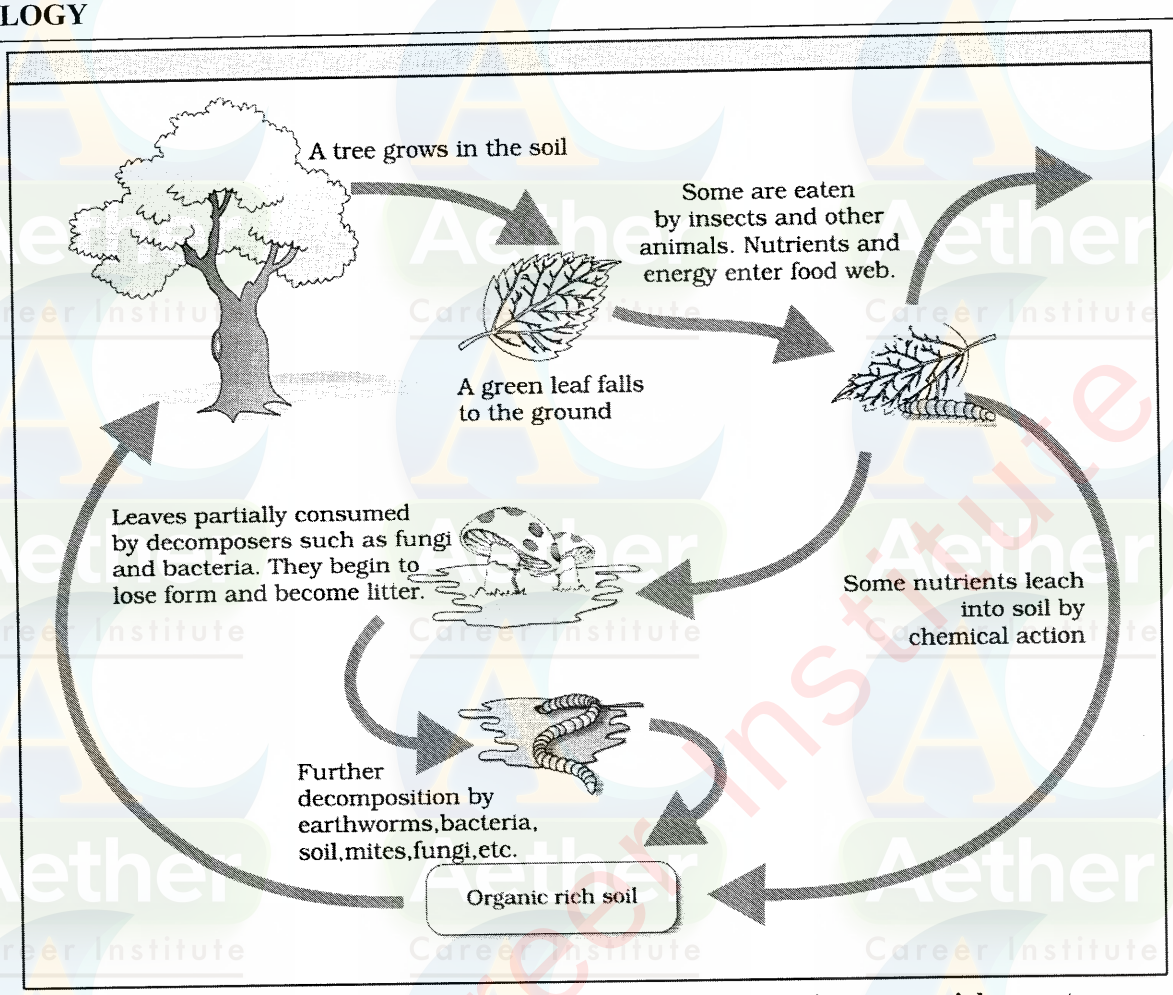


Figure : Diagrammatic representation of decomposition cycle in a terrestrial ecosystem

(C) ENERGY FLOW: ***[NCERT Pg No. 209]***

- **Except for the deep sea hydro-thermal ecosystem, sun is the only source of energy for all ecosystems on Earth.**
- **Of the incident solar radiation less than 50 per cent of it is photosynthetically active radiation (PAR).** We know that plants and photosynthetic bacteria (autotrophs), fix Sun's radiant energy to make food from simple inorganic materials. **Plants capture only 2-10 per cent of the PAR** and this small amount of energy sustains the entire living world. So, it is very important to know how the solar energy captured by plants flows through different organisms of an ecosystem.
- All organisms are dependent for their food on producers, either directly or indirectly. So you find unidirectional flow of energy from the sun to producers and then to consumers.
- Energy flow is the key function of ecosystem. The storage and expenditure of energy in ecosystem is based on the two basic laws of **thermodynamics.**

(i) 1st law - law of conservation of energy- Energy is neither created nor destroyed but only transformed from one state to another state.

(ii) 2nd law- The law of entropy - The transfer of food energy from one to another organisms leads to loss of energy as heat due to metabolic activity.

- Energy in food is in concentrated form, heat energy is highly dispersed. It must be understood that all changes in energy forms can be accounted for energy flow in any system.
- Further, ecosystems are not exempt from the Second Law of thermodynamics. They need a constant supply of energy to synthesise the molecules they require, to counteract the universal tendency toward increasing disorderliness.

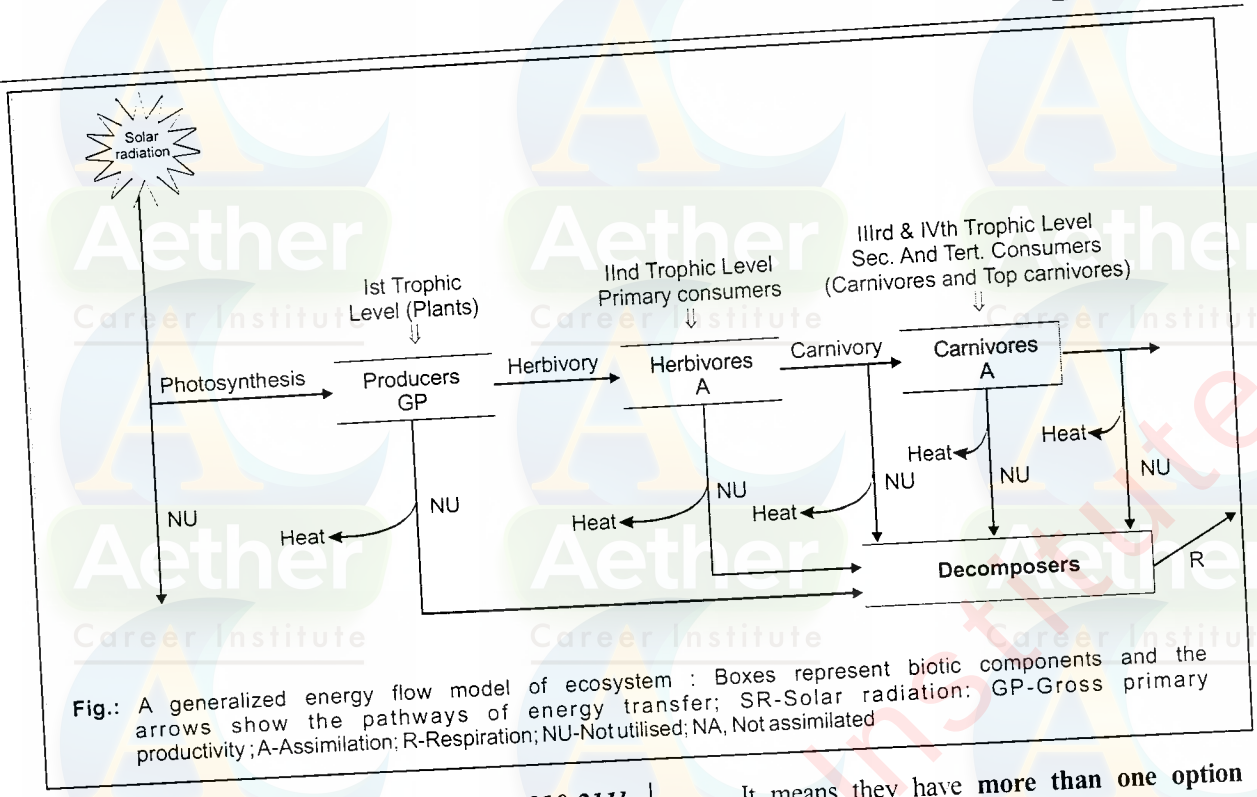
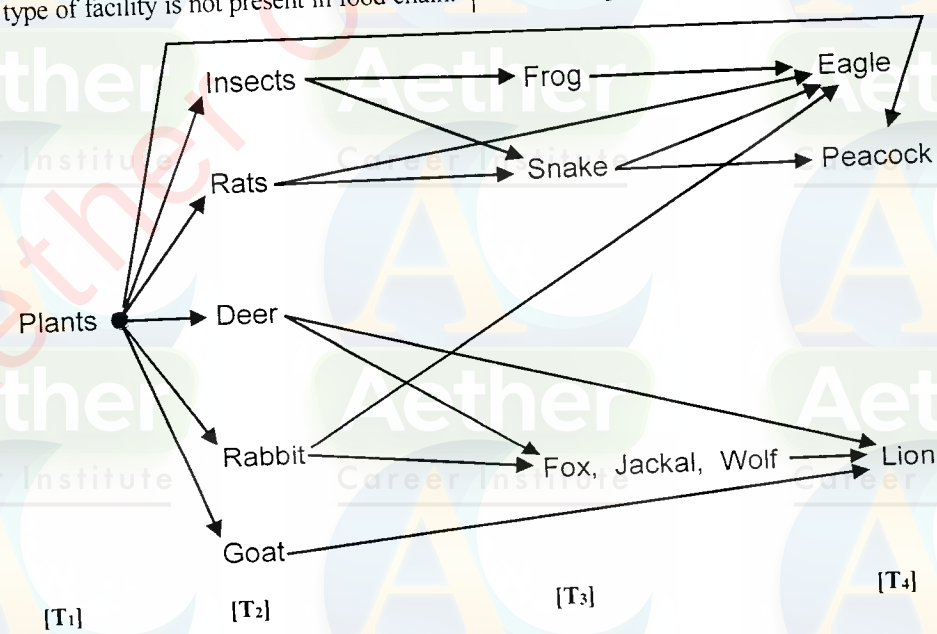


Fig.: A generalized energy flow model of ecosystem : Boxes represent biotic components and the arrows show the pathways of energy transfer; SR-Solar radiation; GP-Gross primary productivity ; A-Assimilation; R-Respiration; NU-Not utilised; NA, Not assimilated

FOOD WEB : ***[NCERT Pg No. 210-211]***

- In big ecosystem many food chains are interlinked together on different trophic levels to form food web. In food web transfer of food energy is unidirectional but from many different alternative pathways.
- In food web members of a particular trophic level obtain their food according to their choice and taste but that type of facility is not present in food chain. It means they have **more than one option or alternative for getting food.**
- **As much as food web is complex that ecosystem is more permanent or stable,** such type of ecosystem is not destroyed naturally and continues for long time. Such ecosystem is not affected by loss of any organism of any particular trophic level. **Those ecosystems which have simple food web are not very stable.**



QUICK FOLLOW UP

Ecosystem

An ecosystem can be visualised as a functional unit of nature, where living organisms interact among themselves and also with the surrounding physical environment.

Component of ecosystem

- **Abiotic**
  - Non-living substances and factors constitute abiotic components.
  - Temperature, Light , Soil, Climate, Rainfall etc.
- **Biotic**
  - All the living members of an ecosystem constitute biotic component.
  - Plants, Animals, Microbes.

Structure

Interaction of biotic and abiotic components result in a physical structure that is characteristic for each type of ecosystem.

- **Species composition**
  - It involves identification and enumeration of plant and animal species of an ecosystem.
- **Stratification**
  - Vertical distribution of different species occupying different levels.

Function

To understand functioning of an ecosystem, energy flow is studied.

- **Productivity**
  - The rate of synthesis of energy containing organic matter or biomass by any trophic level per unit area in unit time. It is expressed in terms of weight ($g/m^2/yr$) or energy ($kcal/m^2/yr$).
  - **Primary productivity**
    - (a) Gross primary productivity
    - (b) Net primary productivity
  - **Secondary productivity**
  - **Net community productivity**
- **Decomposition**
  - Decomposers break down complex organic matter into inorganic substance like carbon dioxide, water and nutrients and the process is called decomposition.
  - The important steps in the process of decomposition are fragmentation, leaching, catabolism, humification and mineralization.
- **Energy flow**
  - Energy flow in an ecosystem is always unidirectional.
  - During energy flow only 10% of energy is transferred from one trophic level to another (Lindemann's law)
- **Nutrient cycling**
  - To maintain continuous supply of nutrients for biotic components of ecosystem exchange, storage and transfer of nutrients occurs.

Trophic structure

Each ecosystem has specific food relationships and interactions that constitute its trophic structure. Producers form first trophic level (T_1) primary consumers form T_2 level and so on.

Ecological pyramids

Graphical representation of the trophic structure.

- **Pyramid of number**
  - Graphical representation of the number of individuals per unit area of various trophic levels stepwise with producers at base and top carnivores at top. Mostly upright but inverted in parasitic food chain and spindle shaped in forest ecosystem.
- **Pyramid of Biomass**
  - Pyramid of biomass represents the total amount of biomass of each trophic level of ecosystem, mostly these pyramids are also upright. E.g. tree ecosystem, forest ecosystem.
- **Pyramid of energy**
  - Graphical representation of amount of energy trapped per unit time and area in different trophic levels form producers to top carnivores of a food chain.
  - Always upright.

Transfer of energy

- **Food chain**
  - A sequence of populations or organisms of an ecosystem through which the food and its contained energy passes with each member becoming the food of a latter member of the sequence. E.g. In a grassland, an operating food chain may be: Grass → Grasshopper → Frog → Snake → Hawk.
  - Grazing food chain or predatory food chain
  - Detritus food chain or Saprophytic food chain
- **Food web**
  - A network of food chains which become interconnected at various trophic levels so as to form a number of feeding connections.
  - More interconnections in a food web means greater stability of the ecosystem.

TOPIC WISE QUESTIONS

INTRODUCTION, STRUCTURE AND FUNCTION OF ECOSYSTEM

Q.1 Word 'ecosystem' was coined by:
(1) Elton (2) Tansley
(3) Odum (4) Billing

Q.2 Vertical distribution of different species occupying different levels, called as:-
(1) Physiognomy (2) Stratification
(3) Dominance (4) Topography

Q.3 Which of the following is not a functional component of an ecosystem:-
(1) Productivity (2) Decomposition
(3) Stratification (4) Nutrient cycling

Q.4 Which of the following is an example of an aquatic ecosystem?
(1) Pond and lake
(2) Wetland and river
(3) Estuary
(4) All of these

Q.5 Which of the following is an example of a terrestrial ecosystem?
(1) Forest
(2) Grassland
(3) Desert
(4) All of these

Q.6 Which of the following is an example of a man-made ecosystem?
(1) Crop fields (2) An aquarium
(3) Both 1 and 2 (4) Waterfall

Q.7 Which of the following is a function of ecosystem
(1) Conversion of inorganic into organic material by the autotrophs
(2) Consumption of the autotrophs by heterotrophs
(3) Decomposition and mineralization of the dead matter
(4) All of these

Q.8 A functional unit of nature, where living organisms interact among themselves and also with the surrounding physical environment is known as
(1) Ecosystem (2) Biome
(3) Biosphere (4) Living world

Q.9 Mass of living matter at a trophic level in an area at any time is called:
(1) Standing state (2) Standing crop
(3) Detritus (4) Humus

Q.10 A functional unit of nature where living organism interact among themselves and with physical environment is called:
(1) Biome (2) Biosphere
(3) Ecosystem (4) Landscape

Q.11 Whichofthe following represents a natural ecosystem?
(1) Crop field (2) Aquarium
(3) Home garden (4) Grassland

Q.12 Verticaldistribution of differentspecies occupying different levels in a biotic community is known as:
(1) Divergence (2) Stratification
(3) Zonation (4) Scarification

Q.13 As per the vertical distribution of species in a forest, shrubs occupy
(1) Top strata (2) Second strata
(3) Bottom layer (4) Third strata

Q.14 The autotrophic component of aquatic ecosystem include
A. Phytoplankton's
B. Zooplanktons
C. Some algae
D. Floating submerged plants
E. Marginal plants found at the edges
(1) A, B, and C (2) Only A and C
(3) B, C, and D (4) A, C, D, and E

PRODUCTIVITY AND DECOMPOSITION

Q.15 Gross primary productivity is :
(1) Rate at which organic molecules are formed in an autotroph
(2) Rate at which organic molecules are used up by an autotroph
(3) Storage of organic molecules in the body of an autotroph
(4) Rate at which organic molecules are transferred to next higher trophic level

Q.16 Which of the following type of primary productivity is utilised by animals in respiration:-
(1) Net primary productivity (NPP)
(2) Net community productivity (NCP)
(3) Gross primary productivity (GPP)
(4) All of the above

BIOLOGY

Direction: (for Q.36-Q-39) In the light of the above statements, choose the correct answer from the options given below:

(A) Statement I is correct but statement II is Incorrect

(B) Statement II is correct but statement I is Incorrect

(C) Both Statements I and II are correct

(D) Both Statements I and II are incorrect

Q.36 **Statement I:** Ecological pyramid is based upon a simple food chain
Statement-II: Ecological pyramid does not take into account the same species belonging to two or more trophic levels
(1) A (2) B (3) C (4) D

Q.37 **Statement-I:** The available biomass for the consumption of heterotrophs can be called net primary productivity
Statement-II: Zooplankton are at the second trophic level in a lake
(1) A (2) B (3) C (4) D

Q.38 **Statement-I:** Vertical distribution of different species occupying different levels is known as Stratification
Statement-II: Secondary productivity is defined as the rate of formation of new organic matter by consumers
(1) A (2) B (3) C (4) D

Q.39 **Statement-I:** The percentage of photosynthetically active radiation (PAR) in the Incident solar radiation is less than 50%
Statement-II: Plants capture only 2-10% of PAR.
(1) A (2) B (3) C (4) D

Q.40 **Statement-I:** Food web is expressed very well by the ecological pyramid
Statement-II: Relationship is expressed in terms of number, biomass or energy in ecological pyramids
(1) A (2) B (3) C (4) D

Q.41 **Statement-I:** The number of trophic levels in the grazing food chain is restricted.
Statement-II: As the transfer of energy follows 10 per cent law only 10 per cent of the energy is transferred to each trophic level from the lower trophic level.
(1) A (2) B (3) C (4) D

Q.42 **Statements I :** The primary productivity varies in different types of ecosystems.
Statements II : Primary productivity is dependent on the plant species inhabiting a particular area.
(1) A (2) B (3) C (4) D

Q.43 **Statement-I:** Pyramid of biomass of aquatic ecosystem is always inverted.
Statement-II: Biomass of producers in sea exceeds the biomass of consumers.
(1) A (2) B (3) C (4) D

NEET- FLASHBACK

Q.1 Secondary productivity is rate of formation of new organic matter by: **[NEET-UG 2013]**
(1) Decomposer (2) Producer
(3) Parasite (4) Consumer

Q.2 Which one of the following processes during decomposition is **correctly** described? **[NEET-UG 2013]**
(1) Leaching - Water soluble inorganic nutrients rise to the top layers of soil
(2) Fragmentation - Carried out by organisms such as earthworm
(3) Humification - Leads to the accumulation of a dark coloured substance humus which undergoes microbial action at a very fast rate
(4) Catabolism - Last step in the decomposition under fully anaerobic condition.

Q.3 The mass of living material at a trophic level at a particular time is called: **[AIPMT-2015]**
(1) Standing state
(2) Net primary productivity
(3) Standing crop
(4) Gross primary productivity

Q.4 In an ecosystem the rate of production of organic matter during photosynthesis is termed as: **[Re-AIPMT 2015]**
(1) Gross primary productivity
(2) Secondary productivity
(3) Net productivity
(4) Net primary productivity

Q.5 The term ecosystem was coined by **[Re-AIPMT 2015]**
(1) E.P. Odum (2) A.G. Tansley
(3) E. Haeckel (4) E. Warming

Q.6 At deep oceanic hydrothermal vents the primary producer are: **[NEET-II 2016]**
(1) Green algae
(2) Chemoautotrophic bacteria
(3) Blue green algae
(4) Coral reefs

Q.7 Which one of the following is a characteristic feature of cropland ecosystem? **[NEET-II 2016]**
(1) Absence of soil organisms
(2) Least genetic diversity
(3) Absence of weeds
(4) Ecological succession

Q.8 Which ecosystem has the maximum biomass? **[NEET-2017]**
(1) Forest ecosystem
(2) Grassland ecosystem
(3) Pond ecosystem
(4) Lake ecosystem

Q.9 Which of the following organisms are known as chief producers in the oceans? **[NEET-2018]**
(1) Euglenoids (2) Dinoflagellates
(3) Cyanobacteria (4) Diatoms

Q.10 What type of ecological pyramid would obtained with the following data? **[NEET-2018]**
Secondary consumer: 120 g
Primary consumer: 60 g
Primary producer: 10 g
(1) Upright pyramid of biomass
(2) Inverted pyramid of biomass
(3) Upright pyramid of numbers
(4) Pyramid of energy

Q.11 Which of the following ecological pyramids is generally inverted? **[NEET-2019]**
(1) Pyramid of biomass in a forest
(2) Pyramid of biomass in a sea
(3) Pyramid of numbers in grassland
(4) Pyramid of energy

Q.12 Match the trophic levels with their correct species examples in grassland ecosystem. **[NEET-2020]**

	Column-I		Column-II
a	Fourth trophic level	(i)	Crow
b	Second trophic level	(ii)	Vulture
c	First trophic level	(iii	Rabbit
d	Third trophic level	(iv)	Grass

(1) a–(iii), b–(ii), c–(i), d–(iv)
(2) a–(iv), b–(iii), c–(ii), d–(i)
(3) a–(i), b–(ii), c–(iii), d–(iv)
(4) a–(ii), b–(iii), c–(iv), d–(i)

BIOLOGY

Q.13 In relation to gross primary productivity and net primary productivity of an ecosystem, which one of the following statements is correct? **[NEET-2020]**

(1) Gross primary productivity is always more than net primary productivity.
(2) Gross primary productivity and net primary productivity are one and same.
(3) There is no relationship between Gross primary productivity and net primary productivity
(4) Gross primary productivity is always less than net primary productivity.

Q.14 Which of the following statements is **incorrect**? **[NEET-2020]**

(1) Energy content gradually increases from first to fourth trophic level
(2) Number of individuals decreases from first trophic level to fourth trophic level
(3) Energy content gradually decreases from first to fourth trophic level
(4) Biomass decreases from first to fourth trophic level

Q.15 The rate of decomposition is faster in the ecosystem due to following factors EXCEPT: **[NEET-2020]**

(1) Warm and moist environment
(2) Presence of aerobic soil microbes
(3) Detritus richer in lignin and chitin
(4) Detritus rich in sugars

Q.16 Which of the following statement is not correct? **[NEET-2021]**

(1) Pyramid of biomass in sea is generally inverted.
(2) Pyramid of biomass in sea is generally upright.
(3) Pyramid of energy is always upright.
(4) Pyramid of numbers in a grassland ecosystem is upright.

Q.17 In The Equation GPP-R = NPP, R represents: **[NEET-2021]**

(1) Radiant Energy
(2) Retardation Factor
(3) Environment Factor
(4) Respiration Losses

Q.18 The amount of nutrients, such as carbon nitrogen phosphorus and calcium present in the soil at any given time, is referred as: **[NEET-2021]**

(1) Climax
(2) Climax community
(3) Standing state
(4) Standing crop

Q.19 Given below are two statements

Statement I. Decomposition is a process in which the detritus is degraded into simpler substances by microbes.

Statement II. Decomposition is faster if the detritus is rich in lignin and chitin

In the life of the above statements, choose the correct answer form the options given below: **[NEET-2022]**

(1) Both Statement I and Statement II are correct
(2) Both Statement I and Statement II are incorrect
(3) Statement I is correct but Statement II is incorrect
(4) Statement I is correct but Statement II is correct

Q.20 Detritivores breakdown detritus into smaller particles. This process is called: **[NEET-2022]**

(1) Catabolism (2) Fragmentation
(3) Humification (4) Decomposition

Q.21 In the equation $\boxed{GPP - R = NPP}$

GPP is Gross Primary Productivity NPP is Net Primary Productivity R here is _____. **[NEET-2023]**

(1) Respiratory quotient
(2) Respiratory loss
(3) Reproductive allocation
(4) Photosynthetically active radiation

Q.22 Identify the correct statements:

A. Detrivores perform fragmentation.
B. The humus is further degraded by some microbes during mineralization.
C. Water soluble inorganic nutrients go down into the soil and get precipitated by a process called leaching.
D. The detritus food chain begins with living organisms.
E. Earthworms break down detritus into smaller particles by a process called catabolism.

Choose the correct answer from the options given below: **[NEET-2023]**

(1) B, C, D only (2) C, D, E only
(3) D, E, A only (4) A, B, C only

NCERT PLUS

Some Important National Parks of India

Name & Location	Important Animals Found
1. Kaziranga National Park District Sibsagar (Assam)	Rhinoceros
2. Sundarbans (Tiger Reserve) 24-Pargana (West Bengal)	Tiger
3. Hazaribagh National Park Hazaribagh (Jharkhand)	Tiger
4. Corbett National Park District Nainital (Uttaranchal)	Tiger
5. Gir National Park District Junagarh (Gujarat)	Asiatic lion
6. Kanha National Park Mandla and Balaghat (M.P.)	Tiger, panther, chital, chinkara, four horned deer
7. Nannda Devi - Uttaranchal (Chamoli District)	Snow leopard, Asiatic black buck

Wildlife Sanctuaries: These are tracts of land with or without lake where wild animals/fauna can take refuge without being hunted. Other activities like collection of forest products, harvesting of timber, private ownership of land etc. are allowed

	Some Important Sanctuaries of India Name & Location	Important Animals
1	Keoladeo Ghana Bird Sanctuary Bharatpur (Rajasthan) Famous for birds	Siberian crane
2	Annamalai Sanctuary Coimbatore (Tamil Nadu)	Tiger, Elephant
3	Dachigam Sanctuary Srinagar (Jammu & Kashmir)	Hangul or Kashmir stag, Musk deer
4	Periyar Sanctuary (Kerala)	Elephants, Leopard, Hornbill
5	Chilka Lake Bird Sanctuary Balagaon (Orissa	Fowls , Ducks, Cranes

(E) Sacred Forests and Sacred Lakes: A **traditional strategy** for the protection of biodiversity has been in practice in **India** and some other Asian countries in the form of **sacred forests.** These are forest patches of varying dimensions protected by tribal communities due to religious sanctity accorded to them.

SPOT LIGHT

Sacred groves:

- India has also a history of religious and cultural traditions that emphasised protection of nature. In many cultures, tracts of forest were set aside, and all the trees and wildlife within were venerated and given total protection. Such **sacred groves** are found in **Khasi and Jaintia Hills in Meghalaya, Aravalli Hills of Rajasthan, Western Ghat regions of Karnataka and Maharashtra and the Sarguja, Chanda and Bastar areas of Madhya Pradesh.** In Meghalaya, the sacred groves are the last refuges for a large number of rare and threatened plants.

(b) Ex-Situ Conservation

- The ex-situ conservation strategies include **botanical gardens, wildlife safari park, zoos, conservation stands and gene, pollen, seed, seedling, tissue culture and DNA banks.**
- Seed gene banks are the easiest way to store germplasm of wild and cultivated plants at low temperature in cold rooms. Preservation of genetic resources is carried out in field gene banks under normal growing conditions.
- **In vitro conservation**, especially by **cryopreservation** in liquid nitrogen at a temperature of **–196°C,** is particularly useful for conserving vegetatively propagated crops like potato.
- **Cryopreservation** is the storage of material at ultra-low temperature either by very rapid cooling and simultaneous dehydration at low temperature (used for tissue culture). The material can be stored for a long period of time in compact, low maintenance refrigeration units.

BIOLOGY

Q.27 Which of the following is not a method of ex situ conservation? **[NEET-2022]**
(1) Cryopreservation (2) In vitro fertilization
(3) National parks (4) Micropropagation

Q.28 *In-situ* conservation refers to : **[NEET-2022]**
(1) Conserve only extinct species
(2) Protect and conserve the whole ecosystem
(3) Conserve only high risk species
(4) Conserve only endangered species

Q.29 The historic Convention on Biological Diversity, 'The Earth Summit' was held in Rio de Janeiro in the year **[NEET-2023]**
(1) 1992 (2) 1986 (3) 2002 (4) 1985

Q.30 Among 'The Evil Quartet', which one is considered the most important cuase driving extinction of species? **[NEET-2023]**
(1) Over exploitation for economic gain
(2) Alien species invasions
(3) Co-extinctions
(4) Habitat loss and fragmentations

Q.31 These are regarded as major causes of biodiversity loss: **[NEET-2024]**
A. Over exploitation
B. Co-extinction
C. Mutation
D. Habitat loss and fragmentation
E. Migration
Choose the correct option:
(1) A, B and D only
(2) A, C and D only
(3) A, B, C and D only
(4) A, B and E only

Q.32 List of endangered species was released by- **[NEET-2024]**
(1) IUCN (2) GEAC
(3) WWF (4) FOAM

Q.33 Tropical regions show greatest level of species richness because **[NEET-2024]**
A. Tropical latitudes have remained relatively undisturbed for millions of years, hence more time was available for species diversification.
B. Tropical environments are more seasonal.
C. More solar energy is available in tropics.
D. Constant environments promote niche specialization.
E. Tropical environments are constant and predictable.
Choose the correct answer from the options given below:
(1) A, B and D only
(2) A, C, D and E only
(3) A and B only
(4) A, B and E only

Q.34 Match List I with List II **[NEET-2024]**

	List I		List II
A.	Robert May	I	Species-Area relationship
B.	Alexander von Humboldt	II.	Long term ecosystem experiment using out door plots
C.	Paul Ehrlich	III.	Global species diversity at about 7 million
D.	David Tilman	IV.	Rivet popper

Choose the correct answer from the options given below:
(1) A-III, B-IV, C-II, D-I
(2) A-II, B-III, C-I, D-IV
(3) A-III, B-I, C-IV, D-II
(4) A-I, B-III, C-II, D-IV

Q.35 The regions with high level of species richness, high degree of endemism and a loss of 70% of the species and habitat are identified as : **[Re-NEET-2024]**
(1) Natural Reserves
(2) Sacred Groves
(3) Biodiversity Hotspots
(4) Biogeographical Regions

Q.36 Which one of the following is not included under in-situ conservation ? **[Re-NEET-2024]**
(1) Wild-life sanctuary
(2) Botanical garden
(3) Biosphere reserve
(4) National park

Q.37 Cryopreservation technique is used for : **[Re-NEET-2024]**
(1) Protection of environment.
(2) Protection of biodiversity hotspots.
(3) Preservation of gametes in viable and fertile condition for a long period.
(4) In-situ conservation.

Q.38 Match List-I with List-II : **[Re-NEET-2024]**

	List-I		List-II
A.	Biodiversity hotspot	I.	Khasi and Jantia hills in Meghalaya
B.	Sacred groves	II.	World Summit on sustainable
C.	Johannesburg, South Africa	III.	Parthenium
D.	Alien species invasion	IV.	Western Ghats

Choose the correct answer from the options given below :
(1) A-IV, B-I, C-II, D-III
(2) A-II, B-III, C-IV, D-I
(3) A-I, B-IV, C-III, D-II
(4) A-III, B-I, C-II, D-IV

QUICK FOLLOW UP

MICROBES IN SEWAGE TREATMENT

- There are two stages of sewage treatment: primary and secondary. Primary treatment is physical and secondary is biological.
- Primary treatment: It is the process of removal of small and large, floating and suspended solids from sewage through two processes of filtration and sedimentation.
- Secondary treatment: It involves activated sludge formation and release of effluent or supernatant into natural water bodies like rivers and streams.

MICROBES IN INDUSTRIAL PRODUCTS

- In industry, microbes are used to synthesize a number of valuable products. Microbial products are of two types:
- **Primary microbial product-** These products, produced by microbes, are used by themselves during their growth e.g., enzymes, amino acids and vitamins.
- **Secondary microbial products**-These products are not used by the microbes for their growth e.g., antibiotics, alcohol or organic acids. Some of the products by microbes that are being commercially produced are as following:
  - **Fermented beverages:** Different types of alcoholic beverages such as whisky, wine, beer, brandy or rum are prepared.
  - **Antibiotics:** Most famous drugs are got from actinomycetes, especially *Streptomyces*, e.g., streptomycin, chloramphenicol, tetracyclin, terramycin, erythromycin.
  - Microbes are also used for commercial and industrial production of certain chemicals like organic acids, alcohols and enzymes.

MICROBES AS BIOFERTILISERS

- Biofertilisers are organisms that enrich the nutrient quality of the soil. The main sources of biofertilizers are bacteria, fungi and cyanobacteria.
- *Rhizobium* (bacteria in symbiotic association with leguminous plants) fix atmospheric nitrogen into organic forms, which is used by the plants as nutrient. Other bacteria can fix atmospheric nitrogen while free-living in the soil (examples *Azospirillum* and *Azotobacter*).
- Fungi are also known to form symbiotic associations with plants (mycorrhiza). The fungal symbiont absorbs phosphorus from soil and passes it to the plant that shows other benefits as resistance to root-borne pathogens, tolerance to salinity and droughtect
- Cyanobacteria e.g., *Anabaena*, *Nostoc*, *Oscillatoria* can fix atmospheric nitrogen. In paddy fields, serve as an important biofertilisers.

MICROBES IN HUMAN WELFARE

Microbes or microorganisms are small microscopic organisms not visible to naked eye. These include a diverse group of organisms-bacteria, fungi, protozoa, microscopic plants. While microbes are usually known as pathogens causing diseases, they are also used by humans in many ways to obtain useful products.

MICROBES IN PRODUCTION OF BIOGAS

- Biogas is a methane rich fuel gas produced by anaerobic breakdown or digestion of biomass with the help of methanogenic bacteria (methanogens).
- Methanogens e.g., *Methanobacterium* grow anaerobically on cellulosic material, produce large amount of methane along with CO_2 and H_2. The excreta (dung) of cattle is rich in these bacteria.

Formation of biogas is three step anaerobic process involving Solubilisation, Acidogenesis and Methanogenesis

MICROBES IN HOUSEHOLD PRODUCTS

- **LAB:** Microbes such as *Lactobacillus* and others commonly called Lactic Acid Bacteria (LAB) grow in milk and convert milk into curd, yoghurt, cheese, etc. This improves the nutritional quality by increasing vitamin B_{12}.
- **Yeast:** Dough which is used for making bread is fermented by **baker's yeast** (*Saccharomyces cerevisiae*).

Microbes are also used to ferment fish, soyabean and bamboo shoots to make foods.

MICROBES AS BIOCONTROL AGENTS

- Biocontrol refers to the use of biological methods for controlling plant diseases and pests. Biological agents involve use of viruses, bacteria and other insects which are natural predators and pests.
- The bacteria *Bacillus thuringiensis* is used to control butterfly caterpillars. With the help of genetic engineering, toxin gene from B. *thuringiensisis* introduced into plants. Such plants are resistant to attack by insects such as lepidopterans.
- Baculoviruses (genus *Nucleopolyhedrovirus*) are being used as biocontrol agents. They are desirable in overall integrated pest management (IPM) programme or when an ecologically sensitive area is being treated.
- *Trichoderma* are free-living fungi; very common in the root ecosystems. They are effective biocontrol agents of several plant pathogens.

SPOT LIGHT

It is believed that **life came first at the level of the giant molecules (non-cellular form) and then eventually first cell or organism evolved.**

(B) Biological Evolution

(i) Origin of first Non-cellular form of life (Protocells):

- Nucleic acid developed the ability of self-duplication **(living property)** probably due to any sudden change called **mutation**.
- Nucleic acid and proteins combined to form **nucleoproteins**.
- These clusters of nucleoproteins surrounded by lipid coat are considered as the **first living form or the first self-replicating metabolic capsule of life.**
- It was not a cell as cytoplasm and plasma membrane was absent.
- These **first non-cellular forms of life** could have originated **3 billion years ago**.
- They would have been giant molecules **(RNA, Protein, Polysaccharides etc.)**. These capsules reproduced their molecules perhaps.

NCERT PLUS

Which was the first living molecule?

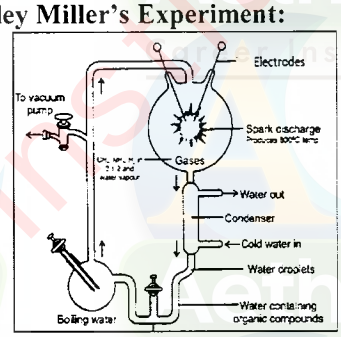
Scientists discovered that some RNA molecules have enzymatic activity, called as **ribozymes**. It means at the time of origin of life, RNA molecule could carry out all the processes of life (replication, protein formation etc.) without the help of any external enzymes, this concept called as **RNA World.**

(ii) Origin of first cellular form (Prokaryotes):

- Over the period of time, genetic material improved, more useful protein synthesized, cell membrane and cytoplasm were formed. Thus non- cellular capsules evolved into the first cells.
- This **first cellular form** of life originated about 2 billion (2BYA) or 2000 million years ago.
- The first living beings were single celled prokaryotes like bacteria.
- The first organism was probably **chemoheterotrophs** and anaerobic.
- Change in mode of nutrition in prokaryotes: **Chemoheterotrophs → Chemoautotrophs → Photoautotrophs → Photoautotrophs (Non-oxygenic) (oxygenic)**
- Some of the chemoheterotrophic bacteria evolved into **chemoautotrophs**. e.g. Iron bacteria.
- With the help of photopigments some bacteria started using light energy and became **photo-autotrophs**. e.g. Sulphur bacteria evolved first and cyanobacteria (blue green algae)] evolved later.
- Liberation of free oxygen by cyanobacteria was a revolutionary change in the history of earth. Atmosphere of earth changed from **reducing to oxidizing** and Ozone layer was also formed later.
- Over the period of time these prokaryotes evolved into unicellular and then multicellular eukaryotes.

Evidences in favour of chemical evolution:

(1) Stanley Miller's Experiment:



- In 1953, S.L. Miller, an American scientist created similar conditions at laboratory scale, which were thought to be on primitive earth.
- He took **CH_4, NH_3, H_2 (in ratio 2:1:2)** and water vapour at **800°C** in a large flask.
- He created **electric discharge** by using two tungsten electrodes as source of energy.
- He observed the formation of amino acids.
- **In similar experiments other scientists observed formation of sugars, nitrogen bases, pigment and fats.**

(2) Evidences from meteorites:

- Analysis of meteorite contents also revealed similar compounds indicating that similar processes are occurring elsewhere in space.
- With these limited evidences, the first part of the conjectured story or Oparin- Haldane theory i.e., chemical evolution was more or less accepted.
- This version of **abiogenesis**, i.e., the first form of life arose slowly through evolutionary forces from non-living molecules is accepted by majority. However, once formed, how the first cellular forms of life could have evolved into the complex biodiversity of today is the fascinating story that will be discussed in **organic evolution**.

(1) WHAT IS ADAPTATIVE RADIATION?

[NCERT. PG. NO.116-118]

- The process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitat) is called adaptive radiation.
- Both the homology and adaptive radiation are based on **divergent evolution.**

Examples:

(i) Adaptive radiation of Darwin's finches:

- Darwin visited to **Galapagos Island** and observed an amazing diversity among small black birds, later called **Darwin finches**.
- All varieties with difference in shape of beaks were evolved by a single ancestral seed-eating finch.
- Darwin conjectured that the ancestral seed eating finch radiated to different geographical area (habitat) and underwent profound **adaptivechanges** and specially in **beak pattern** due to different feeding habits - (Insectivorous, vegetarian etc.) on Galapagos island itself.

Fig. :- Variety of beaks of finches that Darwin found in Galapagos Island

(ii) Adaptive radiations of marsupials of Australia:

- Furthermore, Australia is the home to the great diversity of marsupials (Pouched mammals) but relatively few placental mammals.
- A number of marsupials, each different from other in morphology, feeding habit and habitats evolved from an ancestral stock but all within the Australian continent.

Fig.: Adaptive radiation of marsupials of Australia

(iii) Adaptive radiations of placental mammals: A number of placental mammals have evolved from a common ancestral type in Asia, Africa as well as in Australia.

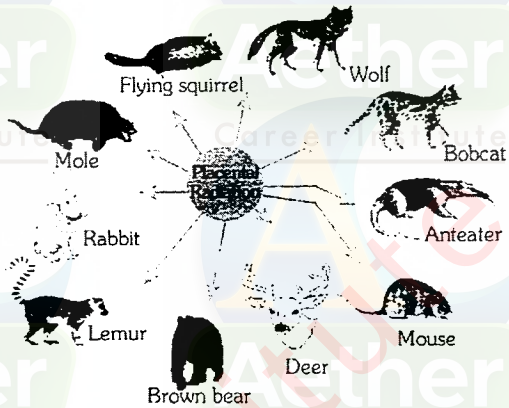


Fig.: Adaptive radiation in placental mammals

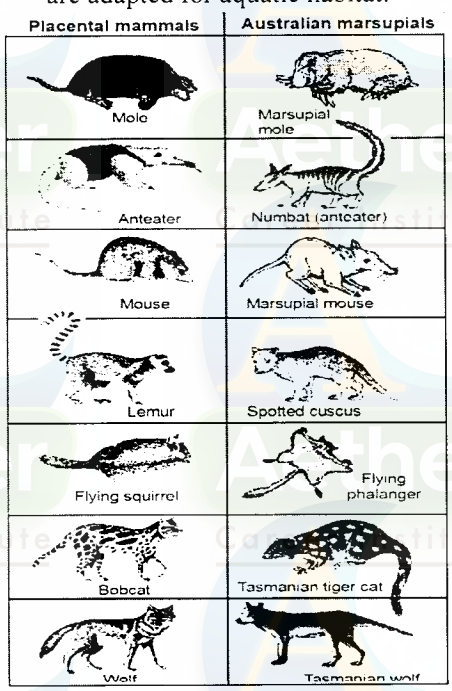
(2) Convergent evolution (Adaptive convergence):

"When more than one adaptive radiation appeared to have occurred in an isolated geographical area (Representing different habitats), this is called convergent evolution.

Examples:

(i) Similarity in Placental mammals and Marsupials in Australia (e.g. placental wolf and Tasmanian wolf).

(ii) Shark and Whale: Shark is a fish while whale is a mammal, they are not closely related but looks very much similar as both are adapted for aquatic habitat.



GENETIC BASIS OF ADAPTATIONS/NATURAL SELECTION

- The essence of Darwinian Theory about evolution is **natural selection**.
- The rate of appearance of new forms is linked to the life cycle or the life span.
- Microbes that divide fast have the ability to multiply and become millions of individuals within hours.
- A colony of bacteria (say A) growing on a given medium has built in variation in terms of ability to utilise a feed component. A change in the medium composition would bring out only that part of the population (say B) that can survive under the new conditions. Here we say that fitness of B is better than that of A under the new conditions.
- In due course of time this variant population outgrows the others and appears as new species. This would happen within days.
- For the same thing to happen in a fish or fowl would take million of years as life spans of these animals are in years.
- Fitness or adaptive ability is based on characteristics which are inherited. It has a genetic basis. Hence, **there must be a genetic basis for getting selected and to evolve.**
- Microbial experiments show that pre-existing advantageous mutations when selected will result in observation of new phenotypes. Over few generations, this would result in Speciation.
- For example, if we transfer a copy of bacterial colony in a medium containing penicillin then those survive are penicillin resistant because they have penicillin resistant mutant gene which enable them to survive in new environment.
- It means mutations are random, but when becomes adaptive later then natural selection fixes them in a population over the generations.

NCERT PLUS

- Unit of natural selection in an **individual** but unit of evolution is **Population**.
- Homology is accounted for the idea of branching descent.
- **Camouflage:** An organism shows resemblance with the surroundings (Act of hiding).

ORIGIN AND EVOLUTION OF MAN

[*NCERT. PG. NO.124-125*]

Evidences shows that both human and apes have evolved from common ancestors. Apes shows more similarity with humans in characteristics .

Evidences for common origin of human & apes:

(i) Shape and size of chromosome no. 3 & 6 of human and chimpanzee is 100% similar.

(ii) The skull of baby chimpanzee(semicircular jaw) is more like adult human skull than adult chimpanzee skull.(Protruded lower jaw)

(iii) Only one amino acid is different in structure of Hb in human and gorilla.

(iv) AB Blood group series is present in both and plasma proteins also shows high degree of similarity.

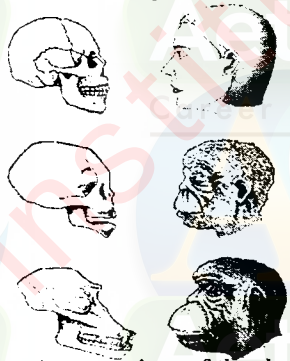


Fig.: A comparison of the skulls of adult modern human being, baby chimpanzee and adult chimpanzee.

- High degree of similarity in chromosomes, genes, blood group antigens etc. in human and apes is called **molecular homology** which strongly supports common ancestry.

	Apes	Human
1.	Semi erect posture and quadripedal locomotion	Complete erect posture with bipedal locomotion
2.	Thick growth of hair on whole body	Body hair vestigial
3.	Less cranial capacity (450 cc) & less intelligent	More cranial capacity (1300-1600cc) & more intelligent
4.	Forelimbs longer than hind limbs	Forelimbs shorter than hind limbs
5.	Protruded or 'U' shaped jaw	Semicircular or 'C' shaped jaw
6.	Thumb is parallel to palm	Thumb is opposable

BIOLOGY

Q.46 Human hand, wing of bat and flipper of whale represent:
(1) Analogous organs
(2) Vestigial organs
(3) Homologous organs
(4) Analogy

Q.47 Potato and sweet potato:
(1) Have edible parts which are homologous organs
(2) Have edible parts which are analogous organs
(3) Are two species of the same genus
(4) Have been introduced in India from the same place

Q.48 Which one of the following describes correctly the Analogous structures ?
(1) Organs with anatomical dissimilarities, but performing same function
(2) Organs with anatomical similarities, but performing different functions
(3) Organs that have no function now, but had an important function in ancestors
(4) Organs appearing only in embryonic stage and disappearing later in the adult

Q.49 Flippers of dolphin are modified :
(1) Fins (2) Hindlimb
(3) Forelimb (4) Gills

Q.50 Darwin's finches are an example of :
(1) Divergent evolution
(2) Adaptive radiation
(3) Both (1) and (2)
(4) Convergent evolution

Q.51 Mark the incorrectly matched pair
(1) Invertebrates Evolved – 500 MYA
(2) First vertebrates – 350 MYA
(3) Ichthyosaurs – 200 MYA
(4) Coelacanth – 150 MAY

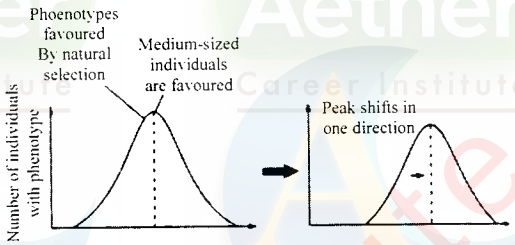
Q.52 In Evidences of evolution, which of the following give clues to common ancestry?
(1) Homology
(2) Divergent evolution
(3) Biochemical similarities among diverse organisms
(4) All are correct

Q.53 Viviparity is considered to be more evolved because :
(1) The young ones are left on their own
(2) The young ones are protected by a thick shell
(3) The young ones are protected inside the mother's body and are looked after they are born leading to more chances of survival
(4) The embryo takes a long time to develop

THEORIES OF EVOLUTION

Q.54 What is true for fitness ?
(1) Inheritable (2) Non-heritable
(3) Temporary (4) Somatic

Q.55 The figure shown below representing the :



(1) Stabilisation (2) Directional change
(3) Disruption (4) Genetic drift

Q.56 Ship used by Darwin :
(1) HSM Beagle
(2) His Majesty service
(3) HMS Beagle
(4) Her Major ship

Q.57 Theory of evolution is mainly concerned with :
(1) Spontaneous generation
(2) Theory of special creation
(3) Gradual change in livings
(4) Conditions of environment

Q.58 If the frequency of dominant allele is 60%, find out the percentage of heterozygous individuals in the population.
(1) 48% (2) 24% (3) 32% (4) 16%

Q.59 Darwin's Theory of Natural Selection was based on:
(1) Inheritance of acquired characters
(2) Mutation
(3) Enormous rate of reproduction in organisms, struggle for existence and survival of the fittest
(4) Changes due to the use and disuse of organs

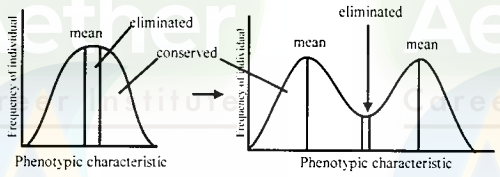
Q.60 Unit of evolution is :
(1) Species (2) Individual
(3) Population (4) Phylum

Q.61 One of the revolutionary concepts in biology was Charles Darwin's 'Origin of Species'.
It deals with :
(1) Gene mutation
(2) Use and disuse of organs
(3) Germplasm Theory
(4) Natural selection or survival of the fittest

Q.62 Which of the following is responsible for evolution according to Neo-Darwinism or modern theory of evolution
(1) Mutation (2) Natural selection
(3) Genetic drift (4) All of the above

Q.96 Mutations are :-
(1) By chance (2) Small or large
(3) Both 1 and 2 (4) Always small

Q.97 This graph indicates which type of natural selection in a population?



(1) Stabilizing selection
(2) Disruptive selection
(3) Directional selection
(4) None of them

HUMAN EVOLUTION

Q.98 Which of the following statement is incorrect regarding *Dryopithecus*?
(1) They walked like chimpanzees
(2) They were quadripede
(3) They were existing about 25 mya
(4) They were more ape-like

Q.99 Brain capacity of *Homo habilis* was :
(1) 650-800 cc (2) 800-900 cc
(3) 600-1000 cc (4) 900-1100 cc

Q.100 Fossils of *Homo erectus* was discovered in :
(1) Java (2) Bangladesh
(3) Ethiopia (4) Tanzania

Q.101 Neanderthal man lived near :
(1) East & West Africa
(2) South Africa
(3) North Africa
(4) East & Central Asia

Q.102 Prehistoric cave art developed about :
(1) 10000 years ago (2) 15000 years ago
(3) 18000 years ago (4) 20000 years ago

Q.103 Agriculture & Human settlement started about :
(1) 10000 years back (2) 20000 years back
(3) 30000 years back (4) 40000 years back

Q.104 Which primate is closest to man regarding organic evolution?
(1) Rhesus monkey (2) Gorilla
(3) Chimpanzee (4) Lemur

Q.105 Which character applies to *Homo sapiens*?
(1) Stood erect first
(2) First tool maker
(3) Cranial capacity 1400-1450 cc
(4) Protruded lower Jaw

Q.106 Which of the following statement is correct?
(1) The skull of adult chimpanzee is more like adult human
(2) The skull of baby chimpanzee is more like adult human
(3) Skull of baby chimpanzee is exactly similar to adult chimpanzee
(4) Skull of baby chimpanzee and adult chimpanzee has no resemblance to skull of human

Q.107 Who lived in near east and central Asia between 1,00,000 - 40,000 years back?
(1) *Homo erectus* (2) *Homo habilis*
(3) Neanderthal man (4) *Australopithecines*

Q.108 Most recent man found as fossil was:
(1) Java man (2) Peking man
(3) Cro-magnon man (4) Neanderthal man

Q.109 What was the cranial capacity of java man :
(1) 400 cc (2) 650 cc
(3) 900 cc (4) 1450 cc

Q.110 Evolution of man was possible because our apelike ancestors :
(1) Showed bipedal movement on open land
(2) Used fire
(3) Felt difficulty in feeding
(4) Developed community hunting

Q.111 Fire for protection and cooking was first used by :
(1) Neanderthal man (2) Cro-magnon man
(3) Java man (4) Morden man

Q.112 Civilisation (eg: Burial ceremony) was started by:
(1) Cro-magnon man (2) *Australopithecus*
(3) Java man (4) Neanderthal man

Q.113 Greatest advantage of bipedal movement :
(1) Fore arms becoming free for carrying out other activities
(2) Greater speed
(3) Support the body properly
(4) Loss of weight

Q.114 Which fossil man had cranial capacity almost equal to modern man ?
(1) *Australopithecus* (2) Java ape man
(3) *Neanderthal* man (4) Peking man

Q.115 Largest cranial capacity was found in :
(1) Peking man (2) Neanderthal man
(3) Java man (4) Cro-magnon man

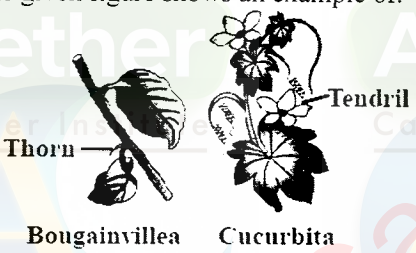
Q.116 Which among the following is the most primitive ancestor of man ?
(1) *Homo habilis*
(2) *Ramapithecus*
(3) *Australopithecus*
(4) *Homo neanderthalensis*

RANKER'S STUFF

Q.1 Gene migration / gene flow, genetic drifts, mutation, genetic recombination and natural selection like five factors affect **Hardy - Weinberg** principle.
Here the **actual** meaning of affect is :
(1) Disturbs genetic equilibrium and thus, causes evolution.
(2) Principle will be applicable
(3) Frequency of an allele remain constant generation to generation
(4) Will not influence evolution

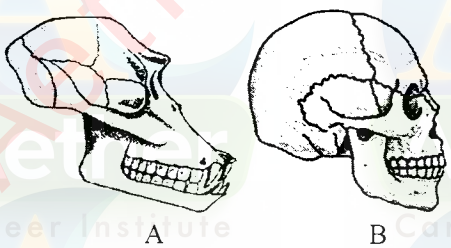
Q.2 What is true about finches ?
(a) Present in galapagos island.
(b) Have changes in beak pattern / shape, as of food available.
(c) Arose from common ancestor.
(d) Best example of adaptive radiation.
(1) a, c, d (2) b, c, d
(3) a, b, c (4) a, b, c, d

Q.3 The given figure shows an example of:



(1) Homologous organs
(2) Convergent evolution
(3) Divergent evolution
(4) Both (1) and (3)

Q.4 The diagram A and B given below shows the skull of two different mammals. Which of the following accurately describes the differences between these skulls?



(1) Skull A has more teeth than skull B.
(2) Skull A has more brain capacity than skull B.
(3) Skull A is of a human and skull B is of an ape.
(4) Skull A is of an ape and skull B is of human.

Q.5 Choose the incorrectly matched pair.
(1) Reptiles — Thick-shelled eggs which do not dry up
(2) *Tyrannosaurus rex* — Fish like reptile
(3) Dinosaurs — May be evolved into birds
(4) Continental drift — South America joined North-America

Q.6 Select the true statements :
(1) *Ramapithecus* and *Dryopithecus* were existing about 50 million years ago
(2) *Ramapithecus* was more man like while *Dryopithecus* was more ape like
(3) *Ramapithecus* was more ape like while *Dryopithecus* was more man-like
(4) Both (1) and (2)

Q.7 Select the incorrect statements :
(1) Natural selection is a heritable variation & by reproduction leave greater number of progenies
(2) During stabilisation of natural selection more individuals acquire value other than mean character value
(3) By the time of 500 million years ago invertebrates were formed and were active
(4) Reptiles lay thick shelled eggs which do not dry up in sun unlike those of Amphibians

Q.8 Which type of selection is industrial melanism, observed in moth, *Biston betularia*:
(1) Stabilising (2) Directional
(3) Disruptive (4) Artificial

Q.9 There would be no evolution if :
(1) The inheritance of acquired characters did not take place
(2) Somatic variations were not inheritable
(3) Genetic variations were not found among members of population
(4) Somatic variations would not transform into germinal variations

Q.10 On Galapagos island Darwin observed variation in beaks of birds (Darwin's finches) and he concluded:
(1) Interspecies variation
(2) Intraspecies variation
(3) Natural selection according to food
(4) Inheritance of acquired characters

Q.14 Among the following sets of examples for divergent evolution, select the **incorrect** option : **[NEET 2018]**
(1) Forelimbs of man, bat and cheetah
(2) Heart of bat, man and cheetah
(3) Brain of bat, man and cheetah
(4) Eye of octopus, bat and man

Q.15 According to Hugo de Vries, the mechanism of evolution is : **[NEET 2018]**
(1) Multiple step mutations
(2) Saltation
(3) Phenotypic variations
(4) Minor mutations

Q.16 Variations caused by mutation, as proposed by Hugo de Vries, are : **[NEET 2019]**
(1) small and directional
(2) small and directionless
(3) random and directional
(4) random and directionless

Q.17 Match the hominids with their correct brain size : **[NEET 2019]**

(a) *Homo habilis*	(i) 900 cc
(b) *Homo neanderthalensis*	(ii) 1350 cc
(c) *Homo erectus*	(iii) 650-800 cc
(d) *Homo sapiens*	(iv) 1400 cc

Select the correct option.

	(a)	(b)	(c)	(d)
(1)	(iii)	(iv)	(i)	(ii)
(2)	(iv)	(iii)	(i)	(ii)
(3)	(iii)	(i)	(iv)	(ii)
(4)	(iii)	(ii)	(i)	(iv)

Q.18 In a species, the weight of newborn ranges from 2 to 5 kg. 97% of the newborn with an average weight between 3 to 3.3 kg survive whereas 99% of the infants born with weights from 2 to 2.5 kg or 4.5 to 5 kg die. Which type of selection process is taking place? **[NEET 2019]**
(1) Disruptive Selection
(2) Cyclical Selection
(3) Directional Selection
(4) Stabilizing Selection

Q.19 Embryological support for evolution was disapproved by: **[NEET-2020]**
(1) Oparin (2) Karl Ernst von Baer
(3) Alfred Wallace (4) Charles Darwin

Q.20 Flippers of Penguins and Dolphins are examples of: **[NEET-2020]**
(1) Natural selection
(2) Adaptive radiation
(3) Convergent evolution
(4) Industrial melanism

Q.21 From his experiments, S.L. Miller produced amino acids by mixing the following in a closed flask: **[NEET-2020]**
(1) CH_3, H_2, NH_3 and water vapour at 600°C
(2) CH_4, H_2, NH_3 and water vapour at 800°C
(3) CH_3, H_2, NH_4 and water vapour at 800°C
(4) CH_4, H_2, NH_3 and water vapour at 600°C

Q.22 Which of the following refer to correct example(s) of organisms which have evolved due to changes in environment brought about by anthropogenic action? **[NEET-2020]**
(a) Darwin's Finches of Galapagos islands.
(b) Herbicide resistant weeds.
(c) Drug resistant eukaryotes
(d) Man-created breeds of domesticated animals like dogs
(1) Only (d) (2) Only (a)
(3) (a) and (c) (4) (b), (c) and (d)

Q.23 Embryological support for evolution was proposed by: **[NEET -2020]**
(1) Ernst Heckel (2) Karl Ernst von Baer
(3) Charles Darwin (4) Alfred Wallace

Q.24 After about how many years of formation of earth, life appeared on this planet? **[NEET-2020]**
(1) 500 billion years (2) 50 million years
(3) 500 million years (4) 50 billion years

Q.25 The phenomenon of evolution of different species in a given geographical area starting from a point and spreading to other habitats is called: **[AIPMT-2012, NEET -2020]**
(1) Saltation (2) Co-evolution
(3) Natural selection (4) Adaptive radiation

Q.26 A Hominid fossil discovered in Java in 1891, now extinct, having cranial capacity of about 900 cc was: **[NEET -2020]**
(1) *Homo erectus*
(2) Neanderthal man
(3) *Homo sapiens*
(4) *Australopithecus*

Q.27 The factor that leads to Founder effect in population is: **[NEET-2021]**
(1) Natural selection
(2) Genetic recombination
(3) Mutation
(4) Genetic drift

Human Health and Disease

Chapter 03

CONTENT

INTRODUCTION: [*NCERT. PG. NO.129-30*]

- For a long time, **health** was considered as a state of body and mind where there was a balance of certain **'humors'.**
- This is what early Greeks like **Hippocrates** as well as **Indian Ayurveda system of medicine** asserted. It was thought that persons with 'blackbile' belonged to hot personality and would have fevers. This idea was arrived at by pure reflective thought.
- The discovery of blood circulation by **William Harvey** using experimental method and the demonstration of normal body temperature in persons with 'blackbile' using thermometer disproved the "good humor hypothesis" of health.
- In later years, biology stated that mind influences, through neural system and endocrine system, our immune system and that our immune system maintains our health. Hence, mind and mental state can affect our health.

HEALTH-

The term health is very frequently used by everybody. Health does not simply mean 'absence of disease' or 'physical fitness'. According to WHO, It could be defined as "**a state of complete physical, mental and social well-being**".

Factor affecting health

- **Genetic disorders :** Deficiencies/defects which the child inherits from parents by birth (Inborn)
- **Infections :** Entry of pathogen or disease-causing micro organism into the host's body
- **Life style :** Including food and water we take, rest and exercise we give to our bodies, habits that we have or lack etc.

Good health can be achieved by

- **Balanced diet**
- **Personal hygiene**
- **Regular exercise**
- **Yoga**

- Awareness about diseases and their effect on different bodily functions, vaccination (immunization) against infectious diseases, proper disposal of wastes, control of vectors and maintenance of hygienic food and water resources are also necessary for achieving good health.
- When people are healthy, they are more efficient at work, this increases productivity & brings economic prosperity. It also increases longevity (average life) & reduces infant & maternal mortality rate.

DISEASE-

When the functioning of one or more organs or systems of the body is adversely affected, characterised by various signs and symptoms, we say that we are not healthy, i.e., we have a disease.

Antibody or Immunoglobulin (Ig):

- These are complex **glycoprotein molecule** made up of 4 polypeptide chains- two light and two heavy chains. Hence, an antibody is represented as $H_2 L_2$.
- These two-chain held together by **disulphide bond** in shape of Y molecule.
- Each heavy and each light chain possesses a variable (V) and a constant (C) region.
- Variable (V) regions of one heavy and one light chains together form an asymmetric **"Antigen binding site (paratope)".** Therefore, it is also called antigen binding fragment (Fab.)
- These two tip tops of antibody (Paratopes) binds with a particular part of antigen **"Antigenic determinant" (epitope)** in a lock and key fashion and thus antigen-antibody reaction takes place.

TYPES OF ANTIBODIES IN HUMAN

S. No.	Group of Antibodies	Main Characters and Occurrence	Functions
1.	IgG	Most common (75%) and **smallest antibodies**. It has capacity to pass through placenta during pregnancy	**Provide passive immunity to foetus**. It also protects us during chronic infection
2.	IgA	**Secretory antibodies,** present in body secretions like **milk or colostrum**, saliva, mucus etc.	**Provide passive immunity to new born baby** and also provide protection from inhaled or ingested pathogens.
3.	IgM	Oldest and first antibody generated in response to antigens, **(largest antibody)**	This antibody appears first at the time of acute infection.
4.	IgD	Present on the surface of B-lymphocytes and acts as receptors for antigen **(Fixed/surface antibody)**	**Activation of B-lymphocytes** and supports immune reactions.
5.	IgE	Present in very small quantities, **(Allergic antibody)**	Stimulation of mast cells, during allergic reactions.

VACCINATION AND IMMUNISATION : ***[NCERT. PG. NO.136]***

- Vaccine is a suspension of attenuated (Weakened/Inactivated) pathogen or antigenic proteins which is taken orally or injected to provide immunity against a disease.
- The principle of immunization or vaccination is based on the property of **'memory'** of the immune system.
- When a vaccine is introduced into the body, the antibodies are produced to neutralize the pathogenic agents.(Primary immune response)
- memory – B and T-cells also produced that recognize the pathogen quickly on subsequent exposure and destroy pathogen with a massive production of antibodies during actual infection. (Secondary immune response)
- **Immunisation:** Making someone resistant against a particular disease. It can be done through **vaccination** (Active immunisation) or by giving preformed antibodies (Passive immunisation).
- **Vaccination:** It is the most common and most effective method of immunisation.
- If a person is infected with some deadly microbes to which quick immune response is required as in **tetanus**, we need to directly inject the preformed antibodies, or antitoxin (a preparation containing antibodies to the toxin). Even in cases of snakebites, the injection which is given to the patients, contain preformed antibodies against the snake venom. This type of immunisation is called **passive immunisation**.

SPOT LIGHT

- **Second generation Vaccines:** Produced through recombinant-DNA technology (RDT). These vaccines are pure and has no side effects.
- Recombinant DNA technology has allowed the production of antigenic polypeptides of pathogen in bacteria or yeast.
- Vaccines produced using this approach allows large scale production & hence greater availability for immunization Eg. **Hepatitis B vaccine** produced from transgenic yeast.

Opium (poppy) plant

- Opiods are **sedative** (Depressant) cum **analgesics** (Pain killer).
- These drugs bind to specific opioid receptors present in our central nervous system and gastrointestinal tract.

(i) Morphine is a very **effective sedative and painkiller** and is very useful in patients who have undergone surgery.

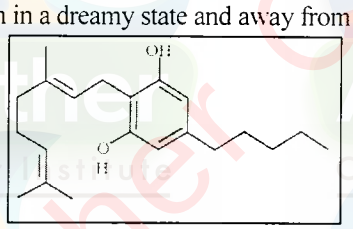
(ii) Heroin, commonly called ***smack*** is chemically **diacetylmorphine** which is a white, odourless, bitter crystalline compound. This is obtained by acetylation of morphine, which is extracted from the latex of poppy plant ***Papaver somniferum***.

(iii) Codeine is the mild & synthetic form used in cough syrups.

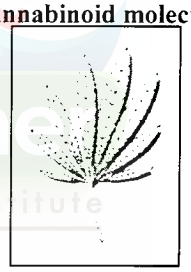
- Generally taken by snorting and injection, heroin is a depressant and slows down body functions.

(C) Hallucinogens :-

- These drugs causes hallucination i.e. alters thoughts, perceptions & feelings of the user. They take the person in a dreamy state and away from the reality.



(a)
Skeletal structure of cannabinoid molecule



(b)
Leaves of *Cannabis sativa*

(c)
Flowering branch of *Datura*

(i) **Cannabinoids:** Product of **hemp plant** (*cannabis sativa*) are called Cannabinoids.

- Natural cannabinoids are obtained from the **inflorescences,** flower tops, leaves and the resin of hemp plant *(Cannabis sativa)* and are used in various combinations to produce **marijuana, hashish, charas and ganja.**
- Interact with cannabinoid receptors present principally in the brain.
- Generally taken by inhalation and oral ingestion, these are known for their effects on cardiovascular system of the body.
- These days cannabinoids are also being abused by some sports persons.

(ii) Other well-known plants with hallucinogenic properties are ***Atropa belladona*** and ***Datura***.

(iii) LSD (Lysergic acid diethyl amides) is a dangerous Hallucinogen, obtained from fruiting bodies of a fungus ***(Claviceps purpurea).***

(D) STINULANT DRUGS: They increases alertness, performance and reduce tiredness and sleep.

COCA ALKALOID OR COCAINE:

- These are obtained from coca plant ***Erythroxylum coca,*** native to South America.
- It interferes with the transport of the neuro-transmitter **dopamine**.
- Cocaine, commonly called **coke** or **crack** is usually snorted.
- It has a potent stimulating action on central nervous system, producing a sense of euphoria (feeling of well being) and increase energy, excessive dosage of cocaine causes **hallucinations**.

- Withdrawal and isolation from family and friends
- Aggressive and rebellious behavior
- No interest in any hobbies
- Change in sleeping patterns and eating habits
- Fluctuations in weight.
- The **side-effects** of the use of anabolic steroids **in females** include masculinisation (features like males), increased aggressiveness, mood swings, depression, abnormal menstrual cycles, excessive hair growth on the face and body, enlargement of clitoris, deepening of voice etc.
- **In males** it includes acne, increased aggressiveness, mood swings, depression, reduction of size of testicles, decreased sperm production, potential for kidney and liver dysfunction, breast enlargement, premature baldness, enlargement of the prostate gland. These effects may be permanent with prolonged use.

PREVENTION AND CONTROL: Following are the measures for prevention and control of alcohol or drugs:

(i) Avoid undue peer pressure to perform more than ones ability in different spheres of life.

(ii) Educating and counselling people to face problems and failures.

(iii) Seeking help from parents and peers to went out feelings of anxiety and guilt.

(iv) Looking for danger signs would help intimely initiation of treatment.

(v) Look out for professional or medical help for de- addiction and rehabilitation.

ALCOHOL: Alcohol acts as a **depressant.**

- Alcohol is rapidly absorbed from the wall of stomach and enters into blood stream within minutes of intake.
- In the liver alcohol is converted into a more toxic substance **acetaldehyde.**
- Alcohol drinking affects cerebrum part of brain immediately (speech affected) and the cerebellum part of brain , so control and coordination of the body affected. (Zig-Zag moments)
- The liver is the organ most affected by alcohol.
- Excess alcohol in the blood causes increase in the synthesis of fat which is deposited in the liver cell and bile ducts. This results in the "**Fatty liver syndrome**" and liver damage **(Cirrhosis).**
- It causes the inflammation in the wall of stomach. In chronic cases the gastric ulcers usually develop.

Practice Section-04

Q.1 Which one depresses brain activity?
(1) Sedatives (2) Opiate narcotics
(3) Both (1) and (2) (4) Hallucinogens

Q.2 Which of the following increases alertness, self confidence and performance?
(1) Opiates (2) Sedatives
(3) Stimulants (4) Depressants

Q.3 Opiate narcotic is:
(1) Bhang (2) Charas (3) Heroin (4) Nicotine

Q.4 Choose the **correct** pair
(1) LSD - Opiates
(2) Heroin - Cannabinoid
(3) Benzodiazepin - Painkiller
(4) Amphetamine - Stimulant

Q.5 LSD is obtained from
(1) Cannabis (2) Claviceps
(3) Erythroxylum (4) Papaver

Q.6 An adolescent often shows changes in moods and emotions due to :
(1) Difficulty in social adjustments
(2) Hormone flushes
(3) Search for self identify
(4) Egocentrism

Q.7 Fatty liver syndrome is due to excessive intake of:
(1) Morphine (2) Tobacco
(3) Alcohol (4) Both (2) and (3)

Q.8 Which one of the following statements is **correct?**
(1) Heroin is a depressant and slows down body function.
(2) Coca alkaloid or cocaine is obtained from coca plant *Erythroxylum coca*, native to North America.
(3) Low dosage of cocaine causes hallucinations
(4) Both (1) and (3)

Q.9 The side-effects of the use of anabolic steroids in males don't include :
(1) Enlargement of clitoris
(2) Mood swings
(3) Increased aggressiveness
(4) Depression

Q.10 The side-effects of the use of anabolic steroids in males don't include :
(1) Enlargement of clitoris
(2) Mood swings
(3) Increased aggressiveness
(4) Depression

BIOLOGY

Q.113 Several viral diseases have been controlled by vaccines but the same has not been possible with AIDS, Why?
(1) Cost of development and production of vaccines
(2) Lack of suitable experimental animal on which vaccines can be tested
(3) Lack of antigenic proteins on the HIV virus
(4) High rate of mutability in HIV

Q.114 Pick wrong one out :-
(1) Elephantiasis - *Wuchereria*
(2) Amoebic dysentery - *Entamoeba histolytica*
(3) Infective stage of *Plasmodium* for human - Sporozoite
(4) Pneumonia - *Salmonella typhi*

Q.115 Which one of the following pairs of disease can spread through blood transfusion?
(1) AIDS and Malaria
(2) AIDS and Asthma
(3) Diabetes mellitus and syphilis
(4) Hepatitis and AIDS

Q.116 In our body, cell growth and differentiation is highly regulated. In cancer cell, there is breakdown of these regulatory mechanism. Cancer cell shows a property called -
(1) Programmed cell death
(2) Contact inhibition
(3) Activation of tumor suppressor gene
(4) Activation of proto-oncogene or cellular oncogene

Q.117 Common cold is not cured by antibiotics because it is:
(1) not an infectious disease
(2) caused by a virus
(3) caused by a Gram-positive bacterium
(4) caused by a Gram-negative bacterium

Q.118 Motile zygote of *Plasmodium* occurs in :
(1) Human RBCs
(2) Human liver
(3) Gut of female *Anopheles*
(4) Salivary glands of *Anopheles*

Q.119 In leukemia, there is tremendous increase in the number of:
(1) RBCs
(2) Platelets
(3) Both (1) and (2)
(4) WBCs and immature leucocyte cells

Q.120 Which of the statement regarding treatment of cancer is false?
(1) Chemotherapy has side effects like hair loss and anaemia.
(2) Iodine-131 is used to treat certain type of thyroid cancer
(3) Cancer can be treated properly only when detected early
(4) Any one therapy is enough to treat any kind of cancer.

Q.121 In which stage of cancer does metastasis occur.
(1) III stage (2) II stage
(3) I stage (4) IV stage

DRUGS AND ALCOHOL ABUSE

Q.122 Withdrawal syndrome is characterized by –
(1) Anxiety and shakiness
(2) Shakiness and sweating
(3) Nausea and vomiting
(4) All of the above

Q.123 Which one alters thoughts and perceptions without any sensory stimulus?
(1) Sedative and tranquillisers
(2) Cocaine
(3) Opiate narcotics
(4) Hallucinogen

Q.124 Which of the following drug is used for treatment of insomnia and depression?
(1) Barbiturates
(2) Amphetamine
(3) Antihistamines
(4) Both (1) and (2)

Q.125 Marijuana is extracted from
(1) Dried leaves and flowers of hemp plant
(2) Ergot fungus
(3) Roots of hemp plant
(4) Cocoa plant

Q.126 Cocaine interferes with transport of :-
(1) GABA
(2) Acetylcholine
(3) Dopamine
(4) Glutamate

Q.127 Tobacco chewing may lead to :-
(1) Mouth cancer
(2) Lung cancer
(3) Bone cancer
(4) Leukemia

RANKER'S STUFF

Q.1 Which are common between AIDS and Hepatitis–B?
(a) Both are viral diseases
(b) Both are infectious diseases
(c) Both can show transmission of infection from mother to foetus
(d) Main affected organ is liver
(e) Both may occur via kissing.
(1) a, b, d, e (2) a, b, c, d, e
(3) a, c, d, e (4) a, b, c

Q.2 Which among the following is correct for monoclonal antibodies used to treat cancer ?
(1) It allows immune system itself to destroy cancer cells
(2) Helps in recognition of tumor cells
(3) They are specific to one type of cancer
(4) All of the above

Q.3 A person suffering from a disease caused by *plasmodium*, experiences recurring chill and fever at the time when:
(1) The sporozoites released from RBCs are being rapidly killed and broken down inside spleen.
(2) The trophozoites reach maximum growth and give out certain toxins.
(3) Infected RBCs get ruptured to release merozoites and certain toxins.
(4) The microgametocytes and mega gametocytes are being destroyed by the WBCs.

Q.4 (A) Loss of appetite
(B) Intestinal ulcer
(C) Sustained high fever (39 – 40°F)
(D) Constipation
These are the symptoms of which of the following disease.
(1) Pneumonia (2) Thyroid
(3) Ascariasis (4) Typhoid

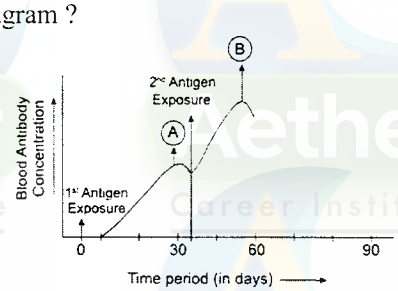
Q.5 Cancer detection is based on :-
(a) Biopsy
(b) Histopathological studies of tissue
(c) Blood test
(d) Bone marrow test
(1) a, b (2) a, c & d
(3) a, b & c (4) a, b, c & d

Q.6 Neoplastic transformation of DNA damage can be brought about by several factors. Choose the factors which lead to oncogenic transformation within exposed cells:
(a) UV rays (b) X-rays
(c) Tobacco smoke (d) Retro-virus
(1) a and b (2) a, b and c
(3) b and c (4) a, b, c and d

Q.7 Which of the following is correct for LSD, morphine and charas respectively?
(1) *Claviceps, Papaver somniferum, Trichoderma*
(2) *Claviceps, Cannabis, Cocca plant*
(3) *Claviceps, Papaver somniferum, Cannabis*
(4) *Papaver somniferum, Claviceps, Cannabis*

Q.8 Read the following symptom of diseases (A & B) and identify them
A. Internal bleeding, muscular pain, fever, anemia and blockage of the intestinal passage.
B. Nasal congestion and discharge, sore throat, hoarseness.
(1) A–Amoebiasis, B–Pneumonia
(2) A–Ascariasis, B–Common cold
(3) A–Typhoid, B–Common cold
(4) A–Ascariasis, B–Pneumonia

Q.9 Which of the following is correct about the given diagram ?



(1) (A) is anamnestic response
(2) Memory cells are responsible for (A)
(3) Memory cells are responsible for (B)
(4) Response "B" is shown when vaccine is injected

Q.10 Which of the following is incorrect about natural killer cells?
(1) Produced in bone marrow
(2) Destroy target cells by cell-lysis
(3) Antigen specific receptors absent, therefore is a part of innate immunity
(4) All of the above

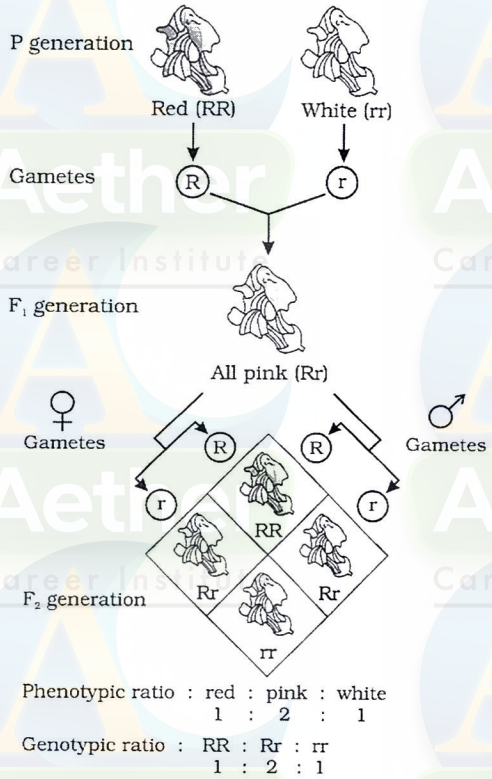


Figure- Results of monohybrid cross in the plant Snapdragon, where one allele is incompletely dominant over the other allele

(b) Flower colour in *Antirrhinum majus*

Incomplete dominance is also seen in flower colour of this plant. This plant is also known as '**Snapdragon** ' or '**Dog flower**'. Incomplete dominance is found in this plant which is same as ***Mirabilis.***

(c) Feather colour in Andalusian Fowls

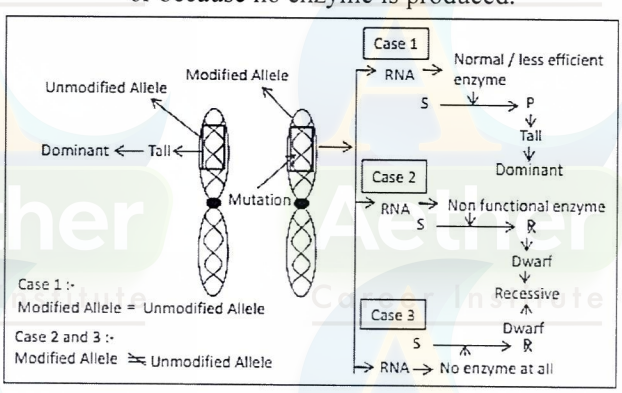
When a black colour fowl is crossed with a white colour fowl, the colour of F_1 generation is blue.

(d) Size of starch grain in pea plant

➢ When a large size is crossed with small size, the size of starch in F_1 generation is intermediate.

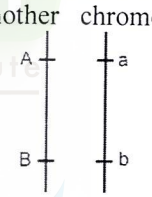
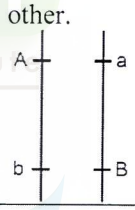
➢ **Explanation of the Concept of dominance:**

- Let us take an example of a gene that contains the information for producing an enzyme. Now there are two copies of this gene, the two allelic forms.
- Let us consider that the normal allele produces the normal enzyme that is needed for the transformation of a substrate S.
- Theoretically, the modified allele could be responsible for production of (i) The normal/less efficient enzyme, or (ii) a non-functional enzyme, or (iii) no enzyme at all.
- In the first case, the modified allele is equivalent to the unmodified allele, i.e., it will produce the same phenotype/trait, i.e., resulting in the transformation of substrate S. Such equivalent allele pairs are very common.
- But, if the allele produces a non-functional enzyme or no enzyme, the phenotype may be affected. The phenotype trait will only be dependent on the functioning of the unmodified allele.
- The unmodified (functioning) allele, which represents the original phenotype is the dominant allele and the modified allele is generally the recessive allele.
- Hence, in the above example the recessive trait is seen due to non- functional enzyme or because no enzyme is produced.



NCERT PLUS

- Arrangement of linked genes on chromosomes-

Cis-arrangement
Two dominant genes are located on one chromosome and both recessive genes on another chromosome

Trans -arrangement
One dominant and one recessive gene on one chromosome while the same on the other.


- **Cis and Trans arrangement of genes can be interchanged due to Crossing Over**
- **Unit conversion –**
  0.1 M (Morgan) = 10 cM (Centimorgan)

Types of Linkage :- There are two types of linkage :

1 Complete Linkage:

- Linkage in which genes always show parental combination. It never forms new combination. Crossing over is absent in it.
- Such genes are located very close on the chromosomes. Such type of linkage is very rare in nature. e.g. male *Drosophila*, female silk moth.

2. Incomplete Linkage:

- When new combinations also appear along with parental combination in offsprings, this type of linkage is called incomplete linkage, the new combinations form due to crossing over.

Sex linkage:

- When the genes are present on sex-chromosome, they are termed as sex linked genes and their linkage is known as sex-linkage.
- Morgan carried out several dihybrid crosses in *Drosophila* to study genes that were sex-linked. The crosses were similar to the dihybrid crosses carried out by Mendel in peas. For example Morgan hybridised yellow-bodied, white-eyed females to brown-bodied, red-eyed males and inter-crossed their F_1 progeny.
- He observed that the two genes did not segregate independently of each other and the F_2 ratio deviated very significantly from the 9:3:3:1 ratio (expected when the two genes are independent).
- He found that the genes white and yellow were very tightly linked and showed only **1.3 percent** recombination while white and miniature wing showed **37.2 percent** recombination.

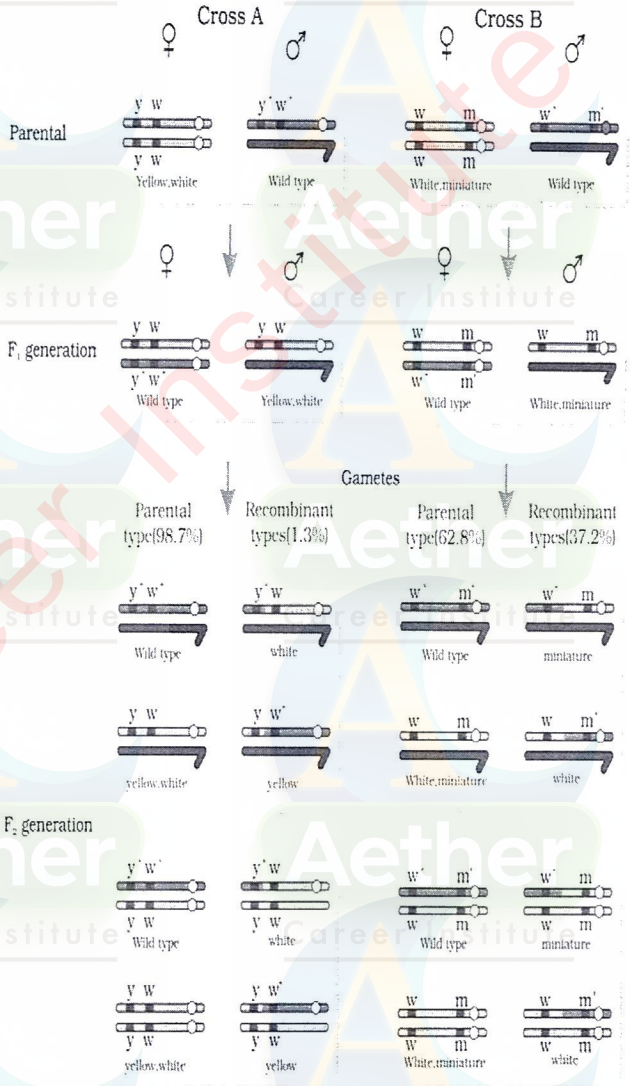


Figure _ Linkage: Results of two dihybrid crosses conducted by Morgan. Cross A shows crossing between gene y and w; Cross B shown crossing between genes w and m. Here dominant wild type alleles are represented with (+) sing in superscript

Note : The strength of linkage between y and w is higher than w and m

BIOLOGY

Q.71 ABO blood group is an example of :
(1) Epistasis
(2) Multiple allelism
(3) Pleiotropism
(4) Complementary genes

Q.72 A child has blood group 'O'. His parents blood group cannot be :
(1) B and O (2) A and O
(3) AB (4) A and B

Q.73 If one parent has blood group A and the other parent has blood group B. The offsprings have which blood group:
(1) AB only (2) O only
(3) B only (4) A, B, AB, O

Q.74 A child of O blood group, has B-blood group father, the genotype of father would be:
(1) I^0I^0 (2) I^BI^B (3) I^AI^B (4) I^BI^0

Q.75 When a red flowered plant was cross pollinated by white flowered one and the offspring were self pollinated to obtain a phenotypic ratio of 1:2:1, it has to be a case of :
(1) Incomplete dominance
(2) Dominance
(3) Recessive epistasis
(4) Pleiotropic effect of genes

Q.76 A gene that shows its effect on more than one character is
(1) Polygene (2) Pleiotropic gene
(3) Multifactor gene (4) Multiple gene

Q.77 In multiple allele system a gamete possesses
(1) Two alleles (2) Three alleles
(3) One allele (4) Several alleles

Q.78 Blood grouping in humans is controlled by
(1) 4 alleles in which I^A is dominant
(2) 3 alleles in which I^A and I^B are dominant
(3) 2 alleles in which none is dominant
(4) 3 alleles in which I^A is recessive

Q.79 Multiple alleles are present :
(1) In different chromosomes
(2) At different loci on chromosome
(3) At the same locus on homologous chromosomes
(4) At the non homologous chromosome

Q.80 (A) Pleiotropic genes have multiple phenotypic effect.
(B) Multiple alleles exhibit same phenotypic expression.
(C) Polygenes exhibit continuous variation.
(1) Statement (A), (B) and (C) are correct
(2) Statement (A), (C) correct and (B) is incorrect
(3) Statement (A), (B) and (C) are incorrect
(4) Statement (B) and (C) are correct and (A) is incorrect

Q.81 Sickle cell anaemia induces due to :
(1) Change of Amino Acid in α – chain of Haemoglobin
(2) Change of Amino Acid in β – chain of Haemoglobin
(3) Change of Amino Acid in both α and β chain of Haemoglobin
(4) Change of Amino acid either α or β chain of Haemoglobin

Q.82 Incomplete dominance is absent in:
(1) *Pisum sativum*
(2) *Antrrhinum majus*
(3) Human ABO blood groups
(4) Both *Pisum sativum* and *Antirrhinum majus*

Q.83 A man with blood group B marries a female with blood group A and their first child is having blood group B. What is the genotype of child?
(1) I^AI^B (2) I^AI^O (3) I^BI^O (4) I^BI^B

Q.84 A child with mother of blood group A and father of blood group AB, will not have which of the following blood group?
(1) A (2) B (3) AB (4) O

Q.85 If mother has blood group B, father has A group, the offspring will be of :
(1) A (2) O
(3) AB (4) Any of the above

Q.86 Sickel cell anemia is the result of _____ mutation in the haemoglobin gene:
(1) Frame shift (2) Deletion
(3) Point (4) None of the above

Q.87 In the inheritance of flower colour in dog flower plant, the F_1 has a phenotype that:
(1) Resembles both of the parents
(2) Does not resemble either of the two parents
(3) Resembles with only one parent
(4) 1 and 3 both

Q.159 in honeybee males produce sperms by
(1) Meiosis
(2) Mitosis
(3) Amitosis
(4) More than one option correct

Q.160 Sex determination in humans takes place by:
(1) Sex chromosomes of father
(2) Measurement of sperm
(3) Measurement of ovum
(4) Sex chromosomes of mother

Q.161 The number of chromosomes in female & male respectively in honeybee is
(1) 16, 16 (2) 16, 32
(3) 32, 16 (4) 32, 32

Q.162 Which of the following is responsible for sex determination in chick?
(1) Sperm (2) Egg
(3) Somatic cell (4) Every cell of body

Q.163 In which of the following sex is determined by female individual?
(1) Human (2) *Drosophila*
(3) Birds (4) Grasshopper

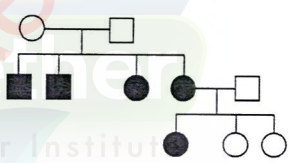
Q.164 Male heterogamy found in case of:
(1) XO type male in Grasshopper
(2) XY type male in human
(3) ZW male in birds
(4) 1 and 2 both

Q.165 In which of the following monosomic male is found:
(1) Human (2) Birds
(3) Honey bee (4) Grasshopper

GENETIC DISORDERS

Q.166 In pedigree analysis, symbol given for sex unspecified is:
(1)  (2)  (3)  (4) 

Q.167 In the given pedigree, Indicate whether the shaded symbols indicate dominant or recessive allele:



(1) Recessive
(2) Codominant
(3) Dominant
(4) It can be recessive or dominant both

Q.168 The inheritance of a particular trait is represented in the family tree over generations in
(1) Pedigree analysis (2) Linkage
(3) Recombination (4) Mutation

Q.169 If a cross is made between two individuals each having genotype Bb, two offsprings are obtained. Out of these first has dominant trait. What is the probability that the second offspring will exhibit recessive trait?
(1) 1/4 (2) 100 (3) Zero (4) 3/4

Q.170 Which one of the following character in man is controlled by recessive gene?
(1) Colourblindness (2) Myotonic dystrophy
(3) Brachy-dactyly (4) Curly hairs

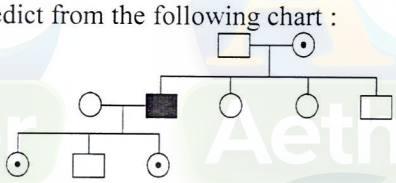
Q.171  This symbol represents
(1) Sex specified (2) Five unaffected offsprings
(3) Mating (4) Normal male

Q.172 Failure of segregation of chromatid during cell division cycle results in the gain or loss of a chromosome(s), called
(1) Aneuploidy
(2) Polyploidy
(3) Euploidy
(4) More than one option is correct

Q.173 Down's syndrome is caused by an extra copy of chromosome number 21. What percentage of offsprings produced by an affected mother and a normal father would be affected by this disorder?
(1) 50% (2) 25% (3) 100% (4) 75%

Q.174 A male human is heterozygous for autosomal genes A and B and is also hemizygous for haemophilic gene h. What proportion of his sperms will be abh?
(1) $\frac{1}{4}$ (2) $\frac{1}{8}$ (3) $\frac{1}{32}$ (4) $\frac{1}{16}$

Q.175 Predict from the following chart :



(1) Character is dominant and carried by X chromosome
(2) Character is carried by Y chromosome
(3) Character is sex linked recessive
(4) Character is autosomal recessive

BIOLOGY

Q.98 Regulation of lac operon by repressor is referred to as:
(1) Positive regulation (2) Negative regulation
(3) Both (1) and (2) (4) None

Q.99 Which is incorrect?
(1) i-gene codes for the repressor of lac operon
(2) z-gene codes for the beta-galactosidase
(3) y-gene codes for transacetylase
(4) Three gene products are required for metabolism of lactose

Q.100 Which is the primary step for regulation of gene expression?
(1) Transport of m-RNA from nucleus to the cytoplasm
(2) Translational level
(3) Processing level
(4) Transcriptional level

Q.101 Find out the correct sequence of structural gene in lac operon:
(1) y, a, z (2) a, z, y
(3) z, y, a (4) z, a, y

MUTATION

Q.102 The concept of sudden genetic change which breeds true in an organism is visualized as:
(1) Natural selection
(2) Inheritance of acquired characters
(3) Mutation
(4) Independent assortment

Q.103 Mutation is:
(1) An abrupt or discontinuous change which is inherited
(2) A factor for plant growth
(3) A change which affects parents only and is never inherited
(4) A change which affects the offspring of F_2 generation

Q.104 The exchange of chromosomal parts between non homologous pairs of chromosome:
(1) Crossing over/Transduction
(2) Translocation
(3) Inversion
(4) Transition

Q.105 Mutation are generally:
(1) Dominant (2) Recessive
(3) Codominant (4) Incompletely dominant

Q.106 Genetic mutations occur in:
(1) DNA and RNA of viruses
(2) RNA only
(3) Protein
(4) RNA and Protein both

Q.107 Which of the following undergoes change in mutation?
(1) Chromosome (2) Structure of gene
(3) Sequence of gene (4) Any of the above

Q.108 The locus of mutation is
(1) Gene (2) Chromosome
(3) Centromere (4) Nucleus

Q.109 Gene mutation is caused
(1) Due to reproduction
(2) Due to linkage
(3) Due to change in sequence of N_2 base
(4) Due to change in sequence of genes in DNA

Q.110 X-rays generally cause
(1) Polyploidy
(2) Frame shift mutations
(3) Chromosomal aberrations
(4) Paramutations

Q.111 Non ionizing radiations commonly used for inducing mutations in organisms are:
(1) UV-rays (2) Beta-rays
(3) X-rays (4) Gamma-rays

Q.112 Ultimate source of genetic variation is (OR) the process which provides raw material for evolution is
(1) Sexual reproduction
(2) Meiosis
(3) Mutation
(4) Independent assortment

Q.113 To be evolutionary successful the mutation must occur in (OR) important mutations occur in :
(1) Somatoplasm
(2) Germplasm
(3) Karyolymph/Zygote
(4) Ergastoplasm

Q.114 Chemical mutagens are far more hazardous than radiations because :
(1) The exposure to chemicals is more prevalent
(2) The organism possess protection for radiation but no protection for chemicals
(3) The chemically induced mutations are more deleterious
(4) The chemicals are synthetics

Q.115 Deletion and insertions of base pairs of DNA causes.
(1) Chromosomal aberration
(2) Euploidy
(3) Frame shift mutation
(4) Aneuploidy

NEET-FLASHBACK

Q.1 Which enzyme/s will be produced in a cell in which there is a nonsense mutation in the lac Y gene? **[NEET-UG – 2013]**
(1) Lactose permease and transacetylase
(2) β-galactosidase
(3) Lactose permease
(4) Transacetylase

Q.2 DNA fragments generated by the restriction endonucleases in a chemical reaction can be separated by : **[NEET-UG – 2013]**
(1) Restriction mapping
(2) Centrifugation
(3) Polymerase chain reaction
(4) Electrophoresis

Q.3 Commonly used vectors for human genome sequencing are - **[AIPMT 2014]**
(1) T-DNA (2) BAC and YAC
(3) Expression Vectors (4) T/A Cloning Vectors

Q.4 In sea urchin DNA, which is double stranded, 17% of the bases were shown to be cytosine. The percentages of the other three bases expected to be present in this DNA are : **[AIPMT 2015]**
(1) G 17%, A16.5%, T32.5%
(2) G 17%, A 33%, T 33%
(3) G8.5%, A 50%, T 24.5%
(4) G 34%, A 24.5%, T 24.5%

Q.5 The movement of a gene from one linkage group to another is called : **[AIPMT 2015]**
(1) Duplication (2) Translocation
(3) Crossing over (4) Inversion

Q.6 Gene regulation governing lactose operon of *E.coli* that involves the lac I gene products is – **[AIPMT 2015]**
(1) Negative and inducible because repressor protein prevents transcription
(2) Negative and repressible because repressor protein prevents transcription
(3) Feedback inhibition because excess of β-galactosidase can switch off transcription
(4) Positive and inducible because it can be induced by lactose

Q.7 Which of the following biomolecules does have a phospho-diester bond? **[Re-AIPMT 2015]**
(1) Nucleotides of Nucleic acids
(2) Fatty acids in a diglyceride
(3) Monosaccharides in a polysaccharide
(4) Amino acids in a polypeptide

Q.8 Identify the correct order of organisation of genetic material from largest to smallest : **[Re-AIPMT 2015]**
(1) Chromosome, genome, nucleotide, gene
(2) Chromosome, gene, genome, nucleotide
(3) Genome, chromosome, nucleotide, gene
(4) Genome, chromosome, gene, nucleotide

Q.9 Which one of the following is not applicable to RNA ? **[Re-AIPMT 2015]**
(1) Chargaff's rule
(2) Complementary base pairing
(3) 5' phosphoryl and 3' hydroxyl ends
(4) Heterocyclic nitrogenous bases

Q.10 Satellite DNA is important because it : **[Re-AIPMT 2015]**
(1) Codes for enzymes needed for DNA replication
(2) Codes for proteins needed in cell cycle
(3) Shows high degree of polylmorphism in population and also the same degree of polymorphism in an individual, which is heritable from parents to children
(4) Does not code for proteins and is same in all members of the population.

Q.11 Which of the following is required as inducer(s) for the expression of *lac* operon ? **[NEET-I 2016]**
(1) Glucose
(2) Galactose
(3) Lactose
(4) Lactose and Galactose

Q.12 A complex of ribosomes attached to a single strand of m-RNA is known as : **[NEET-I 2016]**
(1) Polysome
(2) Polymer
(3) Polypeptide
(4) Okazaki fragment

Q.13 Which of the following is **not** required for any of the techniques of DNA fingerprinting available at present ? **[NEET-I 2016]**
(1) Polymerase chain reaction
(2) Zinc finger analysis
(3) Restriction enzymes
(4) DNA-DNA hybridization

Q.14 Which one of the following is the starter codon? **[NEET-I 2016]**
(1) AUG (2) UGA
(3) UAA (4) UAG

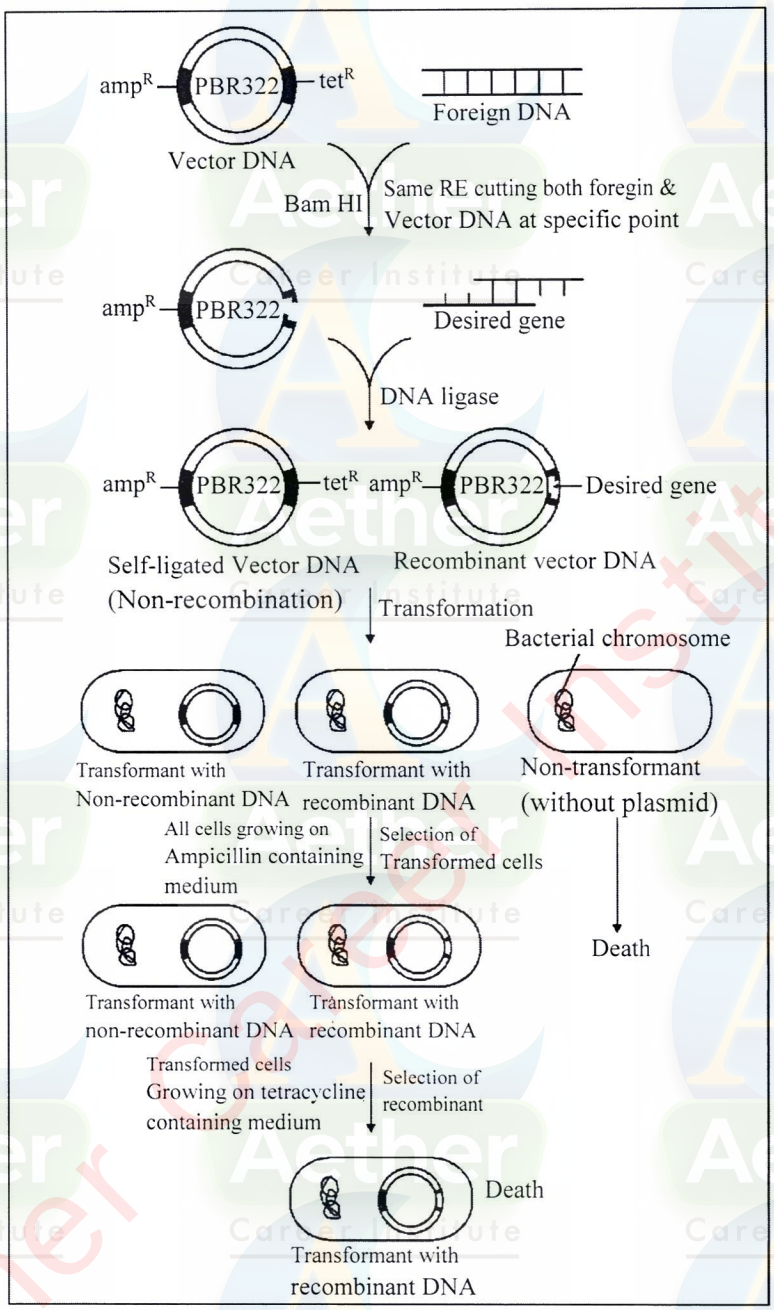


Fig: - (a) Cells are plated onto ampicillin agar: all the transformants produce colonies, (b) The colonies are replica plated onto tetracycline medium. (c) The colonies that grow on tetracycline medium are amp^R tet^R and therefore non-recombinants. Recombinants ($amp^R tet^R$) do not grow, but their position on the ampicillin plate is now known.

- **Blue/white selection:** Alternative selectable marker in pUC8 plasmid differentiates recombinants from non-recombinants on the basis of their ability to produce colour in the presence of a chromogenic substrate. In this, a recombinant DNA is inserted within the coding sequence of an enzyme, β-galactosidase. This results into inactivation of the enzyme.
- Which is referred to as **insertional inactivation. The presence of a chromogenic substrate gives blue-coloured colonies if the plasmid in the bacteria does not have an insert.**

ANSWER KEY

PRACTICE SECTION-01

Que.	1	2	3	4	5	6	7	8	9	10	11	12
Ans:	3	3	4	1	2	4	4	3	4	2	3	4

TOPIC WISE QUESTIONS

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	4	3	2	4	4	1	3	2	3	4	2	2	3	2	4
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	4	3	3	3	1	3	3	2	2	1	1	1	1	1	4
Que.	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Ans.	4	3	4	4	3	3	3	3	4	1	2	3	2	3	2
Que.	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	4	2	1	1	3	4	3	2	4	3	2	2	4	2	2
Que.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	
Ans.	1	2	2	2	1	1	4	2	4	3	2	3	3	2	

RANKER'S STUFF

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	4	1	1	4	1	3	1	2	4	4	3	2	4	4	2
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	4	2	4	2	2	2	2	2	4	1	2	1	1	3	4
Que.	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Ans.	1	3	4	3	2	4	4	2	2	4	2	4	2	3	2
Que.	46	47	48	49	50										
Ans.	1	2	1	1	2										

NEET-FLASHBACK

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	4	4	2	1	3	3	3	2	1	1	3	1	2	1	2
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	4	4	4	2	1	1	1	2	2	1	3	3	3	2	1
Que.	31	32	33	34	35	36	37	38	39	40	41	42	43		
Ans.	4	2	3	4	3	3	2	4	1	1	1	4	1		

NEET-FLASHBACK

Q.1 RNAi results in: **[NEET-UG 2013]**
(1) Silencing of m-RNA translation
(2) Silencing of a specific m-RNA due to complementary dsRNA molecule.
(3) Silencing of m-RNA molecule
(4) Silencing of DNA for m-RNA transcription

Q.2 An analysis of chromosomal DNA using the Southern hybridization technique **does not** use: **[AIPMT 2014]**
(1) Electrophoresis (2) Blotting
(3) Autoradiography (4) PCR

Q.3 Which of the following is not naturally occurring gene : **[AIIMS 2014]**
(1) Cry-gene (2) Bt-gene
(3) RNAi, gene (4) Cellular defense gene

Q.4 Bt-cotton has which of the following special features? **[AIIMS 2014]**
(1) This plant is completely resistant to insects
(2) It requires less fertilizers
(3) Its leaf is resistant to pest but boll is destroyed by bollworms
(4) This plant is resistant to certain insects

Q.5 The crops engineered for glyphosate are resistant/tolerant to: **[AIPMT 2015]**
(1) Bacteria (2) Insects
(3) Herbicides (4) Fungi

Q.6 In Bt cotton, the Bt toxin present in plant tissue as pro-toxin is converted into active toxin due to: **[AIPMT 2015]**
(1) Acidic pH of the insect gut
(2) Action of gut micro-organisms
(3) Presence of conversion factors in insect gut
(4) Alkaline pH of the insect gut

Q.7 Which body of the Government of India regulates GM research and safety of introducing GM organisms for public services? **[AIPMT 2015]**
(1) Indian Council of Agricultural Research
(2) Genetic Engineering Approval Committee
(3) Research Committee on Genetic Manipulation
(4) Bio-safety committee

Q.8 Golden rice is a genetically modified crop plant where the incorporated gene is meant for biosynthesis of: **[Re-AIPMT 2015]**
(1) Vitamin A (2) Vitamin B
(3) Vitamin C (4) Omega 3

Q.9 The introduction of t-DNA into plants involves: **[Re-AIPMT 2015]**
(1) Allowing the plant roots to stand in water
(2) Infection of the plant by *Agrobacterium tumefaciens*
(3) Altering the pH of the soil, then heat shocking the plants
(4) Exposing the plants to cold for a brief period

Q.10 Which of the following is commonly used as a vector for introducing a DNA fragment in human lymphocytes? **[NEET - 2018]**
(1) Retrovirus (2) Ti plasmid
(3) λ phage (4) pBR 322

Q.11 In India, the organisation responsible for assessing the safety of introducing genetically modified organisms for public use is : **[NEET – 2018]**
(1) Indian Council of Medical Research (ICMR)
(2) Council for Scientific and Industrial Research (CSIR)
(3) Research Committee on Genetic Manipulation (RCGM)
(4) Genetic Engineering Approval Committee (GEAC)

Q.12 A 'new' variety of rice was patented by a foreign company, though such varieties have been present in India for a long time. This is related to: **[NEET – 2018]**
(1) Co-667 (2) Sharbati Sonora
(3) Lerma Rojo (4) Basmati

Q.13 Use of bioresources by multinational companies and organisations without authorisation from the concerned country and its people is called : **[NEET – 2018]**
(1) Bio-infringement (2) Biopiracy
(3) Biodegradation (4) Bioexploitation

Q.14 What triggers activation of protoxin to active Bt toxin of Bacillus thuringiensis in boll worm ? **[NEET – 2019]**
(1) Alkaline pH of gut
(2) Acidic pH of stomach
(3) Body temperature
(4) Moist surface of midgut

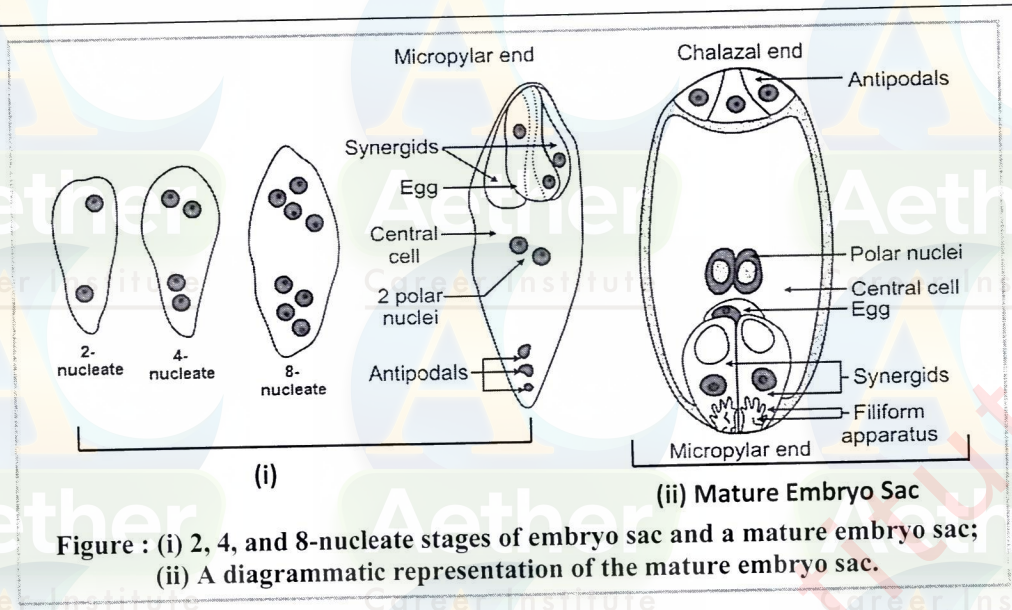


Figure : (i) 2, 4, and 8-nucleate stages of embryo sac and a mature embryo sac; (ii) A diagrammatic representation of the mature embryo sac.

NCERT PLUS

This **eight nucleated** and **seven celled structure** is called **female gametophyte** or **embryo sac** of Angiosperms. This type of embryo sac is known as "**polygonum type**" because it was discovered by **Strasburger** in ***Polygonum*** plant. Polygonum type embryo sac is most **common type** in Angiosperms [***Capsella***]. Polygonum type of embryo sac develops from **single megaspore** so it is also known as **monosporic embryo sac.**

Difference between Egg cell and Secondary nucleus

S. No.	Egg cell	Secondary nucleus
1	It is present near the micropyle, inside the embryo sac.	It is present in the middle of the embryo sac
2	Generally, egg is laterly surrounded by two synergids.	It is not surrounded by synergids
3	Only single nucleus is present in it.(haploid)	It is formed by fusion of two polar nuclei.(Diploid)
4	It is fertilized with one male gamete and form a diploid zygote (Embryo)	It is fused with one male gamete and form a triploid primary endosperm nucleus (Endosperm)

Difference between Male and Female gametophyte

S. No.	Male Gametophyte	Female Gametophyte
1	It is developed from microspore.	It is developed form megaspore.
2	It does not remain embedded permanently in microsporangium.	It remains embedded permanently in megasporangium.
3	Male gametes come out of pollen grain due to the formation of pollen tube.	Female gamete always remains inside, covered by membrane of megasporangium.
4	There are two phases of growth– pre-pollination and post pollination.	Only single phase of growth.
5	It is three celled structure in mature stage.	It has seven cells with 8 nuclei in mature stage.
6	It will disintegrate after fertilization.	Two new structures are formed after fertilization, that is endosperm and Zygote.

POLLINATION *(NCERT Pg. No. 11-12)*

- It is defined as the process of transfer of pollen grains from anther to the stigma of the same flower or of different flower of the same species.
- In flowering plants, both types of gametes (male gamete and female gamete) are nonmotile and brought together for fertilization by pollination.
- Flowering plants have evolved an amazing array of adaptation to achieve pollination.
- They make use of external agents to achieve pollination.
- Pollination is of different types (on the basis of source of pollen)

POLLEN PISTIL INTERACTION

(NCERT Pg. No. 15-18)

- Pollination does not guarantee the transfer of the right type of pollen (compatible pollen of the same species as the stigma). Often, pollen of the wrong type, either from other species or from the same plant (if it is self-incompatible), also land on the stigma.
- The pistil has the ability to recognise the pollen, whether it is of the right type (compatible) or of the wrong type (incompatible). If it is of the right type, the pistil accepts the pollen and promotes post-pollination events that leads to fertilisation.
- If the pollen is of the wrong type, the pistil rejects the pollen by preventing pollen germination on the stigma or the pollen tube growth in the style. The ability of the pistil to recognise the pollen followed by its acceptance or rejection is the result of a continuous dialogue between pollen grain and the pistil. This dialogue is mediated by chemical components of the pollen interacting with those of the pistil.
- All the events from pollen deposition on the stigma until pollen tube enters the ovule are together referred to as **pollen pistil interaction**. It is mediated by chemical components of pollen and pistil.

Artificial hybridization

It is one of the major approaches of crop improvement program. In such crossing experiment it is important to make sure that only desired pollen grains are used for pollination. During such hybridization crossing between different species and often genera take place to combine desirable characters to produce commercially super varieties.

Emasculation

The removal of anthers from the bisexual flower bud before the anther dehisces using a pair of forceps is called emasculation. This prevents the self-pollination.

Bagging

Emasculated flowers have to be covered with a bag of suitable size made up of butter paper to prevent contamination of its stigma with unwanted pollen. This process is called bagging. If the female parent produces unisexual flowers there is no need for emasculation.

STEPS OF FERTILIZATION

The process of fertilization in angiospermic flower is completed in the following steps-

GERMINATION OF POLLEN GRAINS
↓
ENTRY OF POLLEN TUBE INTO OVULE
↓
ENTRY OF POLLEN TUBE INTO EMBRYO SAC
↓
FUSIONS OF GAMETES

[A] GERMINATION OF POLLEN GRAINS

- After pollination, **pollen grain** germinates on the **stigma**. It absorbs moisture and sugar contents from stigma and swell up. The intine of pollen grain grows out through the any one germinal pore of exine, in the form of tube-like out growth is called **pollen tube**.
- When the pollen tube comes down from the stigma into the style, first of all vegetative nucleus enter, into the pollen tube then it is followed by generative cell. The tube nucleus always occupies terminal position in pollen tube. The vegetative nucleus regulates the growth of the pollen tube in style. Meanwhile, the generative cell divides mitotically to form **two male gametes**. Both of the male gametes are **non-motile**.

NCERT PLUS

1. Boron and calcium ions (mainly Boron) are essential for the growth of pollen tube and best temperature for growth of pollen tubs is 20–30°C.
2. Pollen tube shows apical growth and chemotropic movement.

[B] ENTRY OF POLLEN TUBE INTO OVULE:

- Finally, the pollen tube enters in the ovary at that time when ovule becomes mature. Inside the ovary **obturators** guides the passage of pollen tube towards the micropyle.
- It has three paths for the entry of pollen tube: -

(i) POROGAMY
(ii) CHALAZOGAMY
(iii) MESOGAMY

QUICK FOLLOW UP

Sexual Reproduction of Flowering Plants

Female gametophyte
- Megaspore mother cell undergoes meiosis to form four megaspore. Three degenerate and one remain as functional megaspore. It develops into embryo Sac, the female gametophyte.
- This 7 celled (three micropyler, 3 chalazal and one central cell) 8 nucleate embryo is the gametophytic (female) structure in flowering plants.

Male gametophyte
- Pollen grain represent the male gametophyte.
- **Pollengrain**
  - **Intine (Inner layer)** It is made up of pectin & cellulose or pecto-cellulose.
  - **Exine (Outer layer)** This layer is formed by sporopollenin

Gametogenesis Gamete formation occurs inside the female and male gametophytes.

Sporogenesis
- **Microsporogenesis** The process of formation of microspores from a pollen mother cell through meiosis is called microsporogenesis. It take place inside microsporangium.
- **Megasporogenesis** The process of formation of megaspores from the megaspore mother cell is called megasporogenesis.

Special type of reproduction
- **Polyembryony:** Occurrence of more then one embryo in a seed.
- **Parthenogenesis:** Formation of embryo from unfertilized egg.
- **Apomixis:** Apomixis is a form of a sexual reproduction that mimics sexual reproduction.

Post fertilization events
- Following double fertilization events of endosperm and embryo development, maturation of ovules into seeds and ovary into fruit are collectively termed as post fertilization events.
  - Formation of endosperm
  - Formation of embryo
  - Formation of seed
  - Formation of fruit
  - Formation of seed

Pre fertilization events

Pollination
- It is define as the process transfer of pollen grains from anther to the stigma of the same flower or different flower of the same species.
- **Pollination agent**
  - **Abiotic factor**
    - **Anemophily** (By-Wind)
    - **Hydrophily** (By-Water)
  - **Biotic factor**
    - **Ornithophily** (By-Birds)
    - **Entomophily** (By-Insects)
    - **Chiropterophily** (By-Bats)

Self pollination
- **Autogamy**
  - Between single flower E.g. Pea plant
- **Cleistogamous Flowers**
- **Geitogamy**
  - Between two flowers of same plants E.g. Maize

Cross pollination
- When the pollination takes place in between the two different flowers of two different plants of the same species then it is called Xenogamy. E.g. Squash, Broccoli

Fertilization
- After reaching stigma, the microspore germinates by forming pollen tube.
- Pollen tube is formed by emergence of tube cell from germ pore or germinal furrow.
- Pollen tube enters the embryo sac through micropyle (porogamy), chalaza (chalazogamy) or sides (mesogamy).
- **Fertilization**: double fertilization & triple fusion
  - True fertilization (syngamay) → Zygote (2n)
  - False fertilization (Triple fusion) → Endosperm (3n)

BIOLOGY

Q.75 **Statement I:** Both Geitonogamy and Xenogamy require pollinating agents for pollination.
Statement II: Both geitonogamy and Xenogamy decrease inbreeding depression.
(1) Statement-I is incorrect but II is correct.
(2) Both statements I and II are correct.
(3) Statement-I is correct but II is incorrect.
(4) Both statements I and II are incorrect.

Q.76 Which of the following promote pollen germination and tube growth
(1) Sucrose (2) Boron
(3) Magnesium (4) Potassium

Q.77 Which one of the following is false fruit?
(1) Apple (2) Strawberry
(3) Cashew (4) All

Q.78 How many and what type of male gametes are produced by the male gametophyte of angiosperms
(1) One,. multi-ciliated
(2) Two, biciliated
(3) Two, multi-ciliated
(4) Two, non-motile

Q.79 Arising from placenta is megasporangium which is commonly known as :
(1) Ovule (2) Ovary
(3) Ovarian cavity (4) Stamen

Q.80 In angiosperms, functional megaspore generally develops into :-
(1) Micropylar end
(2) Chalazal end
(3) Both (1) and (2)
(4) None

Q.81 How many cells or nuclei are present in male gametophyte of angiosperms
(1) One (2) Two
(3) Three (4) Many

Q.82 Emasculation :-
(1) Prevents self-pollination in female parent
(2) Prevents cross pollination in female parent
(3) Prevents self-pollination in male parent
(4) Prevents cross pollination in male parent

Q.83 Filiform apparatus are found in
(1) Antipodal cell
(2) Egg cell
(3) Secondary nucleus
(4) Synergids

DOUBLE FERTILISATION

Q.84 The diploid and triploid product of double fertilization respectively are :-
(1) Zygote and primary endosperm nucleus
(2) Endosperm and cotyledons
(3) Embryo and perisperm
(4) Zygote and scutellum

Q.85 Double endosperm is found in :-
(1) Wheat (2) Rice
(3) Pea (4) Coconut

Q.86 A typical angiosperm embryo sac at maturity have :-
(1) 7 celled - 8 nucleate
(2) 9 celled - 7 nucleate
(3) 3 celled - 3 nucleate
(4) 2 celled - 2 nucleate

POST-FERTILISATION: STRUCTURES AND EVENTS

Q.87 The central cell after triple fusion becomes the
(1) PEC (2) PEN
(3) Endosperm (4) Embryo

Q.88 Perisperm is
(1) Persistant nucellus in seed
(2) Ovule wall
(3) Ovule coat
(4) Fossil of haustoria

Q.89 Free nuclear division in an angiosperm takes place during
(1) Gamete formation
(2) Endosperm formation
(3) Embryo formation
(4) Flower formation

Q.90 Both male and female flowers are present on the same plant such as
(1) Papaya (2) Castor
(3) Date palm (4) All the above

Q.91 Micropyle in seed helps in the entry of
(1) Male gamete (2) Pollen tube
(3) Water & air (4) All

Q.92 Maize is monoecious plant. It
(1) Prevents autogamy but not geitonogamy
(2) Allows both autogamy and geitonogamy
(3) Allows autogamy but not geitonogamy
(4) Prevents both autogamy and geitonogamy

(1) A-(i), B-(ii), C-(iii), D-(iv)
(2) A-(i), B-(iii), C-(ii), D-(iv)
(3) A-(iv), B-(ii), C-(iii), A-(i)
(4) A-(ii), B-(iii), C-(iv), D-(i)

Q.40 Match the following Columns.

Column I (Other modes of reproduction)		Column II (Examples)	
(A)	A. Parthenocarpy	(i)	Grasses
(B)	B. Apomixis	(ii)	*Citrus*
(C)	C. Polyembryony	(iii)	Banana

(1) A-(i), B-(ii), C-(iii)
(2) A-(ii), B-(i), C-(iii)
(3) A-(iii), B-(ii), C-(i)
(4) A-(iii), B-(i), C-(ii)

Q.41 Match the following columns.

Column I		Column II	
(A)	Lupin	(i)	Vestigeal cotyledon of grass
(B)	Date palm	(ii)	Orange, mango
(C)	Wall of fruit	(iii)	Pericarp
(D)	Fleshy fruits	(iv)	King Harod's palace
(E)	Epiblast	(v)	Arctic tundra

(1) A-(v), B-(iv), C-(iii), D-(ii), E-(i)
(2) A-(i), B-(ii), C-(iii), D-(iv), E-(v)
(3) A-(i), B-(iii), C-(ii), D-(iv), E-(v)
(4) A-(v), B-(iv), C-(i), D-(ii), E-(iii)

Q.42 Match the following Columns.

Column-I		Column-II	
(A)	Hypohydrophily	(i)	*Parthenium*
(B)	Pollen allergy	(ii)	*Zostera*
(C)	Chasmogamous flowers	(iii)	Outbreeding device
(D)	Self-incompatibility	(iv)	Exposed anthers and stigma

(1) A-(i), B-(ii), C-(iii), D-(iv)
(2) A-(iii), B-(iv), C-(i), D-(ii)
(3) A-(ii), B-(i), C-(iv), D-(iii)
(4) A-(iv), B-(iii), C-(i), D-(ii)

Q.43 Match the following Columns.

Column-I		Column-II	
(A)	Water pollinated	(i)	Corn
(B)	Wind pollinated	(ii)	Yucca
(C)	Insect pollinated	(iii)	*Hydrilla*

(1) A-(iii), B-(i), C-(ii)
(2) A-(ii), B-(iii), C-(i)
(3) A-(i), B-(ii), C-(iii)
(4) A-(i), B-(iii), C-(ii)

Q.44 Match the following Columns.

Column-I		Column-II	
(A)	Monoecious	(i)	Papaya
(B)	Dioecious	(ii)	Castor
(C)	Coleoptile	(iii)	Radicle
(D)	Coleorhiza	(iv)	Plumule

(1) A-(ii), B-(i), C-(iv), D-(iii)
(2) A-(iv), B-(iii), C-(i), D-(ii)
(3) A-(i), B-(iv), C-(iii), D-(ii)
(4) A-(iv), B-(i), C-(ii), D-(iii)

Q.45 Match the following Columns.

Column-I		Column-II	
(A)	Endospermic seed	(i)	Wheat
(B)	Non endospermic seed	(ii)	Mango
(C)	True fruit	(iii)	Cashew
(D)	False fruit	(iv)	Pea

(1) A-(iv), B-(ii), C-(iii), D-(i)
(2) A-(i), B-(iv), C-(ii), D-(iii)
(3) A-(i), B-(iii), C-(ii), D-(iv)
(4) A-(ii), B-(iii), C-(iv), D-(i)

Q.46 Match the following Columns.

Column-I		Column-II	
(A)	Viability of pollen grains	(i)	Genetically different pollen gains
(B)	Autogamy	(ii)	Prevailing temperature and humidity
(C)	Pollen allergy	(iii)	Genetically similar pollen grains
(D)	Xenogamy	(iv)	Carrot grass

(1) A-(ii), B-(iii), C-(iv), D-(i)
(2) A-(i), B-(ii), C-(iii), D-(iv)
(3) A-(iii), B-(ii), C-(iv), D-(i)
(4) A-(iv), B-(iii), C-(ii), D-(i)

A-R / STATEMENT TYPE QUESTIONS

Direction: (Q.47-Q.56): In each of the following questions, a statement of Assertion is given followed by corresponding statement of Reason. Of the statements, mark the correct answer as

(A) If both Assertion and Reason are true and Reason is correct explanation of Assertion
(B) If both Assertion and Reason are true, but Reason is not the correct explanation of Assertion
(C) If Assertion is true, but Reason is false
(D) If Assertion is false, but Reason is true

Q.47 **Assertion:** Gynoecium consists of pistil.
Reason: It represents the male reproductive part in flowering plants.
(1) A (2) B (3) C (4) D

Q.48 What is the function of tassels in the corn cob? **(NEET 2023)**

(1) To attract insects
(2) To trap pollen grains
(3) To disperse pollen grains
(4) To protect seeds

Q.49 In angiosperm, the haploid, diploid and triploid structures of a fertilized embryo sac sequentially are: **(NEET 2023)**

(1) Synergids, Primary endosperm nucleus and zygote
(2) Antipodals, synergids, and primary endosperm nucleus
(3) Synergids, Zygote and Primary endosperm nucleus
(4) Synergids, antipodals and Polar nuclei

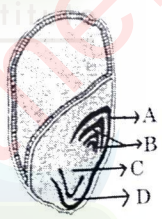
Q.50 Identify the set of correct statements: **[NEET-2024]**

A. The flowers of *Vallisneria* are colorful and produce nectar.
B. The flowers of waterlily are not pollinated by water.
C. In most of water-pollinated species, the pollen grains are protected from wetting and ribbon like.
E. In some hydrophytes, the pollen grains are carried passively inside water.

Choose the correct answer from the options given below:

(1) B, C, D and E only
(2) C, D and E only
(3) A, B, C and D only
(4) A, C, D and E only

Q.51 Identify the part of the seed from the given figure which is destined to form root when the seed germinates. **[NEET-2024]**



(1) D (2) A (3) B (4) C

Q.52 Identify the correct description about the given figure: **[NEET-2024]**

(1) Compact inflorescence showing complete autogamy.
(2) Wind pollinated plant inflorescence showing flowers with well exposed stamens.
(3) Water pollinated flowers showing stamens with mucilaginous covering.
(4) Cleistogamous flowers showing autogamy.

Q.53 Which part of the ovule stores reserve food materials? **[Re-NEET (Grace Marks)-2024]**

(1) Nucellus (2) Integument
(3) Placenta (4) Funicle

Q.54 Pollen grains remain preserved as fossils due to the presence of: **[Re-NEET (Grace Marks)-2024]**

(1) Epidermal layer (2) Tapetum
(3) Exine layer (4) Intine layer

Q.55 The part marked as 'x' in the given figure is: **[Re-NEET (Grace Marks)-2024]**

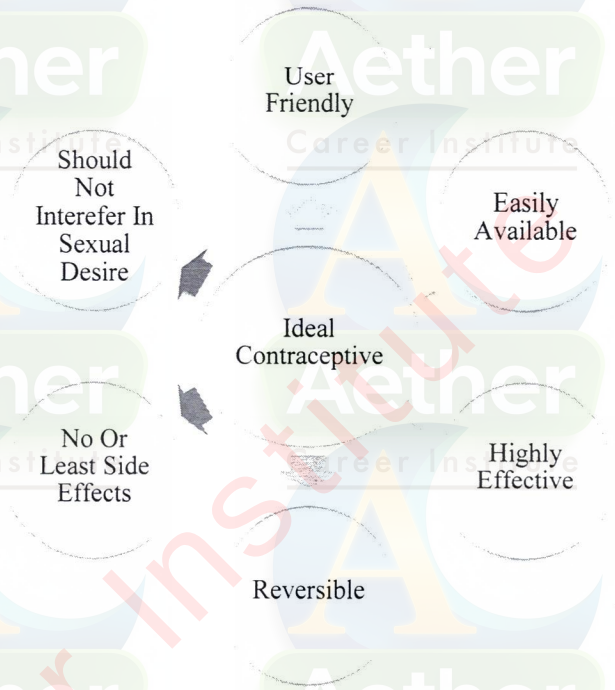
(1) Endosperm (2) Thalamus
(3) Endocarp (4) Mesocarp

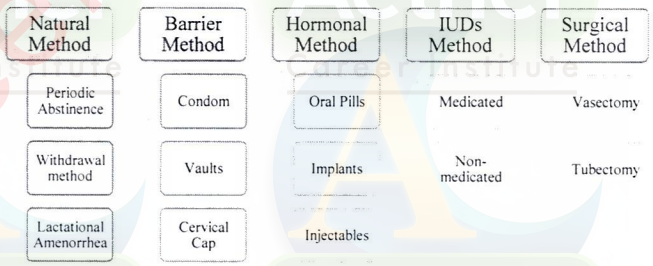
POPULATION STABILISATION AND BIRTH CONTROL [*NCERT. Pg. No.43-46*]

- In the last century, an all-round development in various fields significantly improved the quality of life of the people.
- However, increased health facilities along with better living conditions had an explosive impact on the growth of population.
- The world population which was around 2 billion (2000 million) in 1900 rocketed to about 6 billion by 2000 and 7.2 billion by 2011.
- A similar trend was observed in India too, our population which was approximately 350 million at the time of our independence reached close to the billion mark by 2000 and crossed **1.2 billion in May 2011**. That means, every sixth person in the world is an Indian.
- A rapid decline in death rate, **Maternal Mortality Rate** (MMR) and **Infant Mortality Rate** (IMR) as well as an increase in number of people in reproducible age are probable reasons for this.
- Through our RCH programmes, though we could bring down the population growth rate, it was only marginal.
- According to the 2011 census report, the population growth rate was less than 2 percent, i.e., 20/1000/year, a rate at which our population could increase rapidly.
- Such an alarming growth rate could lead to an absolute scarcity of even the basic requirements, i.e., food, shelter and clothing, in spite of significant progress made in those areas.
- Therefore, the government was forced to take up serious measures to check this population growth rate.
- The most important step to overcome this problem is to motivate smaller families by using various contraceptive methods.

Methods of birth control (CONTRACEPTIVE METHOD):

- Characteristics of **ideal contraceptive** are: -





(1) Natural/ Traditional method:

- Work on the **principle of avoiding chances of ovum and sperms meeting.**
- As no medicines or devices are used in these methods, **side effects are almost nil.** Chances of failure, though, of this method is also high.

(a) **Periodic abstinence** is one such method in which the couples avoid coitus from **day 10 to 17 of the menstrual cycle** when ovulation could be expected, As chances of fertilisation are very high during this period, it is called the **fertile period**. Therefore, by abstaining from coitus during this period, conception could be prevented.

- 1st 7 days after menstrual cycle (M.C.) and 7 days before M.C. is called safe period because in these 14 days ovum is absent in fallopian tubes. Therefore, fertilization usually does not occur.