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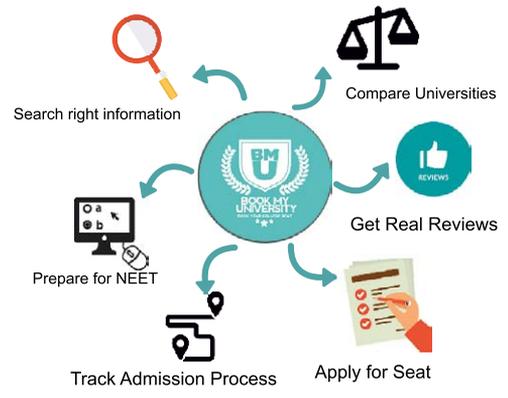


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# BIO

# Digest

This article covers high yield facts of the given topic.

## Biological Classification

- Biological classification is the arrangement of organisms in a hierarchical series of groups and subgroups on the basis of their similarities and differences in their traits.
- A classification system helps in identification of organisms and understanding the relationships amongst different groups of organisms.
- The organisms of the past can be studied only with a proper system of classification and evolutionary tendencies can be known on the basis of relationship and simplicity or complexity found in the members of various taxa.

### SYSTEMS OF CLASSIFICATION

- There are three principle systems of classification-artificial, natural and phylogenetic.

#### Artificial System of Classification

- It is based on one or two external morphological characters for grouping of organisms.
- It often results in placing of unrelated organisms in a group.
- In this type of classification system, form, habit and

habitat were often used as criteria which could change with environment.

- These were in use during the early period of systematics.

#### Natural (Horizontal) System of Classification

- This system considers comparable study of a number of characters for grouping of organisms.
- It gives information about both natural relationship and phylogeny.
- In this system of classification related organisms are placed in the same group.

#### Phylogenetic (Vertical) System of Classification

- It takes into account evolutionary relationships of organisms.
- This system is highly dynamic system as its major source is fossil records.
- In this system, organisms belonging to the same taxa are believed to have common ancestry and may be represented in a family tree called **cladogram**.
- Chances of placing unrelated organisms in a group are negligible.

**Table:** History and development of classification systems

	Name of the scientist	Contribution
(i)	<b>Aristotle</b>	He classified animals as enaima and anaima, on the basis of the presence or absence of red blood cells. He is also known as Father of Zoology.
(ii)	<b>Theophrastus</b>	He is also known as 'Father of Botany classified,' plants as trees, shrubs, undershrubs and herbs. He wrote two books; <i>On the History of plants</i> and <i>On the causes of plants</i> .

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(iii)	<b>B. de Jussieu</b>	He divided the flowering plants into groups on the basis of monocots, dicots, ovary positions, presence or absence of petals, etc.
(iv)	<b>George Bentham and J.D. Hooker</b>	They gave the most important natural system of classification of angiosperms, published in their treatise ' <i>Genera Plantarum</i> '.
(v)	<b>Adolph Engler and Karl A.E. Prantl</b>	They were the first to propose the phylogenetic system or cladistics in the book ' <i>Die Natürlichen Pflanzen Familien</i> '.
(vi)	<b>John Hutchinson</b>	He gave his phylogenetic system of classification in two volumes of the book ' <b>The Families of Flowering Plants</b> ' and described monophyletic origin of angiosperms.
(vii)	<b>Armen Takhtajan</b>	A plant taxonomist of Russia, he worked on phytogeography origin and phylogeny of flowering plants.

### Phenetic Classification

- It is a system of phylogenetic classification which is based on affinities, similarities and dissimilarities of characteristics found in the present day organisms.
- This classification obtains supporting evidences from branches of taxonomy : numerical taxonomy, cytotaxonomy, chemotaxonomy and cladistic taxonomy.

### Numerical taxonomy

- It evaluates resemblances and differences through statistical methods based on a large number of characters obtained from all disciplines of biology.

### Cytotaxonomy

- It is based on cytological information like chromosome number, structure and meiotic behaviour.

### Chemotaxonomy

- It uses the chemical constituents of organisms like amino acids, proteins, DNA sequences, alkaloids, crystals, etc.
- It searches similarity due to common phylogeny or origin from a common ancestor. Arranging organisms on the basis of characters that differ from ancestral characters, will form a phylogenetic tree called **cladogram**.

## TYPES OF CLASSIFICATION SYSTEM

- Depending upon the type of system of classification, organisms are classified into two kingdoms, three kingdoms, four kingdoms, five kingdoms and now into six kingdoms.

### Two Kingdom Classification

- Two kingdom classification system was suggested by Carolus Linnaeus (the father of taxonomy) in 1758. He divided all organisms into two kingdoms - **Kingdom Plantae** and **Kingdom Animalia**.
- The autotrophic organisms were included in the Kingdom Plantae whereas Kingdom Animalia consists of non-photosynthetic heterotrophic organisms.
- This type of classification did not distinguish between the eukaryotes and prokaryotes, unicellular and multicellular and photosynthetic (green algae) and non-photosynthetic

(fungi) organisms. Hence, two kingdom classification was found inadequate.

- *Euglena* is called biological puzzle because it shows autotrophic as well as saprophytic nutrition and shows locomotion.

### Three Kingdom Classification

- Haeckel (1866) separated unicellular animals, algae and fungi from other organisms on the basis of lack of tissue differentiation. The new group was called **Kingdom Protista**.
- Later on fungi and multicellular algae were taken out from the group so that Kingdom Protista came to have only unicellular organisms. The organisms were divided into three Kingdoms : Plantae, Protista and Animalia.

### Four Kingdom Classification

- With the discovery of electron microscope, it became clear that bacteria and related organisms have a different nuclear structure as compared to others.
- They are **prokaryotes** in contrast to others which have a true nucleus and are called **eukaryotes**.
- Copeland (1956) created a separate **Kingdom Monera** for them.
- This divided the living world into four Kingdoms : Monera, Protista, Plantae and Animalia.
- In this system, fungi which are photosynthetic continued to remain with the Kingdom Plantae.

### Five Kingdom Classification

- Five kingdom classification was proposed by an American taxonomist, R.H. Whittaker (1969). It is the most accepted system of classification.
- The kingdoms were named Monera, Protista, Fungi, Plantae and Animalia.
- The main criteria for classification used by him include cell structure, thallus organisation, mode of nutrition, reproduction and phylogenetic relationships. The table given on the next page shows a comparative account of different characteristics of the five kingdoms.

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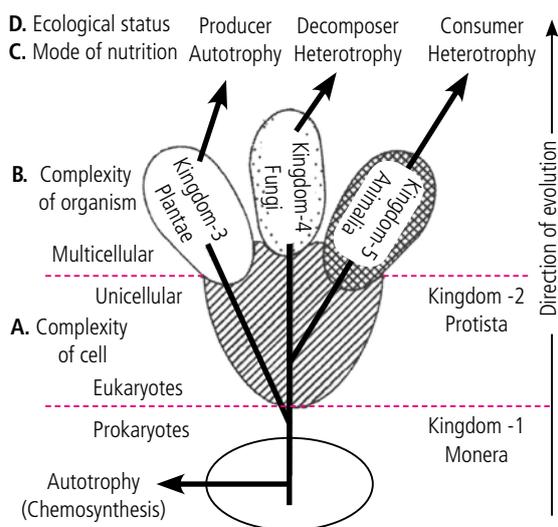


Fig.: Whittaker's five kingdom classification

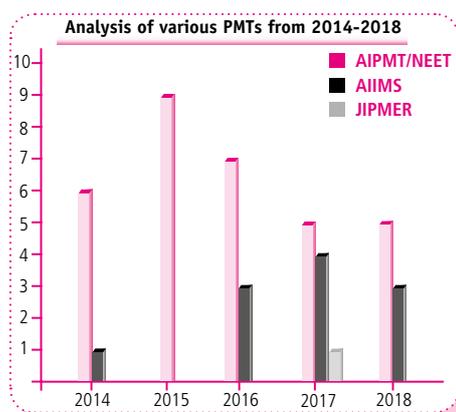


Table: Characteristics of the five kingdoms

Character	Five Kingdoms				
	Monera	Protista	Fungi	Plantae	Animalia
Cell type	Prokaryotic	Eukaryotic	Eukaryotic	Eukaryotic	Eukaryotic
Cell wall	Non-cellulosic (polysaccharide + amino acid)	Present in some	Present (without cellulose)	Present (with cellulose)	Absent
Nuclear membrane	Absent	Present	Present	Present	Present
Body organisation	Cellular	Cellular	Multicellular/ loose tissue	Tissue/organ	Tissue/organ/ organ system
Mode of nutrition	Autotrophic (chemosynthetic and photosynthetic) and heterotrophic (saprophytic/ parasitic)	Autotrophic (photosynthetic) and heterotrophic	Heterotrophic (saprophytic/ parasitic)	Autotrophic (photosynthetic)	Heterotrophic (holozoic/ saprophytic, etc.)

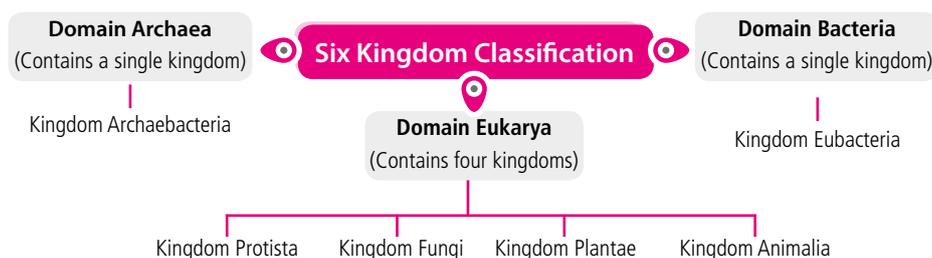
### Shortcomings of five kingdom classification

- The Kingdoms Monera and Protista are still heterogeneous groups. Both include photosynthetic (autotrophic) and non-photosynthetic (heterotrophic), walled and wall-less organisms.
- Phylogenetic relationships, particularly of lower organisms, are not fully reflected. For example, certain green algae and some photosynthetic bacteria get hydrogen from sources other than water but these are assigned to different kingdoms.
- A distinction between unicellular and multicellular organisms is not possible in case of algae. Due to this, unicellular green algae such as *Chlamydomonas*, *Volvox*, etc., have not been included in the Kingdom Protista.
- Viruses have not been included in this system of classification.

- Archaeobacteria differ from other bacteria in structure, composition and physiology.

### Three Domains of Life (Six Kingdom Classification)

- The three-domain system was introduced by **Carl Woese (1990)** that divides cellular life forms into **archaea**, **bacteria** and **eukarya** domains.
- It emphasises the separation of prokaryotes into two groups, originally called Eubacteria (now Bacteria) and Archaeobacteria (now Archaea).
- Thus, the three-domain system divides the monera into two 'domains', leaving the remaining eukaryotic kingdoms in the third domain.
- It is actually a six kingdom classification.



## KINGDOM MONERA

- It is a kingdom of prokaryotes, therefore, also known as prokaryota. Monerans are unicellular and contain most primitive life forms.
- Two major groups of monera include: **Archaeobacteria** and **Eubacteria**. Eubacteria is further of two types : **bacteria** and **cyanobacteria** (blue-green algae).
- The true nucleus with nuclear membrane is absent in bacterial cell. The nuclear material consisting of naked DNA molecule is called as **nucleoid** which is equivalent to a single chromosome.
- A layer of slime over the cell wall is present in bacterial cell. It is usually composed of **polysaccharides**.
- Bacterial cell wall consists of acetyl glucosamine, acetyl muramic acid and a peptide chain of four or five amino acids. All these chemicals together form a polymer called **peptidoglycan**.
- A thin, elastic and selectively permeable plasma membrane is situated just internal to the cell wall in each bacterial cell.
- In many bacteria, the plasma membrane gives rise to infoldings called **mesosomes** which participate in the separation of replicated nucleoid and formation of septa during cell division.
- They lack membrane bound cell organelles like lysosomes, Golgi bodies, mitochondria, sphaerosomes, plastids, etc.
- The ribosomes in bacteria are of 70S type and flagella, if present are unistranded.
- Many bacteria (*e.g.*, *E. coli*) have accessory rings of DNA called **plasmids** in addition to bacterial chromosomes. The plasmid DNA replicates independently and maintain independent integrity.
- The plasmids which temporarily get associated with nucleoid DNA are known as **episomes**.
- Bacteria reproduce asexually by **binary fission**. They lack true sexual reproduction but genetic recombination takes place by three methods: **conjugation**, **transformation** and **transduction**.
- Based on their shape bacteria are grouped under four categories : the spherical **coccus**, the rod shaped **bacillus**, the comma shaped **vibrio** and the spiral **spirillum**.

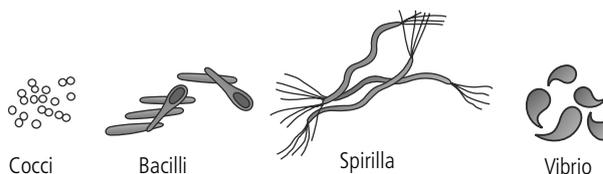


Fig.: Bacteria of different shapes

- Bacteria show both autotrophic and heterotrophic nutrition.
- Autotrophic nutrition is of two types : chemosynthesis and photosynthesis. The bacteria performing these modes of nutrition are called **chemoautotrophs** and **photoautotrophs** respectively.
- Heterotrophic nutrition is of three types : saprotrophic, symbiotic and parasitic.
- **Archaeobacteria** are a group of most primitive prokaryotes characterised by the absence of peptidoglycan in their cell wall.
- Archaeobacteria are of three major types: **methanogens**, **halophiles** and **thermoacidophiles**. Methanogens are obligate anaerobes and produce methane in biogas fermenters, *e.g.*, *Methanobacterium*, *Methanococcus*. Halophiles are "salt-loving" bacteria as they are found in environment with a very high salt concentration. Thermoacidophiles live in extremely acidic environment that have extremely high temperature. They are found in hot sulphur springs.
- **Cyanobacteria** (blue-green algae) are photosynthetic prokaryotes that have evolved more than 3 billion years back and paved the path for evolution of aerobic forms, including aerobic bacteria.

### Mycoplasma (PPLO)

- Mycoplasmas are the simplest, smallest of the free living prokaryotes and are often called PPLOs (Pleuro pneumonia-like organisms). Due to the absence of cell wall the organisms can change their shape and are called pleomorphic. They are insensitive to antibiotics that effect cell wall synthesis like penicillin. Mycoplasmas are heterotrophic in their nutrition.

## KINGDOM PROTISTA

- Kingdom Protista includes all the unicellular eukaryotic organisms. Phylogenetically, the Kingdom Protista acts as a

connecting link between the prokaryotic Kingdom Monera on one hand and the complex multicellular Kingdoms Fungi, Plantae and Animalia on the other hand.

- These are microscopic unicellular and eukaryotic organisms with cosmopolitan habitat. Many protists are found in water bodies in the form of plankton.
- Many forms have more than one similar or dissimilar **nuclei**.
- The cell is surrounded by plasma membrane and well developed membrane bound organelles are present inside the cell.
- Five modes of locomotion are recognised in the protista: pseudopodial, flagellar, ciliary, wriggling and mucilage propulsion.
- Mode of nutrition may be photosynthetic, holozoic, saprotrophic, parasitic, symbiotic, etc.
- Most of the free living protists perform aerobic respiration, however, the parasitic protists respire anaerobically.
- Protists reproduce by both asexual and sexual methods.
- Asexual reproduction occurs through binary or multiple fissions (under favourable conditions), budding, encystment, sporulation, etc., (during unfavourable conditions).
- Sexual reproduction is executed through conjugation or by the fusion of nuclei called syngamy.
- The major groups of protists include **chrysophytes, dinoflagellates, euglenoids, slime moulds** and **protozoans**.
- **Chrysophytes** include diatoms and golden algae. They are found in fresh water as well as in marine environments. The cell wall of chrysophytes are embedded with silica and thus are indestructible.
- They produce diatomaceous earth and are the chief 'producers' in the oceans.
- **Dinoflagellates** are mostly marine and photosynthetic. They appear yellow, green, brown and blue or red depending on the main pigment present in their cells, e.g., *Glenodinium*, *Peridinium*, etc.
- Majority of **euglenoids** are fresh water organisms found in stagnant water. A protein rich layer called pellicle is present instead of a cell wall which makes their body

flexible. Euglenoids are photosynthetic in the presence of sunlight, however, when deprived of sunlight they behave like heterotrophs.

- **Slime moulds** are saprophytic protists. They form an aggregate called **plasmodium** which may move and spread over several feet under favorable conditions.
- **Protozoans** are heterotrophs and live as predators or parasites. They are considered to be primitive relatives of animals.

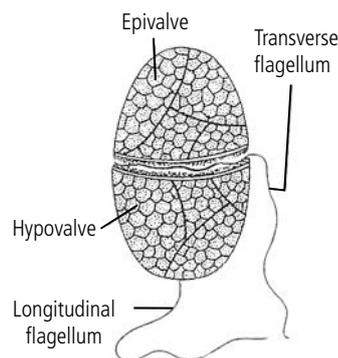


Fig.: *Glenodinium*

#### Major groups of protozoans

- **Amoeboid protozoans** : They live in freshwater, sea water or moist soil. They move and capture their prey with the help of pseudopodia. Some of them such as *Entamoeba* are parasites.
- **Flagellated protozoans** : The members of this group are either free-living or parasitic. They have flagella. The parasitic forms such as *Trypanosoma* cause disease called sleeping sickness.
- **Ciliated protozoans** : These are aquatic and actively moving organisms because of presence of thousands of cilia, e.g., *Paramecium*.
- **Sporozoans** : These include diverse organisms that have an infectious spore-like stage in their life cycle, e.g., *Plasmodium*.



#### INTEXT PRACTICE QUESTIONS

1. Which group of protista is considered to be primitive relatives of animals and live as predators?
2. What are three major types of archaeobacteria?
3. Name the branch of taxonomy which is based on cytological information.

## KINGDOM FUNGI

- They are achlorophyllous, heterotrophic, spore-forming, non-vascular, eukaryotic organisms which often contain chitin or fungal cellulose in their cell wall and possess glycogen as food reserve.
- They have absorptive type of nutrition and are parasites or saprotrophs.
- The body of fungus is filamentous and is called mycelium. The filaments are known as hyphae. Hyphae are either multicellular or multinucleate.
- Reproduction is of three types : sexual, vegetative and asexual.
- Vegetative reproduction occurs by **budding, fission, fragmentation, sclerotia** and **rhizomorphs**.
- Asexual reproduction occurs through the formation of different type of spores.

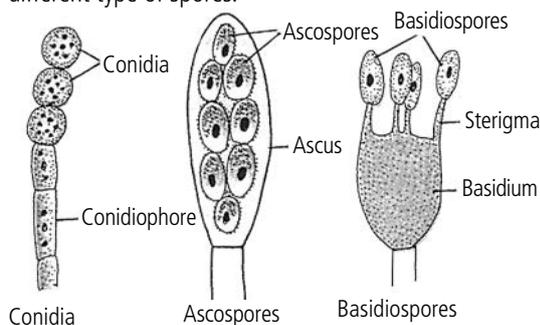
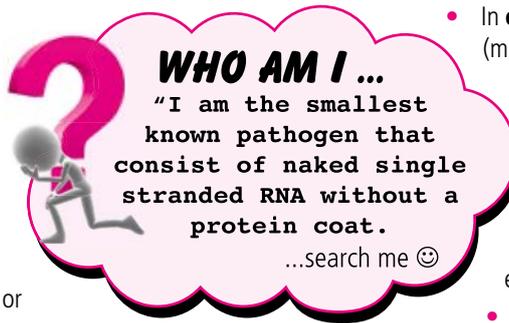


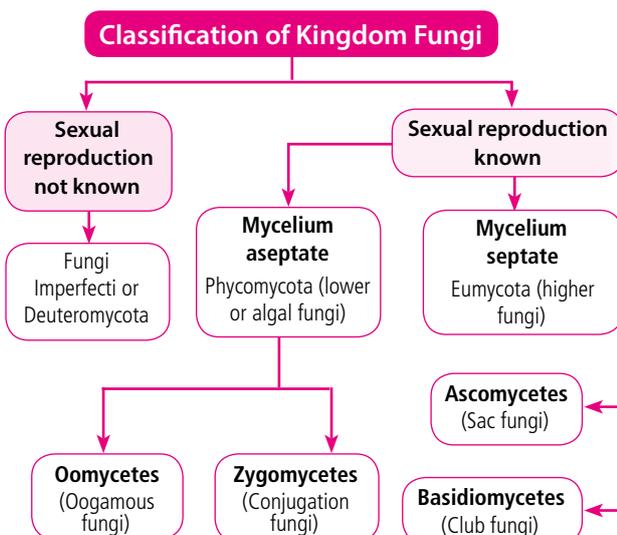
Fig.: Types of fungal spores

- Sexual reproduction occurs by planogametic copulation, gametangial contact, gametangial copulation, spermatogamy and somatogamy.



- In **oomycetes**, the mycelium is coenocytic (multinucleate and aseptate).
- Asexual reproduction involves the formation of spore containing sacs or sporangia which produce zoospores in aquatic environment. In terrestrial environment, the sporangia often behave as spores and equivalent to conidia.
- Zoospores are usually biflagellate, while gametes are usually non-flagellate.

- Sexual reproduction takes place by gametangial contact and the product of sexual reproduction is oospore. Some examples are *Albugo candida*, *Phytophthora infestans*, *Pythium debaryanum*, etc.
- **Zygomycetes** is a class of terrestrial fungi which are mostly saprotrophic, rarely parasitic. The mycelium is **coenocytic**.
- Motile cells (zoospores and planogametes) are absent. Sexual reproduction occurs through gametangial copulation or conjugation.
- The gametes are multinucleate and are called **coenogametes**.
- Sexual reproduction produces a diploid spore called **zygospore**.
- Some examples are *Rhizopus stolonifer*, *Mucor pusillus*, *Pilobolus crystallinus*, etc.
- **Ascomycetes** include pigmented moulds, yeasts, morels, truffles, cup fungi and powdery mildews. Nutritionally, they are saprotrophic, decomposers and parasitic.
- The mycelium consists of **septate** hyphae.
- Motile structures do not occur in the life cycle.
- The common mode of asexual reproduction is through the formation of conidia. However, in yeasts asexual



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reproduction occurs through budding and fission. Oidia stage is found in some other ascomycetes.

- Sexual reproduction takes place through gametangial contact.
- Fertilisation takes place in two steps **plasmogamy** and **karyogamy**.
- Karyogamy is delayed after plasmogamy and a new transitional phase called **dikaryophase** appears in the life cycle.
- The cells of dikaryophase are called **dikaryotic cells**. Each cell possesses two nuclei ( $n + n$ ). Later the two nuclei fuse and the cells become diploid.
- The fungi form fruiting bodies, in which reduction division occurs, leading to formation of haploid spores.
- Some examples are yeast, *Aspergillus*, *Penicillium*, *Claviceps* and *Neurospora*.
- **Basidiomycetes** grow in soil on logs and in living plant bodies as parasites.
- The mycelium is septate and branched. Septa have dolipores (pores with barrel-shaped outgrowths).
- Vegetative reproduction occurs by **fragmentation**. The asexual spores are not found.
- The sex organs are absent but plasmogamy is brought about by fusion of two vegetative or somatic cells of different strains or genotypes. The resultant structure is **dikaryotic** which gives rise to basidium.
- Karyogamy and meiosis takes place in the basidium producing four basidiospores. Some examples are *Agaricus*, *Ustilago* and *Puccinia*.
- **Deuteromycetes** are commonly known as imperfect fungi because only the asexual or vegetative phases of these fungi are known.
- Some members of deuteromycetes are saprophytes or parasites while a large number of them are decomposers of litter and help in **mineral cycling**.
- The mycelium is usually septate and branched.
- The deuteromycetes reproduce only by asexual spores known as **conidia**. Some examples are *Trichoderma*, *Alternaria* and *Colletotrichum*.

Most fungi are heterotrophic and absorb soluble organic matter from dead substrates and hence are called saprophytes. Those fungi that depend on living plants and animals are called parasites. They can also live as symbionts, *i.e.*, in association with algae as lichens and with roots of higher plants as mycorrhiza.

## KINGDOM PLANTAE

- It includes all eukaryotic chlorophyll containing organisms commonly called **plants**.
- A few members such as bladderwort and Venus flytrap are

insectivorous while few others such as *Cuscuta* are parasitic.

- Plant pigments include chlorophyll, carotenes, xanthophylls, phycobilins.
- Reproduction is both by sexual (by fertilisation of gametes and formation of seeds) and asexual means (by the formation of spores or by vegetative propagation).
- Growth is indefinite, number and structure of organs are not definite.
- Kingdom Plantae includes **algae, bryophytes, pteridophytes, gymnosperms** and **angiosperms**.
- Two distinct phases are present in life cycle of plants : the diploid sporophytic phase and the haploid gametophytic phase that alternate with each other.
- These two phases follow each other rigidly but in different patterns in different plant groups. This phenomenon is called **alternation of generation**.

## KINGDOM ANIMALIA

- This kingdom is characterised by heterotrophic, eukaryotic organisms that are multicellular and their cells lack cell wall.
- They depend directly or indirectly on plants for food. The mode of nutrition is by ingestion of food, *i.e.*, **holozoic**.
- The food reserves are stored as glycogen or fat.
- Most of them are capable of locomotion.
- Nerve cells are present which help to transmit impulses in response to external stimuli.
- They have a definite shape and size and follow a definite growth pattern also.

### IMPORTANT DAYS IN MAY

<b>May 01</b>	: International Labour Day
<b>May 07</b>	: World Asthma Day, World Athletic Day
<b>May 08</b>	: World Thalassaemia Day
<b>May 11</b>	: National Technology Day, World Migration Bird Day
<b>May 12</b>	: International Nurses Day
<b>May 14</b>	: International Mothers Day
<b>May 17</b>	: World Hypertension Day
<b>May 18</b>	: World AIDS Vaccine Day
<b>May 20</b>	: World Metrology Day
<b>May 21</b>	: Anti-Terrorism Day
<b>May 22</b>	: International Day for Biological Diversity
<b>May 24</b>	: National Commonwealth Day
<b>May 25</b>	: World Thyroid Day
<b>May 31</b>	: World No Tobacco Day

- The sexual reproduction takes place by copulation of male and female followed by embryological development. Regeneration of whole organisms and formation of spores are found in some lower organisms.

## VIRUSES, VIROIDS, LICHENS AND PRIONS

- Pasteur gave the name virus. D.J. Ivanowsky (1892) is credited with the discovery of virus. Beijerinck (1896), called it '*contagium vivum fluidum*' (living infectitious fluid).
- The viruses are ultramicroscopic, highly infectious agents and non-cellular organisms characterised by having an inert crystalline structure outside the living cell.
- Once they infect a cell they take over the machinery of the host cell to replicate themselves, killing the host.
- Viruses contain **capsid**, the proteinaceous covering and genetic material, that could be either DNA or RNA.
- Viruses that infect plants have single stranded RNA while those that infect animals have either single or double stranded RNA or double stranded DNA. Bacteriophages are usually double stranded DNA viruses.
- In humans, viruses cause diseases like mumps, smallpox, herpes, influenza and AIDS.
- In plants, the symptoms of virus infection can be mosaic formation, leaf rolling, yellowing, leaf curling and stunted growth.
- Stanley (1935) crystallised Tobacco Mosaic Virus (TMV) for the first time.
- An inert virus is called **virion** that can be crystallised and stored indefinitely.
- **Viroids** are the smallest self replicating particles discovered by Diener (1971) to describe the causal agent of the "Potato spindle tuber disease."
- Viroids are infectious RNA particles devoid of protein coat. Like viruses, they are obligate parasites.

- Viroids are known to cause diseases in plants only, e.g., Potato spindle tuber, Chrysanthemum stunt.
- **Lichens** are dual organisms or entities which contain a permanent association of a fungus or **mycobiont** and an alga or **phycobiont**.
- The algal component is autotrophic while fungal component is heterotrophic.
- Algae prepare food for fungi and fungi provide shelter and absorb mineral nutrients and water for algae.
- Decrease in lichen population of an area is indicative of air pollution.
- **Prions** are highly resistant glycoprotein particles which function as infectious agents and discovered by Prusiner (1983). They are not affected by proteases, nucleases, temperature upto 800°C, UV radiation and formaldehyde.
- Prions accumulate in nervous tissue and bring about its degeneration.
- Common diseases caused by them are mad cow disease, scrapie of sheep, kuru, Creutzfeldt-Jakob disease (CJD).



### WHO AM I ...

- |                        |        |
|------------------------|--------|
| 1. Viroid              | Pg. 15 |
| 2. Agar agar           | Pg. 21 |
| 3. <i>Zamia pygmae</i> | Pg. 23 |
| 4. Chalaza             | Pg. 53 |



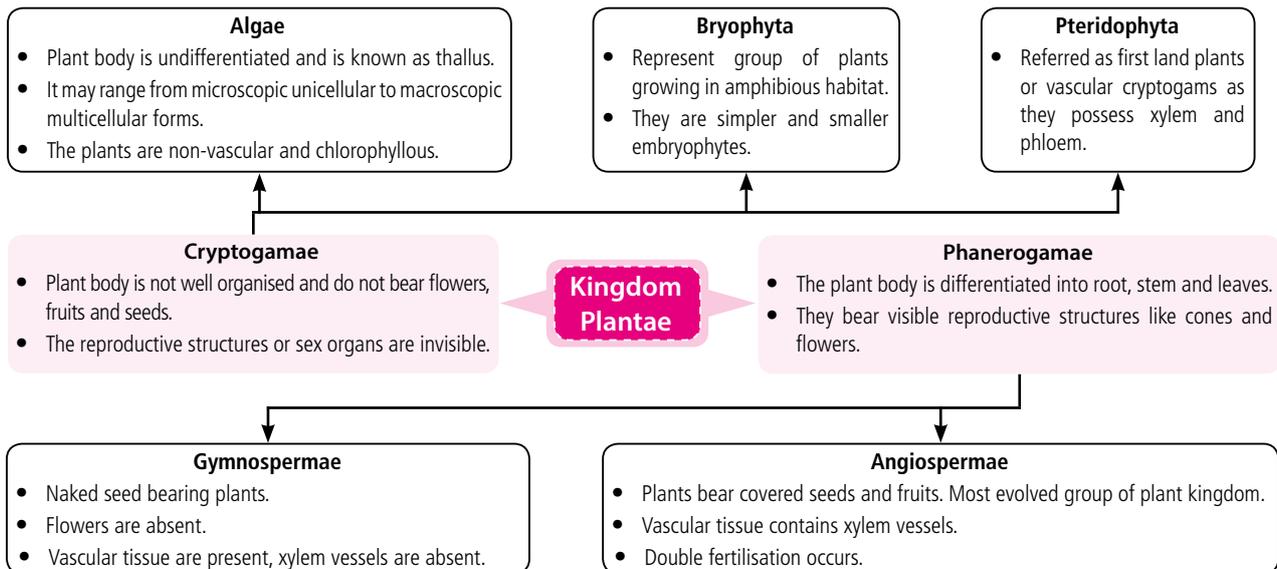
### INTEXT PRACTICE QUESTIONS

4. Name the class of fungi lacking crosswalls in the mycelium.
5. Name the protein shell of a virus.

# Plant Kingdom

- The Kingdom Plantae includes multicellular, eukaryotic, chlorophyll containing organisms. The plant cells have an eukaryotic structure with prominent chloroplasts and cell wall mainly made up of cellulose.
- According to traditional systems of classification, the

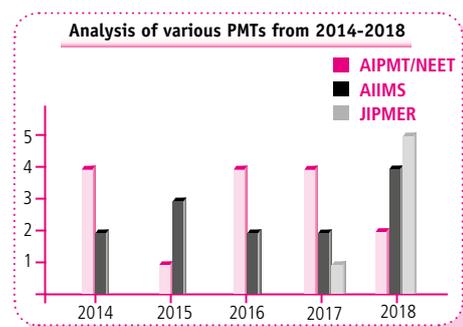
Kingdom Plantae is divided into two subkingdoms : Cryptogamae and Phanerogamae. Cryptogamae (plants without seeds) is further divided into algae, bryophyta and pteridophyta, while phanerogamae (plants with seeds) is further divided into gymnospermae and angiospermae.



## ALGAE

- Algae are chlorophyllous, simple, non-vascular, thalloid plants.
- As per Linnaeus' two kingdom classification, all members of algae were grouped into plant kingdom along with bacteria and fungi.
- These are usually aquatic, either marine or freshwater, a few algae occur in moist terrestrial habitat.
- Algae are covered by **mucilage** which protects them from epiphytic growth and decaying effect of water and also prevents **desiccation**.
- Algae mainly contain **chlorophyll a**, **carotenes** and **xanthophylls**.
- Algae are usually classified on the basis of their pigments, flagellation and storage products.
- Most of algae are autotrophic. Some are parasitic (*Cephaleuros*, *Harveyella*).
- Vegetative, asexual and sexual modes of reproduction are present.
- Vegetative reproduction may take place by fragmentation (e.g., *Ulothrix*, *Oedogonium*), fission (e.g., *Chlamydomonas*),

homogonia (e.g., *Oscillatoria*), tubers (e.g., *Chara*), budding (e.g., *Polysiphonia*), etc.



- Asexual reproduction takes place by flagellated **zoospores** (e.g., *Ulothrix*, *Oedogonium*); non-motile, thin walled **aplanospore** (e.g., *Chlorella*, *Microspora*) and non-motile, thick walled **hypnospores** (e.g., *Vaucheria*, *Chlamydomonas nivalis*), thick walled akinetes (e.g., *Cladophora*), palmella stage (e.g., *Chlamydomonas*).
- Sexual reproduction involves **isogamy**, **anisogamy** and **oogamy** in different groups.
- Life cycle may be haplontic, diplontic or diplohaplontic.

**Table :** Characteristics of different classes of algae

Classes	Structure	Occurrence	Major pigments	Reserve food material	Reproduction		
					Vegetative	Asexual	Sexual
<b>Chlorophyceae</b> (Green algae) <i>e.g., Spirogyra, Ulothrix</i>	Colonial, filamentous etc. Cellulosic cell wall, starch sheathed pyrenoids, motile cells with 2-4 equal flagella	Mostly fresh-water a few are marine, a marked tendency towards terrestrial habitat	Chl. <i>a</i> and <i>b</i> , carotenes and xanthophyll	True starch and sugar	Fragmentation or fission	Zoospores	Isogamous to advanced oogamous
<b>Phaeophyceae</b> (Brown algae) <i>e.g., Fucus, Sargassum</i>	Simple filamentous to bulky parenchymatous with giant size, plant body is often differentiated into holdfast, stipe and lamina, motile cells with 2 lateral flagella	Mostly marine and also occur in the intertidal and brackish waters	Fucoxanthin, flavoxanthin, $\beta$ -carotenes, Chl. <i>a</i> and <i>c</i> .	Laminarin, mannitol	Fragmentation is most common	Zoospores, tetraspores etc.	Isogamous to oogamous
<b>Rhodophyceae</b> (Red algae) <i>e.g., Polysiphonia, Porphyra</i>	Simple filamentous to complex forms, motile cells are not known	Few freshwater, others are marine (deepest growing algae of oceans)	Phycocerythrins, phycocyanin, allophycocyanin, carotenoids, Chl. <i>a</i> and <i>d</i>	Floridean starch	Uncommon	Monospores, carpospores, polyspores etc.	Advanced oogamous type producing special carpospores

### Economic Importance

- **Food :** Certain algae are used as food *e.g., Porphyra, Laminaria, Sargassum*, etc., *Chlorella* is rich source of proteins, hence used as food supplement.
- **Photosynthesis :** Nearly 50% of total photosynthesis on earth is carried out by algae. They are essential for respiration of aquatic life.
- **Alginic acid :** A phycocolloid obtained from phaeophyceae such as *Laminaria, Macrocystis, Fucus*, etc., is used in stabilising emulsions, flameproof plastics and security glass.
- **Agar-agar :** A phycocolloid extracted from species of red algae such as *Gelidium* and *Gracilaria* is used as a solidifying agent in culture medium.
- **Carrageenan :** Obtained from red algae *Chondrus crispus* and used as pharmaceutical emulsifier, cleaning agent and in textile, leather and brewing industries.
- **Medicines :** Red algae *Corallina* is capable of curing worm infections. Brown algae *Laminaria* and *Aseophyllum* have antibiotic properties while *Durvillea* has vermifuge properties. Antibiotics are also extracted from green algae *Chlorella* and *Caulerpa*.
- **Sewage disposal :** Green algae like *Chlamydomonas, Chlorella, Scenedesmus* are components of sewage oxidation tanks which provide aerobic conditions for disposal of sewage by decomposers.

### Algae of unusual habitats

- **Halophytic algae** - Occur in saline sea water and salt lakes and can withstand high concentration of salts, *e.g., Chlamydomonas ehrenbergii, Stephanoptera*.
- **Epiphytic algae** - Grow on larger algae, bryophytes and angiosperms, *e.g., Oedogonium* and *Microspora* are found attached to larger species of *Vaucheria, Cladophora* and *Rhizoclonium*.
- **Epizoic algae** - Grow on animals such as snails, fishes and tortoise, *e.g., Cladophora crispata* (epizoic on snail).
- **Endozoic algae** - Occur in tissues of animals, *e.g., Zoochlorella* in *Hydra viridis*.
- **Cryophytic algae** - Grow on ice or snow and impart attractive colours to snow covered mountains, *e.g., Haematococcus nivalis* imparts red colour to alpine and arctic mountains while *Chlamydomonas yellowstonensis* and *Mesotaenium* species are responsible for green snow in Europe.
- **Parasitic algae** - Grow as parasites on many plants and animals, *e.g., Cephaleuros virescens* causes red rust in tea and coffee plantations
- **Thermophytes** - Occur in hot water springs (50-70°C temperature) as are able to survive high temperatures due to absence of well organised nucleus, *e.g., Oscillatoria brevis, Heterohormogonium* sp.

## BRYOPHYTES

- Bryophytes are most primitive non-vascular terrestrial plants of moist habitats in which a multicellular diploid sporophyte is completely dependent on an independent multicellular haploid gametophyte.
- They are called **"amphibians of plant kingdom"** because although they are terrestrial plants fundamentally but require presence of water to complete their life cycle.
- Bryophytes are divided into three classes - **hepaticopsida** (liverworts), **anthocerotopsida** (hornworts) and **bryopsida** (mosses).
- The dominant phase of the plant is a free living gametophyte.
- The gametophytes are either thalloid (not differentiated into true roots, stem and leaves) or leafy shoot having stem-like central axis and leaf-like appendages.
- The vascular tissues are completely absent.
- Rhizoids are present instead of roots which may be unicellular or multicellular.
- Vegetative reproduction occurs through fragmentation, tubers, gemmae, e.g., *Marchantia*, adventitious branches, e.g., *Riccia*.
- Two types of sex organs are present, male **antheridium** and female **archegonium**. Both are multicellular and jacketed.
- Antheridium produces a number of flagellate male gametes called sperms or antherozoids.
- Archegonium is **flask-shaped** with tubular **neck** and a swollen **venter**.
- The venter encloses a venter cavity having a sterile venter canal cell and a fertile egg or oosphere.
- An external layer of water is essential for the swimming of male gametes to the archegonia.
- Embryo stage is present. The embryo grows into a sporophyte.
- The sporophyte consists of **foot, seta** and **capsule**.
- Sporophyte produces haploid meiospores inside its capsule.
- Each spore on germination produces a gametophyte, either directly or a juvenile filamentous stage called **protonema** (in case of mosses).
- Bryophytes show heteromorphic or heterologous **alternation of generations**.

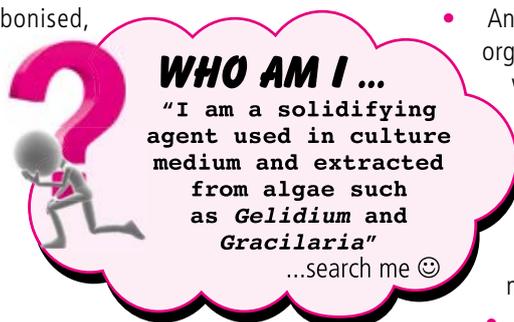
**Table :** Characteristics of different classes of bryophytes

Features	Hepaticopsida	Anthocerotopsida	Bryopsida
Common name	Liverworts	Hornworts	Mosses
Gametophytic plant body	May be thallose or foliose, Unicellular rhizoids.	Thallose, aseptate rhizoids	Gametophyte has two growth stages: thalloid protonema stage and leafy gametophore stage. Obliquely septate rhizoids.
Sex organs	Present on dorsal surface of thallus.	Present on dorsal surface of thallus.	Develop from the superficial cells at the apex of leafy gametophore.
Sporophyte or sporogonium	Simple, represented by capsule only e.g., <i>Riccia</i> or differentiated into foot, seta and capsule (e.g., <i>Marchantia</i> ).	Differentiated into a bulbous foot, small meristematic seta and long cylindrical capsule.	Differentiated into foot, seta and capsule.
Elaters	Generally present, absent in some like <i>Riccia</i> .	Pseudoelaters are present in the capsule.	Absent
Sporogenous cells	Develops from endothecium.	Develops from amphithecium and endothecium, forms sterile columella.	Develops from outer layer of endothecium, inner layer forms sterile columella.
Dehiscence of capsule	Irregular and indefinite	Irregular	Regular
Examples	<i>Riccia</i> , <i>Marchantia</i> , <i>Sphaerocarpos</i> , etc.	<i>Anthoceros</i> , <i>Notothylus</i> , <i>Megaceros</i> , etc.	<i>Sphagnum</i> , <i>Polytrichum</i> , <i>Funaria</i> , etc.

### Importance of Bryophytes

- Prevention of soil erosion :** Mosses form dense mats over the soil and prevent soil erosion by running water.
- Soil formation :** They make an important link in ecological succession on rocky areas by taking part in soil formation in rocky crevices, formed by lichens. For example, growth of *Sphagnum* fills ponds and lakes with soil.
- Water retention :** Some bryophytes or mosses can absorb water such as *Sphagnum* which can retain or absorb 18-26 times water of its weight. This water retention capability is employed by gardeners to keep seedlings and cut plants moist during transportation and propagation.
- Peat :** *Sphagnum* often grows in acidic marshes where there is little decay. The dead parts of moss and other

marshy plants slowly get carbonised, compressed and fossilised over thousands of years to produce a dark spongy mass called peat. It is dried, compressed and cut to form blocks. Peat is used as good manure to overcome soil alkalinity and it increases water retention as well as aeration of soil.



- Bryophytes seldom attain great heights and thus remain small in size. It may be due to absence of roots and vascular tissues, absence of cuticle on plant body, absence of mechanical tissues and requirement of external sheet of water for capillary conduction.

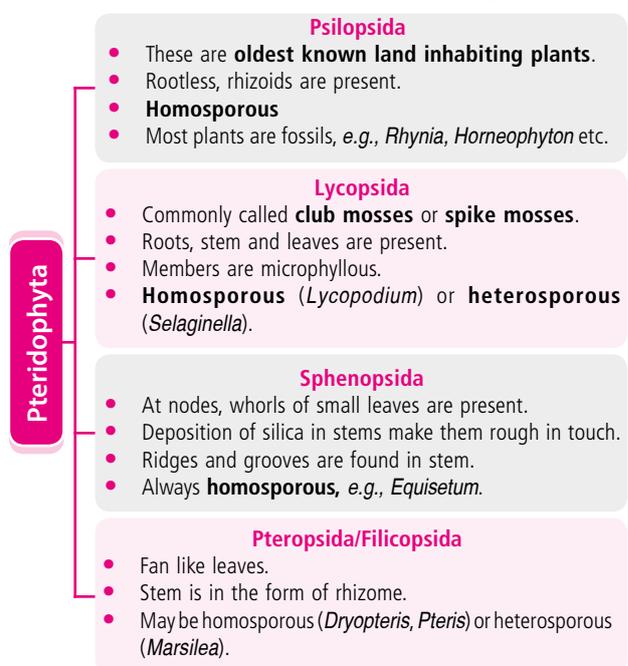
## PTERIDOPHYTES

- Pteridophytes are seedless vascular plants that have sporophytic plant body and inconspicuous gametophytes.
- The sporophyte is differentiated into true roots, stem and leaves.
- All the vegetative parts possess vascular tissues (xylem and phloem) organised in definite groups or steles.
- On the basis of leaf structure, pteridophytes may be **microphyllous** (having simple leaves with single vein, which do not form leaf gaps in the stem stele), e.g., *Equisetum* and **megaphyllous** (having pinnate leaves with complex series of veins that form prominent leaf gaps in the stem stele), e.g., *Pteris*.
- The branching of the stem may be dichotomous type or monopodial.
- The sporophyte reproduces asexually by means of spores, produced in small capsules called **sporangia**.
- Leaves bearing sporangia are called sporophylls which may be widely scattered or clustered in definite areas and structures called **cones** or **strobili**.
- The diploid spore mother cells or sporocytes within the sporangia undergo **meiosis** to form haploid spores.
- The spores produced are of only one type in homosporous pteridophytes (e.g., *Lycopodium*, *Pteridium*) or of two types (smaller **microspores** and larger **megaspore**) in heterosporous pteridophytes (e.g., *Selaginella*, *Marsilea*).
- The spores germinate to produce haploid gametophyte, called **prothallus**.
- The homosporous pteridophytes produce bisexual gametophytes (both antheridia and archegonia are borne on same prothallus) whereas heterosporous ones produce unisexual (antheridia and archegonia develop on separate male and female prothallus) gametophytes.
- The sexual reproduction is **oogamous** type.

- Antheridia are small and sessile male sex organs comprising of androcytes each of which produces a male antherozoid. Archegonia are female sex organs partially embedded and consists of 4-rowed neck.
- Water is essential for fertilisation, as it assists in carrying bi-or multiflagellate sperms to archegonia.

The diploid zygote formed after fertilisation develops into an embryo which remains attached to the **gametophyte** and gets nourishment during its early stage of **development**.

- Pteridophytes exhibit alternate succession of sporophytic and gametophytic generation.
- Pteridophytes can be classified into following types:



## Economic Importance of Pteridophytes

- **Food** : Pteridophytes constitute a good source of food to animals. Sporocarps of *Marsilea* are cooked and eaten by certain tribals.
- **Binding of soil** : Pteridophytes bind the soil even along hill slopes, thus, preventing soil erosion.
- **Scouring** : Stems of some plants are used in scouring or cleaning of utensils and polishing of metals, e.g., *Equisetum*.
- **Nitrogen fixation** : Some ferns e.g., water fern *Azolla* form symbiotic association with nitrogen fixing cyanobacterium *Anabaena azollae*. These are used as biofertilisers in paddy fields.

- **Medicines** : Rhizomes of male shield fern are used to obtain anti-helminthic drug. *Equisetum* is used in preparation of diuretic, haemostatic and haemopoietic drugs.
- **Ornamentals** : Ferns are known for their attractive foliage, hence are grown as ornamental plants and used in bouquets and floral decorations.

#### Evolution of Seed Habit

- The ability of plant to form seed is called seed habit. It

is considered to be originated in pteridosperms during Devonian-carboniferous periods. The development of zygote into young embryo within female gametophyte in heterosporous plants (e.g., *Selaginella*) is a precursor to the evolution of seed habit.

- The differentiation of spores into microspores and megaspores (**heterospory**) and their dependence on the parent sporophyte for the nutrition are certain features considered as pre-requisites for the formation of seeds.



### INTEXT PRACTICE QUESTIONS

1. Name the reserve food material in *Porphyra*.
2. Why bryophytes are known as “amphibians of plant kingdom”?
3. Which group of pteridophytes are oldest known land inhabiting plants?

## GYMNOSPERMS

- Gymnosperms are plants with naked seeds, having freely exposed ovules on megasporophylls. They are referred to as **phanerogams without ovary** and act as connecting link between pteridophytes and angiosperms.
- The plant body is differentiated into root, stem and leaves.
- The plants possess well developed tap root system. In some cases, the roots are symbiotically associated with algae (e.g., coralloid roots of *Cycas*) or with fungus (e.g., mycorrhizal roots of *Pinus*).
- The stem is **erect, aerial, solid, woody and branched**.
- The gymnosperms include world's tallest tree-*Sequoia sempervirens* measuring about 115m in height and 8.9m in girth. The smallest gymnosperm is *Zamia pygmaea*, which has underground tuberous stem. It reaches only upto 25cm in height.
- The vascular tissues, xylem and phloem are present. They are arranged in vascular bundles. The vascular bundles of stem are **conjoint, collateral and open**. Xylem vessels are absent. Xylem vessel is mostly absent.
- Secondary growth occurs and annual rings are distinct in most of the gymnosperms.
- Gymnosperms are heterosporous. The two types of sporangia are borne on special leaf-like structures called **sporophylls**. The microsporangia are borne on microsporophylls (stamens) and the megasporangia on megasporophylls (carpels).
- The sporophylls are aggregated in the form of **cones or strobili**.
- The microsporangium produces numerous light **pollen grains**.
- Pollination is anemophilous. Some of the pollen grains come in direct contact with the micropylar end of ovules and reach upto the **nucellus**.

- Fertilisation occurs by siphonogamy, i.e., the male gametes reaches the female gamete by forming a tube.
- The diploid zygote, develops into an embryo while still enclosed within the ovule and the ovule becomes a seed.
- During seed development, the endosperm (haploid) supplies nutrients to the developing embryo.
- The seeds of gymnosperm are naked and remain attached to the megasporophyll.
- Polyembryony is common in *Pinus*. The number of cotyledons may be one or two or a whorl of many.
- Gymnosperms can be classified into following types:

#### Cycadopsida

- Primitive group, containing plants with palm like habit and fern like foliage. Plants are dioecious.
- Wood is manoxylic.
- Male cones are large with compactly arranged microsporophylls.
- Megasporophylls are loosely arranged and do not form a cone.
- Plants are mostly xerophytic.
- Examples : *Cycas*, *Zamia*, etc.

#### Coniferopsida

- Includes larger dominant gymnosperms.
- Monoecious.
- Stem branches are dimorphic, i.e., with long and dwarf shoots. Wood is pycnoxylic.
- Sporophylls form cones.
- Examples : *Pinus*, *Ginkgo*, *Taxus*.

#### Gnetopsida

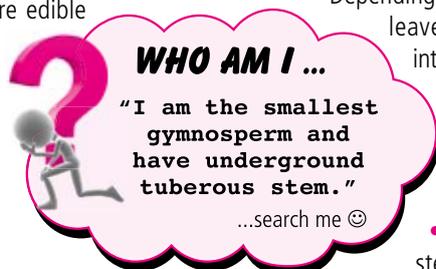
- Includes advanced gymnosperms.
- Branches are dimorphic (long and dwarf shoots) as well as leaves are also dimorphic (scale and foliage leaves).
- Xylem shows vessels.
- Ovules are orthotropous.
- Examples : *Gnetum*, *Ephedra*, *Welwitschia*.

### Gymnosperms

- Ginkgoales (Under coniferopsida) is represented by only one living member, *Ginkgo biloba* (living fossil). Plants have dimorphic branches.
- Leathery, fan shaped leaves present having dichotomously branched veins. Plants are dioecious. Male gametes are multiflagellate and motile.

### Economic Importance of Gymnosperms

- **Food** : Seeds of *Pinus gerardiana* are edible and are eaten after roasting.
- **Timber**: The softwood of gymnosperms is used in preparation of light furniture, plywood, packing cases, etc.
- **Paper** : A wide range of gymnosperms are utilised in manufacture of paper e.g., *Picea*, *Pinus*, *Abies*, etc.
- **Resin** : It is a semifluid secretion containing terpenes, resin, acids and esters which solidifies on exposure to air. It helps in sealing, is antiseptic and toxic to pests, thus, prevents microbial and insect attack. Resin is commercially extracted to obtain turpentine and rosin.
- **Ephedrine** : It is a drug obtained from *Ephedra* and used in curing respiratory ailment, including asthma.



- Angiosperms are the most recently and highly evolved plants.
- Angiosperms are found in most environments on the earth.
- Plant body is sporophytic and represented by herbs, shrubs, trees, twiners, trailers, climbers, etc.
- Sporophytic plant body is differentiated into roots, stem and leaves.

- Depending upon the number of cotyledons (embryonic leaves) in the seeds, angiosperms are divided into two subgroups : **dicotyledonous** and **monocotyledonous** plants.

- Xylem contains **vessels** and phloem possesses **sieve tubes** and **companion cells**.

- Secondary growth occurs in root and stem of dicots.

- Sporophylls are aggregated to form flowers. Both microsporophylls and megasporophylls are specialised to form **stamen** and **carpel** producing male and female gametes respectively.

- Female gametophyte is represented by embryo sac. All the cells of embryo sac are **haploid**.

- Pollination takes place by several agencies such as air, water, birds, insects, bats, etc.

- The flowers possess showy petals, edible pollen and nectar to attract various pollinating agents.

- Pollen grains or microspores reach stigmatic surface found at the tip of carpel or megasporophyll.

- Embryo sac develops upto **8-nucleate** state before fertilisation. There is a three cell egg apparatus, three antipodal cells and two polar nuclei.

- **Double fertilisation** is characteristic feature of angiosperms. One of the two male gametes, fuses with egg to form zygote while other fuses with central cell to form primary endosperm nucleus (PEN). Zygote develops into embryo.

- **Central cell** containing triploid primary endosperm nucleus forms triploid endosperm. Endosperm provides nourishment to developing embryo.

- Synergids and antipodals degenerate after fertilisation.

- Fertilised ovules ripen into seeds. The seeds are covered within fruits.

- A **fruit** is a ripened ovary which not only protects the seeds but also help in their dispersal.

### Adaptations to land

- Seed plants, i.e., gymnosperms and angiosperms are the most successful of all the land plants. They are well adapted to land conditions because of the following features.
  - Presence of extensive underground root system for anchoring and absorption of water and minerals.
  - Presence of vascular tissue system for conduction of water and minerals.
  - Well developed mechanical tissue system.
  - Development of cambium for secondary growth in thickness.
  - Production of pollen grains in large numbers.
  - Transformation of megasporangium into ovule and development of female gametophyte inside the ovule.
  - Presence of external water is not required for fertilisation.
  - Zygote develops within the ovule to form an embryo.

## ANGIOSPERMS

- Angiosperms are seed plants in which seeds are formed inside fruits and the sporophylls are organised into flowers.

**Table:** Comparison between dicots and monocots

Features	Dicots	Monocots
Cotyledons	Usually two	One cotyledon
Flowers	Penta or tetramerous	Trimerous
Pollen grains	Three germ pores	Single germinal furrow

Leaf venation	Reticulate except a few	Parallel except a few
Primary root	Often long lived forming tap root system. Adventitious roots occur in some.	Short-lived tap roots absent, instead adventitious roots are found.
Stem tissue	Concentric arrangement of epidermis, cortex, endodermis, pericycle, pith, etc.	Undifferentiated, a ground tissue occurs.
Vascular bundles of stem	In a ring, cambium (open), thus secondary growth present.	Scattered, cambium is absent (closed).
Root	Pith absent or small. Vascular bundles 8 or less.	Pith present. Vascular bundles more than 8.
Xylem vessels	Polygonal	Rounded

- Flowering plants or angiosperms have exploited insects, birds and several other animals as agents of pollination, fruit and seed dispersal. It is one major reason for present day dominance of flowering plants.

## ALTERNATION OF GENERATION

- During the life cycle of sexually reproducing plants, there is an alternation between gamete producing haploid gametophyte and spore producing diploid sporophyte.
- Different plant groups as well as individuals representing them, differ in the following patterns:
- Haplontic life cycle** - Sporophytic generation is represented by one-celled zygote. Meiosis in zygote results in the formation of haploid spores. The haploid spore forms free living gametophyte by mitosis. It is represented by many algae such as *Volvox*, *Spirogyra* and *Chlamydomonas*.

- Diplontic life cycle** - Diploid sporophyte is dominant, photosynthetic and independent phase of the plant. The gametophytic phase is represented by the single to few-celled haploid gametophyte. **All seed bearing plants, i.e., gymnosperms and angiosperms and alga *Fucus* and *Sargassum* exhibit this kind of pattern.**
- Haplodiplontic life cycle** - Bryophytes and pteridophytes exhibit this kind of pattern. In bryophytes, a dominant independent, photosynthetic, thalloid phase is represented by a gametophyte and it alternates with short-lived multicellular sporophyte totally or partially dependent on the gametophyte for its anchorage and nutrition.

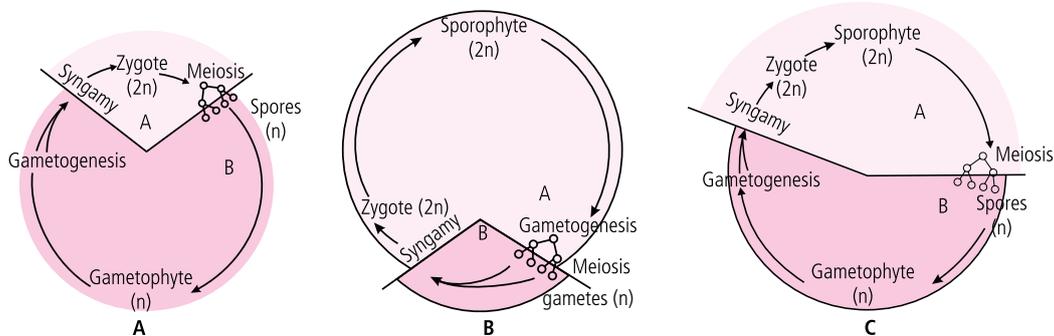


Fig.:A. Haplontic life cycle B. Diplontic life cycle C. Haplodiplontic life cycle.

- In pteridophytes, the diploid sporophyte is represented by a dominant, independent, photosynthetic, vascular plant body. It alternates with multicellular, saprophytic / autotrophic, independent but short-lived haploid gametophyte.
- Some algal genera such as *Ectocarpus* and *Polysiphonia* also exhibit haplodiplontic life cycle.



## INTEXT PRACTICE QUESTIONS

- How primary endosperm nucleus is formed during double fertilisation?
- Name two algae showing diplontic life cycle.
- Which group of plants are considered as highly evolved and most recent?

# CHECK YOUR VITALS

## for NEET, AIIMS and JIPMER



Maximise your chance of success in medical entrance exams by reading this article. This section is specially designed to optimise your preparation by practising more and more. It is a unitwise series having chapterwise question bank, allowing you to prepare systematically and become more competent.

-  Recall question or single concept question – indicated by a single finger.
-  Application question or question which requires 2 or 3 concepts - indicated by 2 fingers.
-  Application question or question which requires 3 or more concepts - indicated by 3 fingers.

### UNIT-I : DIVERSITY IN THE LIVING WORLD

#### CHAPTER-1 : THE LIVING WORLD

##### Multiple Choice Questions

-  1. New systematics is not based on the
  - (a) study of all types of variations in the species
  - (b) traits indicating primitiveness and advancement
  - (c) inter-relationship of species
  - (d) natural affinities amongst organisms.
-  2. Sub-class is an intermediate category which includes
  - (a) families
  - (b) sub-families
  - (c) orders
  - (d) sub-orders.
-  3. Plant specimens are dried and stored as the form of herbarium with a label that does not contain
  - (a) collector's name
  - (b) height of the plant
  - (c) local name
  - (d) date of collection.
-  4. Taxonomic key is an artificial analytic device. Each statement of the key is called
  - (a) lead
  - (b) indent
  - (c) bracket
  - (d) both (a) and (b).
-  5. Catalogue is a
  - (a) handy book containing instructions
  - (b) book containing information and index of plants
  - (c) list or register that enumerates methodically all the species found in a particular place
  - (d) treatise having all information about a particular taxon.
-  6. Any rank of a taxonomic group is called (i) whereas smallest group is (ii).

(a) species	genus
(b) genus	taxon
(c) taxon	species
(d) species	variety
-  7. A group of interconnected families is called
  - (a) order
  - (b) class
  - (c) phylum
  - (d) genus.
-  8. Which of the following statements is/are correct?
  - (i) Category belongs to one particular rank.
  - (ii) Botanical gardens have collection of living plants and animals for reference.
  - (iii) Famous botanical garden of Kew is located in France.
  - (iv) Monographs contain information on one taxon.

(a) (i) and (ii)	(b) (i) and (iv)
(c) (ii) and (iii)	(d) (iii) and (iv)
-  9. *Catla catla* have the identical specific and generic name. It is an example of
  - (a) tautonym
  - (b) synonym
  - (c) homonym
  - (d) none of these.
-  10. Which of the following is correctly matched?

(a) Fabaceae	–	Order
(b) Muscidae	–	Class
(c) Poales	–	Order
(d) Primata	–	Family

11. The term species was coined by  
 (a) John Ray (b) Linnaeus  
 (c) Darwin (d) Ernst Mayr.
12. The taxonomic hierarchy includes \_\_\_\_\_ obligate categories.  
 (a) eight (b) seven  
 (c) six (d) nine.
13. Which of the following is not a family?  
 (a) Solanaceae (b) Canidae  
 (c) Sapindales (d) Gramineae
14. All living organisms are classified into various groups. The first step of taxonomic study of an organism is  
 (a) identification (b) description  
 (c) nomenclature (d) classification.
15. Which of the following is not a code of nomenclature?  
 (a) ICBN (b) ICVN  
 (c) ISBN (d) ICNCP

### Match The Columns

16. Match Column I with Column II.
- | Column I         | Column II                       |
|------------------|---------------------------------|
| A. Julian Huxley | (i) Concept of new systematics  |
| B. C. Linnaeus   | (ii) <i>Historia Plantarum</i>  |
| C. Aristotle     | (iii) <i>Historia Animalium</i> |
| D. Theophrastus  | (iv) Binomial nomenclature      |
17. Match the Column I with Column II. (There can be more than one match for items in column I.)
- | Column I            | Column II                                |
|---------------------|--|
| A. Zoological park  | (i) Original specimen cited by an author |
| B. Botanical garden | (ii) Preserved animal specimens          |
| C. Museum           | (iii) Kew                                |
| D. Holotype         | (iv) Preserved plant specimens           |
| E. Taxon            | (v) Order                                |
|                     | (vi) Birs Munda Jaivik Udyan             |
|                     | (vii) Species                            |
|                     | (viii) Living plants                     |
|                     | (ix) Animals allowed to bred             |
|                     | (x) Family                               |

### Passage Based Questions

- 18.(A) Complete the given passage with appropriate words or phrases.  
 Binomial nomenclature was developed by (i). In this system each organism is given only one name that comprises of two words (ii) and (iii). (ii) name starts with a (iv) letter whereas (iii) name starts with (v) letter. (i) gave rules for plants in (vi) and for animals in the 10<sup>th</sup> edition of (vii). Binomial name is written in (viii) and name of the author is kept in (ix) script.

- (B) Read the given passage and correct the errors, wherever present.  
 Metabolism is of two kinds - anabolism includes all breakdown reactions and catabolism constitutes all building up reactions. Anabolism stores energy and potential energy is changed into kinetic energy. Catabolism is required for growth, maintenance and storage. All organisms are able to sense and respond to internal factors. The awareness of the surroundings and response to external stimuli is known as homeostasis.

### Assertion & Reason

- In each of the following questions, a statement of Assertion (A) is given and a corresponding statement of Reason (R) is given just below it. Of the statements, mark the correct answer as :  
 (a) If both A and R are true and R is the correct explanation of A  
 (b) If both A and R are true but R is not the correct explanation of A  
 (c) If A is true but R is false  
 (d) If both A and R are false.
19. **Assertion** : Growth is irreversible increase in mass of an organism during its life span.  
**Reason** : Living organisms show internal growth due to addition of materials and formation of cells inside the body.
20. **Assertion** : Reproduction is not essential for survival of an individual.  
**Reason** : Organisms reproduce for perpetuation of a population.
21. **Assertion** : Living organisms constantly require energy.  
**Reason** : They have to perform various activities to overcome entropy or tendency to randomness.
22. **Assertion** : In binomial nomenclature, new names are derived from Latin or are Latinised.  
**Reason** : Latin is a newly evolving language.
23. **Assertion** : All the living organisms have a defining property of self-consciousness.  
**Reason** : Self-consciousness is the ability to sense and respond to environmental factors.
24. **Assertion** : In classical taxonomy, species are believed to be static.  
**Reason** : Species are delimited on the basis of morphological characters.
25. **Assertion** : Different members of a species are able to interbreed freely and produce fertile offspring.  
**Reason** : All the members of a species whether present in one population or different population are derived from different ancestors.
26. **Assertion** : Class is a taxonomic category that includes one or more families.  
**Reason** : All the families in a class have similar features and common ancestor.

27. **Assertion** : Correlated characters are those similar or common characters that are used in delimitation of a taxon above the rank of species.

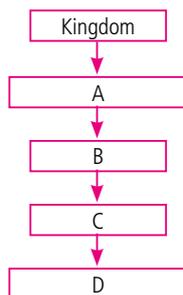
**Reason** : Genus is a group of related species that resemble one another in certain correlated characters.

28. **Assertion** : Keys contain list of characters and their alternates.

**Reason** : Keys are analytical in nature.

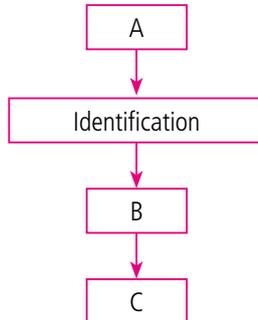
### Figure Based Questions

29. Refer to the given flow chart and answer the following questions.



- (a) Identify A, B, C and D in the given flow-chart.  
 (b) Briefly describe the labelled part C.  
 (c) Members of D share more similar characteristics than other given taxons. Explain.

30. Study the given flow chart of systematic study and answer the following questions.



- (a) Identify A, B and C in the given flow chart.  
 (b) Briefly define the labelled part B.  
 (c) What are the types of C? State about the more advantageous type of C.

## CHAPTER-2 : BIOLOGICAL CLASSIFICATION

### Multiple Choice Questions

1. Natural system of classification is better than artificial system of classification because
- it allows coming together of unrelated organisms
  - it brings about affinities on the basis of a number of characters
  - there is no stress on comparative study
  - there is no stress on actual study of each and every organism.

2. The reserve food in dinoflagellates is stored in the form of

- leucosin and volutin
- paramylum
- starch and oils
- pyrenoids.

3. Select the correct statement regarding asexual reproduction in fungi.

- Cilia help the zoospores to swim in aquatic habitat for proper dispersal.
- Oidia are individual cells that multiply by budding.
- Conidia are motile exogenous spores.
- Basidiospores are meiospores which are formed endogenously.

4. Which of the following cell organelle is absent in mycoplasma?

- Endoplasmic reticulum
- Lysosomes
- Mitochondria
- All of these

5. X is a spirally coiled, filamentous blue green alga covered by a sheath of mucilage. X can be easily cultivated in tanks and can be used as a palatable protein rich food supplement for humans and animals. Identify X.

- Nostoc*
- Gunnera*
- Trifolium*
- Spirulina*.

6. In which of the following dinoflagellates bioluminescence was reported for the first time?

- Noctiluca*
- Ceratium*
- Alexandrium*
- Pyrocystis*

7. Magna and minuta forms are found in the lumen of the intestine of

- Collozoum*
- Acanthometra*
- E. histolytica*
- Pelomyxa*.

8. Read the following statements regarding archaeobacteria and select the incorrect option.

- Halophiles give offensive smell and undesirable pigmentation to the salt.
- Archaeobacteria are employed in the production of gobar gas.
- Branched-chain amino acids help thermoacidophiles to tolerate high temperature.
- Both (a) and (c).

9. Food particles in *Amoeba* are less active in

- circumfluence
- circumvallation
- invagination
- import.

10. Identify the organism according to the given features.

- They have greyish, yellowish, greenish, orange, etc., colouration.
  - They are perennial with slow growth.
  - They cannot tolerate air pollution due to SO<sub>2</sub>.
  - They show three types of structures : crustose, foliose and fruticose.
- Mycorrhizae
  - Deuteromycetes
  - Lichens
  - Zygomycetes

11. Which of the following methods of sexual reproduction in *Paramecium* is called "Purification Act"?

- (a) Endomixis (b) Hemixis  
(c) Cytogamy (d) Conjugation

12. In which of the following fungi mature sporangia are thrown away upto a distance of 2m?

- (a) *Mucor pusillus* (b) *Rhizopus stolonifer*  
(c) *Absidia carymbilera* (d) *Pilobolus crystallinus*

13. Consider the following differences between ascomycetes and basidiomycetes and select correct set of differences.

	Ascomycetes	Basidiomycetes
(i)	Club like fungi with central pores.	Sac like fungi with doliopores.
(ii)	Clamp connections do not occur.	Clamp connections occur between adjacent cells.
(iii)	Sex organs are absent.	Sex organs are common.
(iv)	Mitospores are formed exogenously.	Meiospores are formed exogenously.

- (a) (i) and (iii) (b) (ii) and (iv)  
(c) (i) and (iv) (d) (ii) and (iii)

14. Wriggling type of locomotion is seen in

- (a) *Paramecium* (b) zooflagellates  
(c) *Globigerina* (d) sporozoans.

15. A horticulturist used certain bacteria X to cure off the bitterness of leaves of tea and tobacco. Name the bacteria X.

- (a) *Pseudomonas fluorescense*  
(b) *Bacillus megatherium*  
(c) *Clostridium butylicum*  
(d) *Acetobacter aceti*

### Match The Columns

16. Match Column I with Column II.

Column I	Column II
A. <i>Nostoc</i>	(i) Death cap
B. <i>Giardia</i>	(ii) Star jelly
C. <i>A. phalloides</i>	(iii) The spindle organism
D. <i>Euglena</i>	(iv) Grand old man of intestine

17. Match the Column I with Column II. (There can be more than one match for items in column I.)

Column I	Column II
A. Tobacco Mosaic Virus	(i) Nitrogen fixing cyanobacteria
B. <i>Anabaena</i>	(ii) Bioluminescence
C. <i>Gonyaulax</i>	(iii) Soft rot of apple
D. <i>Rhizopus</i>	(iv) ssRNA

- E. *Paramecium* (v) Prevent growth of mosquitoes  
(vi) Slipper animalcule  
(vii) Alcoholic fermentation  
(viii) 2130 capsomeres  
(ix) Red tide  
(x) Cyclosis

### Passage Based Questions

18.(A) Complete the given passage with appropriate words or phrases.

Virus is a/an (i) parasite which is inert outside the host cell. An inert virus is called (ii). Three architectural forms are found in viruses: (iii), (iv) and (v). A virus is a (vi) and the genetic material is (vii). In general, viruses that infect plants have (viii) and viruses that infect animals have (ix). The protein coat is made up of small subunits called (x) that protects the nucleic acids.

(B) Read the given passage and correct the errors, wherever present.

Slime moulds are parasitic protists. They live usually amongst flourishing vegetation. The chief mode of nutrition is parasitic. Under suitable conditions, they form an aggregation called paramylum which spread over several feet. The spores lack true walls. The spore germinates to produce a single naked *Amoeba* like cell called microcyst.

### Assertion & Reason

In each of the following questions, a statement of Assertion (A) is given and a corresponding statement of Reason (R) is given just below it. Of the statements, mark the correct answer as :

- (a) If both A and R are true and R is the correct explanation of A  
(b) If both A and R are true but R is not the correct explanation of A  
(c) If A is true but R is false  
(d) If both A and R are false.

19. **Assertion** : Rhizomorphs pass the unfavourable periods in dormant stage.

**Reason** : Rope-like twisted subterranean masses of hyphae are seen in Rhizomorphs.

20. **Assertion** : Some protists are often known as armoured dinoflagellates.

**Reason** : Sculptured plates are present in these protists.

21. **Assertion** : Chemotaxonomy is based on comparative cytological studies.

**Reason** : Lineage can be traced with the help of chromosomal studies.

22. **Assertion** : *Aquaspirillum magnetotacticum* contains magnetosomes.

**Reason** : Magnetosomes help the bacteria to orientate themselves along geomagnetic lines.

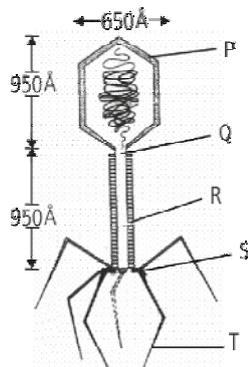
23. **Assertion** : Cyanobacteria are both autotrophic and heterotrophic.

**Reason** : Cyanobacteria possess bacteriochlorophyll.

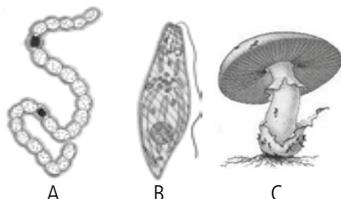
24. **Assertion :** Life cycle with gametic meiosis is found in majority of protozoan protists.  
**Reason :** Meiosis takes place at the time of zygote germination.
25. **Assertion :** Sexual reproduction in zygomycetes produces a resting spore called zygospores.  
**Reason :** During the formation of zygospores in zygomycetes a distinct large food laden non-motile female gamete is not produced.
26. **Assertion :** *Gonyaulax catenella* are poisonous to vertebrates.  
**Reason :** *Gonyaulax catenella* produce saxitoxin into the sea water which kills fishes and other aquatic animals.
27. **Assertion :** Archaeobacteria are known as living fossils.  
**Reason :** Archaeobacteria can live under extremely hostile conditions where very few other organisms can dare subsist.
28. **Assertion :** Pilli are shorter and narrow.  
**Reason :** Formation of pili is controlled by a nucleoid gene.

### Figure Based Questions

29. Study the given structure of T<sub>2</sub> bacteriophage and answer the following questions.



- (a) Identify the labelled parts P, Q, R, S and T.  
(b) Name the genetic material usually present in T<sub>2</sub> bacteriophage.  
(c) Briefly explain the labelled part P.
30. Refer to the given figures and answer the following questions.



- (a) Identify the organisms A, B and C in the above figures.  
(b) Name the kingdoms to which A, B and C belongs.  
(c) Explain the mode of fertilisation in A, B and C.

## CHAPTER-3 : PLANT KINGDOM

### Multiple Choice Questions

1. In rhodophyceae, the photosynthetic pigments include  
(a) Chlorophyll *a* and *c* type  
(b) Chlorophyll *a* and *d* type  
(c) Chlorophyll *a* and *b* type  
(d) Chlorophyll *b* and *d* type.
2. Plant 'X' has thalloid body organisation and sex organs are two types of gametophores. Plant 'Y' has radial body symmetry and the sporophyte have capsule, seta and foot. Identify X and Y from the given option.
- | X                     | Y                  |
|-----------------------|--------------------|
| (a) <i>Funaria</i>    | <i>Polytrichum</i> |
| (b) <i>Riccia</i>     | <i>Marchantia</i>  |
| (c) <i>Marchantia</i> | <i>Funaria</i>     |
| (d) <i>Porella</i>    | <i>Riccia</i>      |
3. Bryophytes do not attain much heights, due to  
(i) absence of mechanical and vascular tissues.  
(ii) requirement of external sheet of water for capillary conduction.  
(iii) pressure of less developing roots.  
(iv) absence of roots and cuticle.  
(a) (i) and (ii)                      (b) (i), (iii) and (iv)  
(c) (i), (ii) and (iv)                (d) (iii) and (iv)
4. How many of the followings are edible red algae?  
*Porphyra, Sargassum, Fucus, Rhodymenia, Chondrus, Laminaria, Macrocystis*  
(a) Three    (b) Four    (c) Six    (d) Two
5. (i) is called maiden hair fern and (ii) is called male shield fern.
- | (i)                    | (ii)              |
|------------------------|-------------------|
| (a) <i>Adiantum</i>    | <i>Salvinia</i>   |
| (b) <i>Dryopteris</i>  | <i>Salvinia</i>   |
| (c) <i>Adiantum</i>    | <i>Dryopteris</i> |
| (d) <i>Selaginella</i> | <i>Adiantum</i>   |
6. Select the incorrect statement about megasporophyll in gymnosperm?  
(a) It bears megasporangia.  
(b) Megasporangium bears two functional megaspores.  
(c) Female gametophyte is produced inside the megasporangium.  
(d) Megaspore is retained inside the megasporangium.
7. *Dryopteris* and *Cycas* resemble each other as they both  
(a) show circinate ptyxis    (b) have sori  
(c) bear terminal cones    (d) have prothallus.
8. Cycads and conifers have  
(a) non-motile sperms    (b) motile sperms  
(c) motile and non-motile sperms respectively  
(d) non-motile and motile sperms respectively.

9. *Ulothrix* is an unbranched, green, filamentous alga where the sexual reproduction is  
 (a) isogamous type (b) oogamous type  
 (c) anisogamous type (d) both (a) and (b).
10. *Selaginella* shows traits essential for formation of seed, such as  
 (a) multiflagellate spermatozoids  
 (b) heterospory  
 (c) axial or adaxial sporangia  
 (d) pseudodichotomous branching.
11. A pair of pneumocysts or air bladders present in the region of branching, in  
 (a) *Fucus* (b) *Dictyota*  
 (c) *Chondrus* (d) *Polysiphonia*.
12. The female sex organ in *Riccia* and *Marchantia* is  
 (a) antheridium (b) carpogonium  
 (c) archegonium (d) oogonium.
13. Which of the following groups contains bryopsida only?  
 (a) *Funaria*, *Sphaerocarpos*, *Porella*  
 (b) *Sphaerocarpos*, *Sphagnum*, *Polytrichum*  
 (c) *Sphagnum*, *Porella*, *Riccia*  
 (d) *Polytrichum*, *Funaria*, *Sphagnum*
14. In both gymnosperms and angiosperms  
 (a) sporophylls are aggregated to form cones  
 (b) ovules mature in seeds  
 (c) ovules are borne on stalk or funiculus  
 (d) endosperm is post-fertilisation structure.
15. Plant body of *Cycas* is  
 (a) monoecious (b) dioecious  
 (c) monopodial (d) dichotomous.

### Match The Columns

16. Match the Column I with Column II.
- | Column I               | Column II           |
|------------------------|---------------------|
| A. <i>Porphyridium</i> | (i) Ribbon-shaped   |
| B. <i>Spirogyra</i>    | (ii) Unicellular    |
| C. <i>Ectocarpus</i>   | (iii) Filamentous   |
| D. <i>Dictyota</i>     | (iv) Heterotrichous |
17. Match the Column I with Column II. (There can be more than one match for items in column I.)
- | Column I       | Column II                |
|----------------|--------------------------|
| A. Agar        | (i) <i>Chondrus</i>      |
| B. Bromine     | (ii) <i>Gelidium</i>     |
| C. Algin       | (iii) <i>Laminaria</i>   |
| D. Carrageenan | (iv) <i>Rhodomela</i>    |
| E. Funori      | (v) <i>Gracilaria</i>    |
|                | (vi) <i>Polysiphonia</i> |
|                | (vii) <i>Fucus</i>       |
|                | (viii) <i>Sargassum</i>  |
|                | (ix) <i>Gloiopeltis</i>  |
|                | (x) <i>Macrocystis</i>   |

### Passage Based Questions

- 18.(A) Complete the given passage with appropriate words or phrases.  
*Chlamydomonas* is a microscopic, (i), green alga, having (ii) flagella. It shows an unique feature of asexual reproductive stage called (iii). In this stage, a large number of near naked cells devoid of flagella lie inside a mass of (iv). The stage develops in response to (v) condition. They also produce zoospores, (vi) and (vii). It show (viii) meiosis after sexual reproduction and thus life cycle is (ix).
- (B) Read the given passage and correct the errors, wherever present.  
 Ferns are seeded non vascular plants. The plant body is a gametophyte which is differentiated into stem, leaves and rhizoids. Ferns once dominated the earth in tertiary period. Young stem shows circinate ptyxis. Parts of stem, young leaves, petiole are covered with hairs or scales called sori. The fertile leaves containing sporangia are called prothallus.

### Assertion & Reason

- In each of the following questions, a statement of Assertion (A) is given and a corresponding statement of Reason (R) is given just below it. Of the statements, mark the correct answer as :
- (a) If both A and R are true and R is the correct explanation of A  
 (b) If both A and R are true but R is not the correct explanation of A  
 (c) If A is true but R is false  
 (d) If both A and R are false.
19. **Assertion** : *Cycas* is called living fossil.  
**Reason** : *Cycas* possesses a number of characters of extinct pteridosperms and cycads.
20. **Assertion** : Sexual reproduction in algae involves isogamy, anisogamy and oogamy.  
**Reason** : Sex organs are non-jacketed and one called gametangia.
21. **Assertion** : *Porphyra* is an edible marine brown alga.  
**Reason** : It is popularly known as kelp.
22. **Assertion** : Gametophyte produces gametes whereas sporophyte produces spores.  
**Reason** : In bryophytes, sporophytic plant body dominates over gametophytic plant body.
23. **Assertion** : A protonema stage occurs in mosses.  
**Reason** : Protonema is a juvenile stage.
24. **Assertion** : *Sphagnum* is used in transportation of seedlings and cut plants.  
**Reason** : Dry *Sphagnum* can absorb 18-26 times its weight of water.
25. **Assertion** : In diplontic life cycle, gametophyte is dominant.  
**Reason** : In diplontic life cycle, there is no free living sporophyte.

26. **Assertion :** Male and female cone of conifers are borne on different plant.

**Reason :** Majorly conifers are dioecious.

27. **Assertion :** External water for transport of male gametes is not required in gymnosperms.

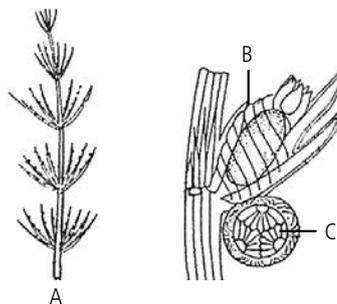
**Reason :** A pollen tube is formed by the male gametophyte for effecting fertilisation.

28. **Assertion :** *Corallina* is important component of reef formation along with corals.

**Reason :** *Corallina* algae produce limestone.

### Figure Based Questions

29. Refer to the given figures and answer the following questions.

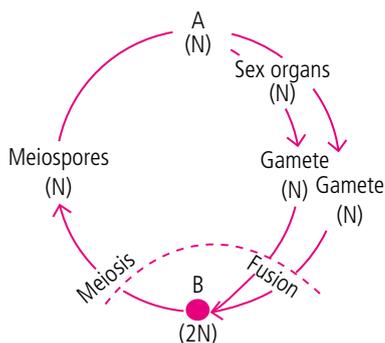


(a) Identify the plant A. What do the labelled parts B and C denote?

(b) Briefly describe the plant A.

(c) What is the significance of B and C?

30. Consider the given figure and answer the following questions.



(a) Which type of life cycle pattern is represented by the given figure?

(b) Identify A and B in the given figure and describe alternation of generation between A and B.

(c) Give two examples that exhibit this type of life cycle pattern.

## CHAPTER-4 : ANIMAL KINGDOM

### Multiple Choice Questions

1. Which of the following statements are correct regarding advancement of ctenophora over cnidaria?

- (i) Organ level of organisation
- (ii) Independent muscle cells
- (iii) Complete digestive tract
- (iv) Determinate cleavage

- (a) (i) and (ii) only
- (b) (i) and (iv) only
- (c) (ii) and (iii) only
- (d) (ii), (iii) and (iv)

2. Read the following statements and select the correct ones.

- (a) Phylum Arthropoda is the second largest animal phylum.
- (b) Presence of water vascular system is the most distinctive feature of echinoderms.
- (c) Malpighian tubules help in osmoregulation and excretion.
- (d) Bioluminescence is the well-marked property in coelenterata.

3. Regeneration is well marked in

- (a) *Planaria*
- (b) *Asterias*
- (c) *Antedon*
- (d) All of these.

4. Read the following features.

- (i) 12 pairs of cranial nerves present.
- (ii) Heart is four chambered.
- (iii) Skull is dicondylic.
- (iv) Renal portal system is absent.

Identify the class from the given characters.

- (a) Reptilia
- (b) Mammalia
- (c) Aves
- (d) Amphibia

5. The cartilaginous fish receives information of the temperature fluctuations in the surrounding water through

- (a) Mullerian ducts
- (b) operculum
- (c) Ampulla of Lorenzini
- (d) proboscis gland.

6. Body is divided into proboscis, collar and trunk in

- (a) *Amphioxus*
- (b) *Herdmania*
- (c) *Climatius*
- (d) *Balanoglossus*.

7. Organism X has cylindrical and curved body with thin walls. It is found attached by its siliceous roots to the bottom of deep sea near the Philippine. Skeleton of X is costly marriage gift in Japan. Identify X.

- (a) *Sycon*
- (b) *Euplectella*
- (c) *Hydra*
- (d) *Oniscus*

8. Read the following statements regarding class chondrichthyes and select the incorrect option.
- The exoskeleton comprises of cycloid, ctenoid and ganoid scales.
  - 10 pairs of cranial nerves present.
  - Kidneys are mesonephric.
  - Lung or air bladder is absent.

9. In urochordata, notochord is present in
- head region only
  - from head to tail region
  - larval tail only
  - none of these.

10. Select the option with the correct differences between male and female *Ascaris*.

	Male <i>Ascaris</i>	Female <i>Ascaris</i>
(i)	It is larger than female.	It is smaller than male.
(ii)	Posterior end is curved.	Posterior end is straight.
(iii)	No cloaca present.	Cloaca is present.

- (i) and (ii) only
- (ii) and (iii) only
- (ii) only
- (iii) only

11. Which of the following shows parental care?

- Ichthyophis*
- Pipa*
- Rhacophorus*
- All of these

12. Larval form of Class crinoidea of echinoderms is

- pluteus
- echinopluteus
- auricularia
- doliolaria.

13. How many of the following snakes are poisonous?

*Python, Naja, Bungarus, Dryophis, Hydrophis, Eryx, Ptyas, Callophis*

- 5
- 4
- 2
- 6

14. Which of the following is not a flight adaptation in birds?

- Presence of urinary bladder
- Well developed brain and eyes
- Warm-bloodedness
- Presence of single functional ovary

15. Which of the following is not an example of bony fish?

- Labeo*
- Catla*
- Clarias*
- Pristis*

### Match The Columns

16. Match the Column I with Column II.

Column I	Column II
A. <i>Chalina</i>	(i) Sail-by-the wind
B. <i>Velella</i>	(ii) The coat of mail shell
C. <i>Chiton</i>	(iii) The sea gooseberry
D. <i>Pleurobrachia</i>	(iv) The deadman's fingers

17. Match the Column I with Column II. (There can be more than one match for items in column I.)

Column I	Column II
A. <i>Obelia</i>	(i) Echinopluteus
B. <i>Wuchereria</i>	(ii) Strobilation
C. <i>Echinus</i>	(iii) Metagenesis
D. <i>Aurelia</i>	(iv) Trochophore larva
E. <i>Nereis</i>	(v) Sexual dimorphism
	(vi) Planula larva
	(vii) Aristotle's Lantern
	(viii) Microfilaria larva
	(ix) Metamorphosis
	(x) Scyphistoma

### Passage Based Questions

- 18.(A) Complete the given passage with appropriate words or phrases.

Phylum Platyhelminthes have dorsoventrally flattened body, hence are called (i). These are mostly (ii) in animals including human beings and have special adhesive organs like (iii). Specialised cells called (iv) help in osmoregulation and excretion. Asexual reproduction occurs by (v) in flatworms. Phylum Aschelminthes appear (vi) in cross section. They have (vii) level of body organisation. The excretory system have complicated giant cells called (viii). Fertilisation is (ix) and development may be direct or indirect.

- (B) Read the given passage and correct the errors, wherever present.

Reptiles are the creeping and burrowing warm blooded vertebrates. Respiration always takes place through gills. Skull is dicondylic and kidneys are mesonephric. Ten pairs of cranial nerves are present and lateral line system is present. Reptiles are mostly viviparous and embryonic membranes develop during development.

### Assertion & Reason

In each of the following questions, a statement of Assertion (A) is given and a corresponding statement of Reason (R) is given just below it. Of the statements, mark the correct answer as :

- If both A and R are true and R is the correct explanation of A
- If both A and R are true but R is not the correct explanation of A
- If A is true but R is false
- If both A and R are false.

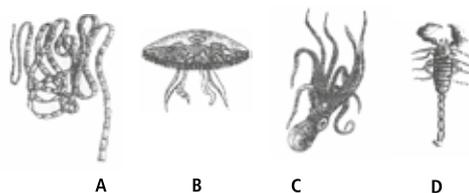
19. **Assertion :** *Ornithorhynchus* and *Echidna* are egg laying animals but are placed under Class Mammalia.

**Reason :** *Ornithorhynchus* and *Echidna* are warm blooded and have mammary glands.

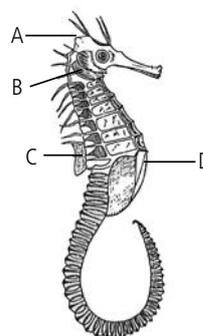
20. **Assertion** : Body of vertebrates can be divided into two equal halves by a single plane only.  
**Reason** : In vertebrates, the important body organs are paired and occur on the two sides of a central axis.
21. **Assertion** : Ctenophores do not have nematocysts.  
**Reason** : Special adhesive cells, lasso cells are present in ctenophores.
22. **Assertion** : Lamprey mostly feeds upon dead fishes.  
**Reason** : Lamprey has mouth with jaws.
23. **Assertion** : Presence of ambulacral system is the characteristic feature of phylum echinodermata.  
**Reason** : Ambulacral system helps in autotomy and regeneration of echinoderms.
24. **Assertion** : *Chimaera* shows the characters of a shark.  
**Reason** : *Chimaera* possesses operculum, distinct anus and urinogenital aperture like shark.
25. **Assertion** : Crocodiles are ammonotelic.  
**Reason** : Renal portal system are less developed in crocodiles.
26. **Assertion** : The blood of *Herdmania* is green.  
**Reason** : Vanadium is present in the blood of *Herdmania*.
27. **Assertion** : The annelids are the evolutionary precursor of molluscs.  
**Reason** : Both annelids and molluscs bear metameric segmentation and trochophore larva.
28. **Assertion** : The nerve cord of chordates lies dorsal to the notochord.  
**Reason** : The nerve cord of chordates is always hollow.

### Figure Based Questions

29. Refer to the given figures and answer the following questions.



- (a) Identify the animals A-D and also mention the phylum to which they belong.  
(b) Which of the given animals is/are eucoelomates?  
(c) Explain the respiratory system of organisms A and B.
30. Consider the given figure and answer the following questions.



- (a) Identify the organism with labelled parts A-D.  
(b) Mention the function of labelled part A.  
(c) Describe how the parental care is performed by sea horse.

## SOLUTIONS

### CHAPTER-1 : THE LIVING WORLD

1. (d) 2. (c) 3. (b) 4. (a) 5. (c)  
6. (c) 7. (a) 8. (b) 9. (a) 10. (c)  
11. (a) 12. (b) 13. (c) 14. (b) 15. (c)
16. A-(i), B-(iv), C-(iii), D-(ii)  
17. A-(vi, ix), B-(iii, viii), C-(ii, iv), D-(i), E-(v, vii, x)
- 18.(A) (i) Carlous Linnaeus (ii) generic  
(iii) specific (iv) capital  
(v) small (vi) *Species Plantarum*  
(vii) *Systema Naturae* (viii) italics  
(ix) Roman
- (B) Metabolism is of two kinds - anabolism includes all ~~breakdown~~ building up reactions and catabolism constitutes all ~~building-up~~ breakdown reactions. Anabolism stores energy and potential kinetic energy is changed into kinetic potential energy. ~~Catabolism~~ Anabolism is required for growth, maintenance and storage. All organisms are able to sense and respond to ~~internal~~ environmental

factors. The awareness of the surroundings and response to external stimuli is known as ~~homeostasis~~ consciousness.

19. (b) 20. (b) 21. (a) 22. (c) 23. (d)  
24. (b) 25. (c) 26. (d) 27. (b) 28. (b)
29. (a) The given flow chart represents taxonomic categories showing hierarchial arrangement in descending order. A is Phylum or Division, B is Class, C is Order and D is Family.
- (b) Labelled part C in the given flow chart represents Order. It is a type of taxonomic category with one or more related families sharing certain similar characters. For example, the Family Solanaceae is placed in the Order Polymoniales along with four other related families such as Convolvulaceae, Boraginaceae, Hydrophyllaceae and Polemoniaceae.
- (c) Members of labelled part D (Family) share more similar characteristics because the number of similar characters in

categories decreases from lowest rank (family) to highest rank (kingdom).

30. (a) In the given flow chart, A is Characterisation, B is Classification and C is Nomenclature.
- (b) In systematic study, the organism to be studied is described for all its morphological and other characteristics and based on that identification is done. Then the organism is classified (B) on the basis of its resemblance to different taxa. Sometimes, it is possible that the organism may not resemble any existing taxa or groups. A new taxa or group is raised to accommodate it.
- (c) Two types of names have been given to organisms-common or vernacular and scientific. Vernacular names are given to the organisms in a particular language and region of the world. A scientific name is the one which is given by biologist and is understood to represent a particular organism in every part of the world. It is advantageous over the vernacular names. Every species has a single and specific scientific name.

#### CHAPTER-2 : BIOLOGICAL CLASSIFICATION

1. (b) 2. (c) 3. (b) 4. (d) 5. (d)  
 6. (a) 7. (c) 8. (c) 9. (a) 10. (c)  
 11. (b) 12. (d) 13. (b) 14. (d) 15. (b)  
 16. A-(ii), B-(iv), C-(i), D-(iii)  
 17. A-(iv, viii), B-(i, v), C-(ii, ix), D-(iii, vii), E-(vi, x)  
 18. (A) (i) obligate (ii) virion  
 (iii) helical (iv) cuboidal  
 (v) binal (vi) nucleoprotein  
 (vii) infectious (viii) ssRNA  
 (ix) ssRNA or dsRNA or dsDNA (x) capsomeres
- (B) Slime moulds are parasitic saprophytic protists. They live usually amongst flourishing decaying vegetation. The chief mode of nutrition is parasitic saprophytic. Under suitable conditions, they form an aggregation called paramyctum plasmodium which spread over several feet. The spores lack possess true walls. The spore germinates to produce a single naked *Amoeba* like cell called microcyst myxamoeba.
19. (b) 20. (a) 21. (d) 22. (b) 23. (d)  
 24. (c) 25. (b) 26. (a) 27. (b) 28. (d)
29. (a) In the given figure, P, Q, R, S and T represents capsid, Collar, Tail sheath, Basal plate and Tail fibre respectively.
- (b) The genetic material usually present in T<sub>2</sub> bacteriophage is double stranded DNA.
- (c) Labelled part P represents sheath or capsid. It is the proteinaceous covering around the bacteriophage which protects the nucleoid from damage (by physical or chemical

agents). Capsid consists of number of subunits called capsomeres which are arranged in helical or polyhedral geometric forms.

30. (a) In the given figures, A represents *Nostoc*, B represents *Euglena* and C represents *Agaricus*.
- (b) *Nostoc*, *Euglena* and *Agaricus* belong to the Kingdom Monera, Protista and Fungi, respectively.
- (c) *Nostoc* (A) reproduces through fragmentation, hormogones, akinetes and occasionally by heterocysts. The mode of reproduction in *Euglena* (B) is asexual type. It occurs by longitudinal binary fission. *Agaricus* (C) reproduces through plasmogamy where fusion of protoplasts without fusion of their nuclei takes place.

#### CHAPTER-3 : PLANT KINGDOM

1. (b) 2. (c) 3. (c) 4. (a) 5. (c)  
 6. (b) 7. (a) 8. (c) 9. (a) 10. (b)  
 11. (a) 12. (c) 13. (d) 14. (b) 15. (b)  
 16. A-(ii), B-(iii), C-(iv), D-(i)  
 17. A-(ii, v), B-(iv, vi), C-(iii, vii, viii, x), D-(i), E-(ix)  
 18. (A) (i) unicellular (ii) two  
 (iii) palmella stage (iv) mucilage  
 (v) unfavourable (vi) aplanospores  
 (vii) hypnospores (viii) zygotic  
 (ix) haplontic
- (B) Ferns are ~~seeded~~ seedless ~~non-vascular~~ vascular plants. The plant body is a ~~gametophyte~~ sporophyte which is differentiated into stem, leaves and ~~rhizoids~~ roots. Ferns once dominated the earth in ~~tertiary~~ carboniferous period. Young ~~stem~~ leaves shows circinate ptyxis. Parts of stem, young leaves, petiole are covered with hairs or scales called ~~sori~~ ramenta. The fertile leaves containing sporangia are called ~~prothallus~~ sporophylls.
19. (a) 20. (b) 21. (d) 22. (c) 23. (b)  
 24. (a) 25. (d) 26. (d) 27. (a) 28. (a)
29. (a) In the given figures, A represents *Chara*, B represents Nucule or oogonium and C represents Globule or antheridium.

## MEMORY Capsule

To easily remember the Human Taxonomy, the mnemonic "A child may promote his happiness sometimes" can be used as follows :

A	: Animalia	His	: Hominidae
Child	: Chordata	Happiness	: <i>Homo</i>
May	: Mammalia	Sometimes	: <i>sapiens</i>
Promote	: Primate		

(b) *Chara* (A) is an aquatic green alga, grows at the bottom of shallow fresh water bodies. The plant is fixed to the substratum by means of highly branched multicellular rhizoids. The axis of the plant is jointed and the joints represent nodes having whorls of short laterals. It is food for many aquatic animals.

(c) Antheridium or globule (C) is the male sex organ. It is rounded in shape. It lies below the female sex organ called oogonium or nucule (B). Nucule is ovate shaped. Both antheridium and oogonium have multicellular coverings which bring them close to the sex organs of bryophyte.

30. (a) The given figure represents haplontic life cycle.

(b) A is gametophyte and B is zygote which is the only sporophytic structure.

The haploid plant body, i.e., gametophyte produces haploid gametes. Male and female gametes fuse and produce a diploid zygote. The zygote remains single celled. It does not multiply itself. Meiosis occurs at the time of zygote germination. Meiospores are haploid structures. They germinate and give rise to gametophytic (N) plant body. Haplontic life cycle is most primitive type of life cycle.

(c) This type of life cycle is found in *Spirogyra* and *Ulothrix*.

#### CHAPTER-4 : ANIMAL KINGDOM

1. (d) 2. (b) 3. (d) 4. (b) 5. (c)

6. (d) 7. (b) 8. (a) 9. (c) 10. (c)

11. (d) 12. (d) 13. (b) 14. (a) 15. (d)

16. A-(iv), B-(i), C-(ii), D-(iii)

17. A-(iii, vi), B-(v, viii), C-(i, vii), D-(ii, x), E-(iv, ix)

18. (A) (i) flatworms (ii) endoparasites  
(iii) hooks / suckers (iv) flame cells  
(v) transverse binary fission (vi) circular fission  
(vii) organ system (viii) renette cell  
(ix) internal

(B) Reptiles are the creeping and burrowing warm blooded vertebrates. Respiration always takes place through gills-lungs. Skull is dicondylic monocondylic and kidneys are mesonephric metanephric. Ten Twelve pairs of cranial nerves are present and lateral line system is present absent. Reptiles are mostly viviparous oviparous and embryonic membranes develop during development.

19. (a) 20. (a) 21. (b) 22. (d) 23. (c)

24. (c) 25. (b) 26. (a) 27. (a) 28. (b)

29. (a) In the given figure;

A is Tapeworm : Phylum Platyhelminthes

B is *Aurelia* : Phylum Coelenterata

C is Octopus : Phylum Mollusca and

D is *Palamneus* : Phylum Arthropoda.

(b) The animals which possess true coelom are called eucoelomates. Octopus (C) and *Palamneus* (D) are eucoelomates.

(c) Both tapeworm (A) and *Aurelia* (B) lack proper respiratory system. Gaseous exchange occurs by diffusion through body surface.

30. (a) The given organism is *Hippocampus* (seahorse). The labelled parts A, B, C and D are operculum, pectoral fin, dorsal fin and brood pouch respectively.

(b) Operculum (A) is a bony structure and a protective covering for the gills.

(c) Seahorse exhibits sexual dimorphism. The male seahorse bears a brood pouch in which the female lays eggs and the latter remain there till they hatch. Thus, the parental care is performed by the male.

Contributed by : Chandana Kaushik (Karnataka)

#### SOLUTIONS TO APRIL 2019 WORD GRID

Q	N	S	P	E	R	M	T	I	O	V	A	T	R	P
E	P	I	G	E	N	E	T	I	C	S	C	I	O	N
E	O	N	L	I	U	N	I	P	O	R	T	E	R	M
N	R	K	Y	F	G	O	H	Y	P	H	A	R	A	P
D	E	P	C	A	T	A	L	Y	S	I	S	L	E	B
O	P	G	O	N	A	D	N	T	C	U	T	L	O	X
S	H	L	G	O	U	T	A	T	S	E	L	R	Y	L
K	O	O	E	R	M	L	O	Y	I	I	O	L	E	I
E	T	T	N	W	K	O	M	E	C	S	E	A	R	N
L	O	T	O	H	I	P	U	L	I	M	M	C	E	K
E	T	I	L	E	H	S	E	L	U	D	G	E	L	A
T	A	S	Y	Y	Y	G	L	U	T	E	N	A	A	G
O	X	R	S	E	M	T	R	O	P	I	S	M	X	E
N	I	I	I	N	E	C	T	A	R	C	N	U	I	A
T	S	B	S	C	U	T	E	L	L	U	M	G	N	R

- |     |                |     |            |
|-----|----------------|-----|------------|
| 1.  | Gluten         | 11. | Nectar     |
| 2.  | Gigantism      | 12. | Hypha      |
| 3.  | Uniporter      | 13. | Phototaxis |
| 4.  | Endoskeleton   | 14. | Linkage    |
| 5.  | Relaxin        | 15. | Gout       |
| 6.  | Epigenetics    | 16. | Scutellum  |
| 7.  | Glycogenolysis | 17. | Pellicle   |
| 8.  | Catalysis      | 18. | Symphysis  |
| 9.  | Tropism        | 19. | Scion      |
| 10. | Moulting       | 20. | Xylem      |

# ZOOM IN BIO



The syllabus for NEET is very vast which impedes students from acquiring in-depth knowledge and covering the entire syllabus at the same time. An important topic for NEET is therefore presented here in elaborate form to enable students grasp the topic, analyse the type of questions and SCORE HIGH.

## Physiology of Digestion

The digestive system helps the body to digest food. Human digestive system is made up of gastrointestinal (GI) tract and the digestive glands. The GI tract is a series of hollow organs joined together in a long, twisting manner from the mouth to the anus. The organs that make up the GI tract are mouth, oesophagus, stomach, small intestine and large intestine (including the rectum and anus). Food enters the mouth and passes out through the anus. The salivary glands, gastric glands, liver, pancreas and gall bladder are the digestive glands of the digestive system.

Mouth performs mastication which refers to the mechanical breakdown of food by chewing and chopping actions of the teeth. Mastication breaks up the food into small particles, which provides a greater surface area for digestion and enables the food to pass through the oesophagus.

**Teeth** are hard structures which are meant for holding, cutting, grinding and crushing the food.

**Tongue** is a strong muscular organ that helps in chewing of food. It also aids in swallowing and is an organ of taste. Upper surface of tongue bears four types of papillae;

**Vallate papillae** : Usually 8-12 in number. They are largest of all four types.

**Fungiform papillae** : Most numerous near the tip. Each papilla contains five taste buds.

**Filiform papillae** : Smallest and most numerous. They contain tactile receptors not taste buds.

**Foliate papillae** : Not developed in humans. Their taste buds degenerate in early childhood.

Bacteria in the GI tract, also called gut flora or microbiome, helps in digestion. Parts of the nervous and circulatory system also play a role in the digestive process. **Together, a combination of nerves, hormones, bacteria, blood and the organs of the digestive system completes the complex task of digesting the foods and liquid a person consumes each day.**

Digestion is important for breaking down food into nutrients, which the body uses for providing energy, growth and cell repair. Food must be converted into smaller molecules of nutrients (*i.e.*, carbohydrates, proteins, fats and vitamins) before the blood absorbs them and carries them to cells throughout the body.

Organs of the GI tract contain a muscular layer that enables their walls to move. The involuntary movement of muscular walls of alimentary canal is called **peristalsis**. It propels food and liquid through the GI tract and mixes the contents within each organ. Peristalsis looks like an ocean wave travelling through the muscle as it contracts and relaxes. Peristalsis initiates in oesophagus as soon as the food enters into it through mouth. This movement is completely involuntary.

Digestion works by moving food through the GI tract. Digestion begins in the mouth with chewing and ends in the small intestine. As the food passes through the GI tract, it mixes with digestive juices, causing large molecules of food to break down into smaller molecules. The body then absorbs these smaller molecules through the walls of the small intestine into the blood stream, which delivers them to rest of the body. Waste products of digestion pass through the large intestine and out of the body as a solid matter called stool.

## Histology of Alimentary Canal

Four basic layers of alimentary canal from inner lumen to outer surface are : mucosa, submucosa, muscularis externa and serosa.

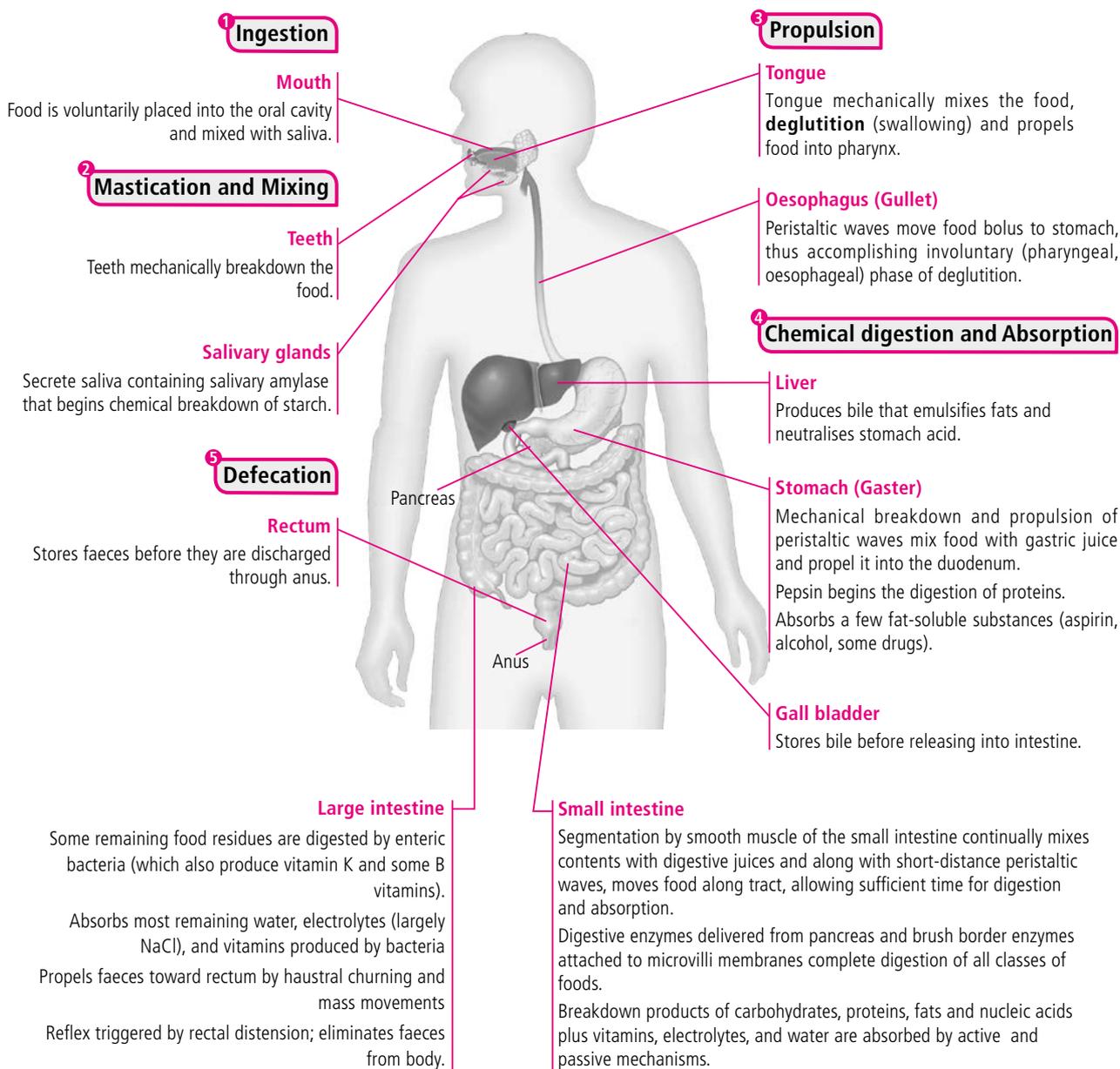


Fig.: Steps in human digestion

## Snap Shots

- **Bolus** is a ball of chewed food bound together with saliva that is formed in the mouth by the action of tongue. The bolus is shaped to a size that allows it to pass into the oesophagus after swallowing *i.e.*, deglutition which is a reflex response to presence of food in pharynx.

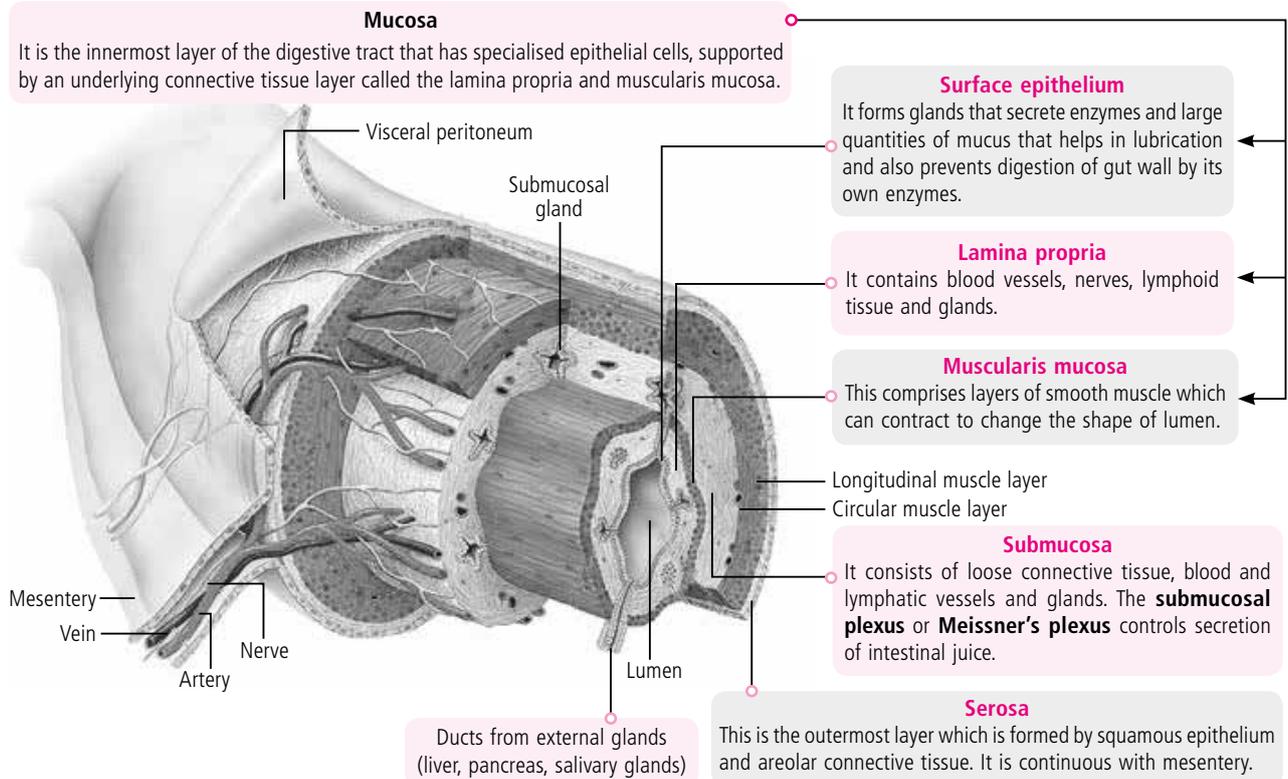


Fig.: Layers of alimentary canal

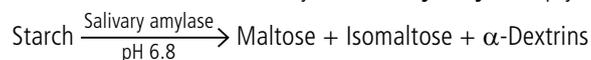
## DIGESTION OF FOOD

### Digestion of Carbohydrates

Polysaccharides and disaccharides are broken down into monosaccharides by action of **carbohydrases**.

#### 1. Action of saliva in oral cavity

In the oral cavity, food is mixed with saliva. Saliva contains an enzyme **salivary amylase** (ptyalin) which acts on starch.



About 30 percent starch is hydrolysed in oral cavity.

#### Role of different substances present in saliva:

- Lysozyme acts as an antibacterial enzyme.
- Thiocyanate ions act as antimicrobial agent.
- Bicarbonate ions neutralise the acid in food.
- Mucus moistens and dissolves food. It also lubricates the oesophagus.

#### 2. In small intestine

Brunner's gland of duodenum, secrete viscous, enzyme-free, alkaline and watery mucoid fluid in response to stimuli from vagus nerve (10<sup>th</sup> cranial nerve) and secretin (gastrointestinal hormone).

This secretion enables duodenum to withstand acidic chymes entering from the stomach, until it is neutralised by alkaline pancreatic juice and bile.

Mucus protects duodenal wall from getting digested.

### Action of Various Carbohydases in Duodenum

#### 1. Action of pancreatic juice

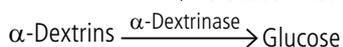
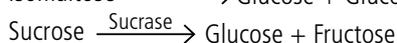
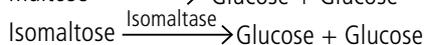
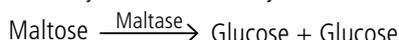
Pancreatic  $\alpha$ -amylase converts starch into simple sugars.

Bicarbonate neutralises HCl of the chyme that enters the duodenum.



#### 2. Action of intestinal juice

Various enzymes of intestinal juice act as follows:



### Lactose intolerance

It is an impaired ability to digest lactose, a sugar found in milk and other dairy products. It is due to deficiency of enzyme lactase, that is required to breakdown lactose into glucose and galactose, which can then be absorbed into bloodstream and used for energy. It causes gas, nausea, diarrhoea, abdominal cramps.

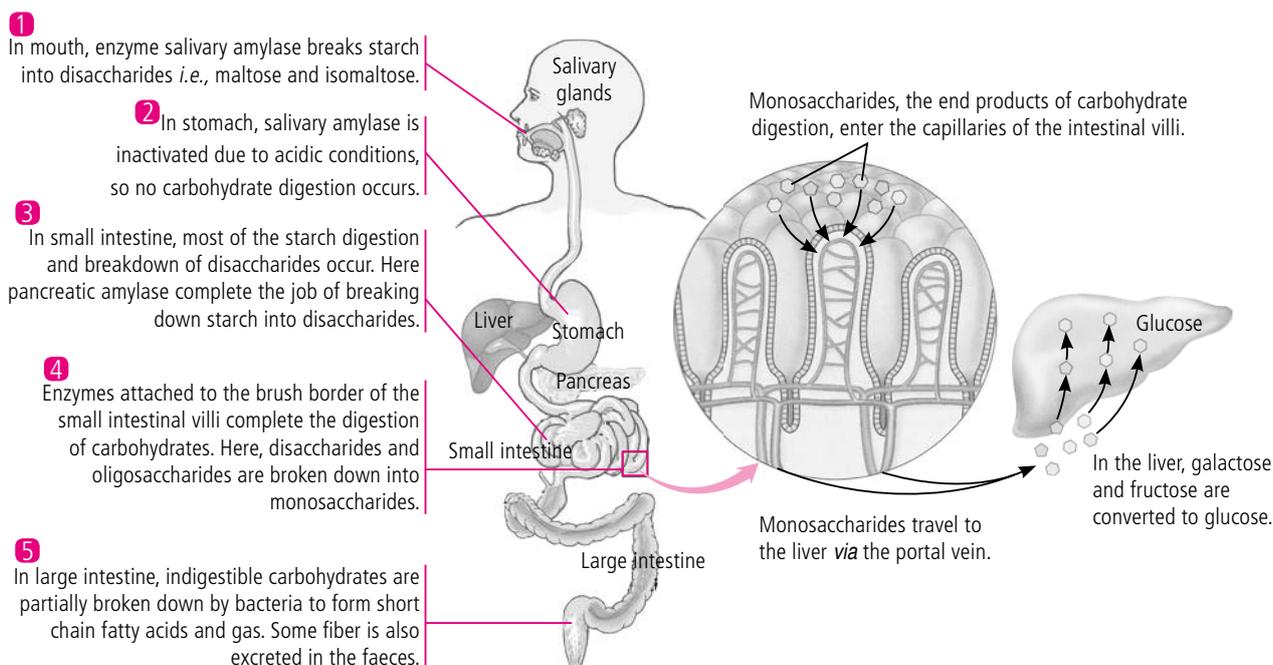


Fig.: Digestion and absorption of carbohydrates

### Digestion of Proteins

**Proteases or peptidases** are protein hydrolysing enzymes, that are mostly secreted in inactive forms as **proenzymes**. Proenzymes are converted into their active forms at their sites of action.

Protein digestion does not occur in oral cavity as saliva does not contain any protein digesting enzymes.

#### In stomach

Stomach stores food for 4-5 hours. Gastric juice secreted by gastric gland of stomach contains HCl, proenzymes (pepsinogen and prorennin).

HCl maintains strongly acidic pH of 1.5 – 2.5 in stomach.

**Chyme** - Thick acidic mixture of gastric juice and semi-digested food formed in the stomach.

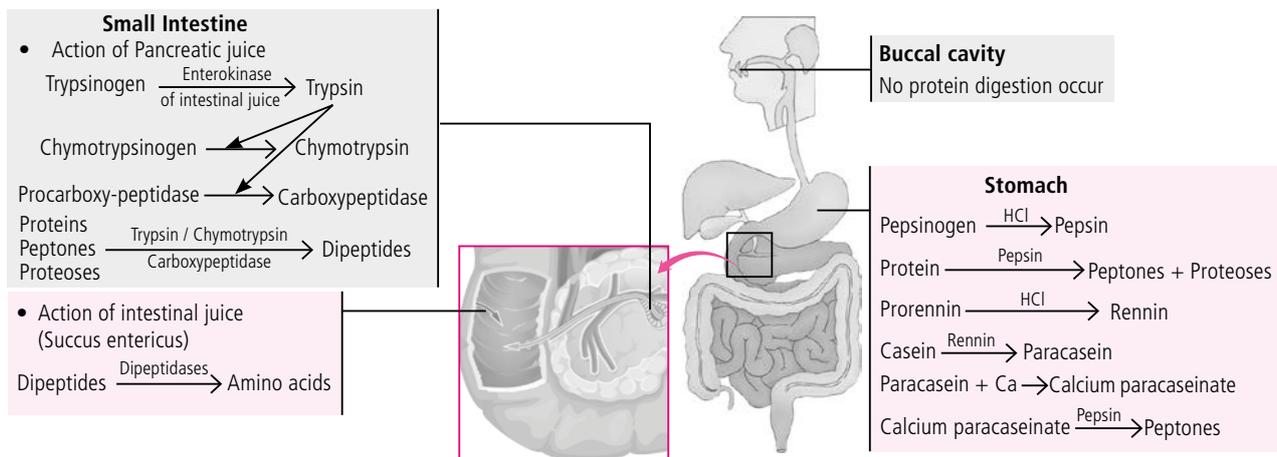


Fig.: Digestion of proteins

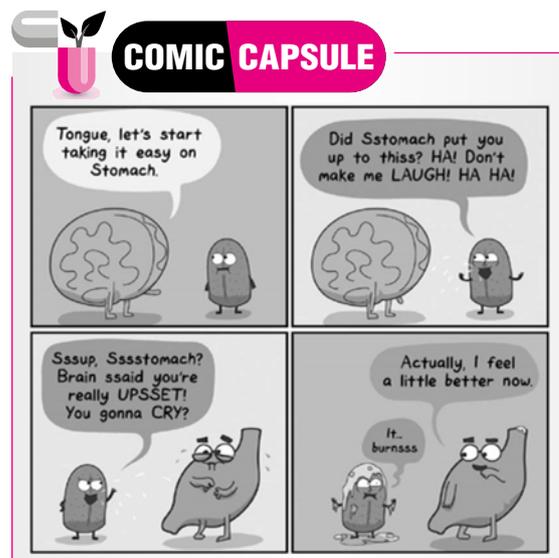
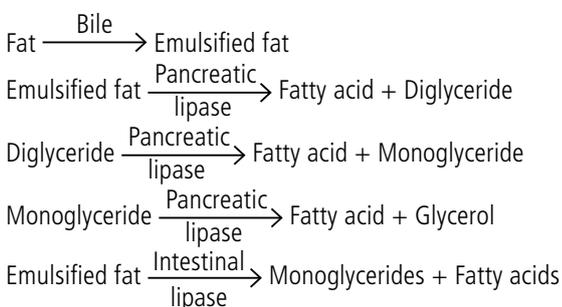
## Digestion of Fats

Almost the entire fat portion of the diet consists of triglycerides (neutral fats) which are made up of three fatty acid molecules and a single glycerol molecule.

1. **In mouth:** Lipases are not present in saliva hence, fats are not digested in buccal cavity.

2. **In stomach:** Gastric juice contains small amount of gastric lipase which converts some fats into monoglycerides and fatty acids.

3. **In small intestine :** Bile salts of the bile break down fat droplets into many small ones by reducing the surface tension of fat droplets. This process is called **emulsification**. This increases lipase action on fat. Lipase is present in the pancreatic juice and intestinal juice. Pancreatic lipase is the principle enzyme for digestion of fat.



## • Snap Shots

- Chyle** is a white or pale yellow fluid taken up by the lacteals (lymph capillaries) from the intestine during digestion. It mainly consists of absorbed fat.

## Digestion of Nucleic Acids

Nucleic acids are digested in small intestine.



## REGULATION OF DIGESTION

Activities of GI tract are under both neural and hormonal control and some local factors for proper co-ordination among different parts.

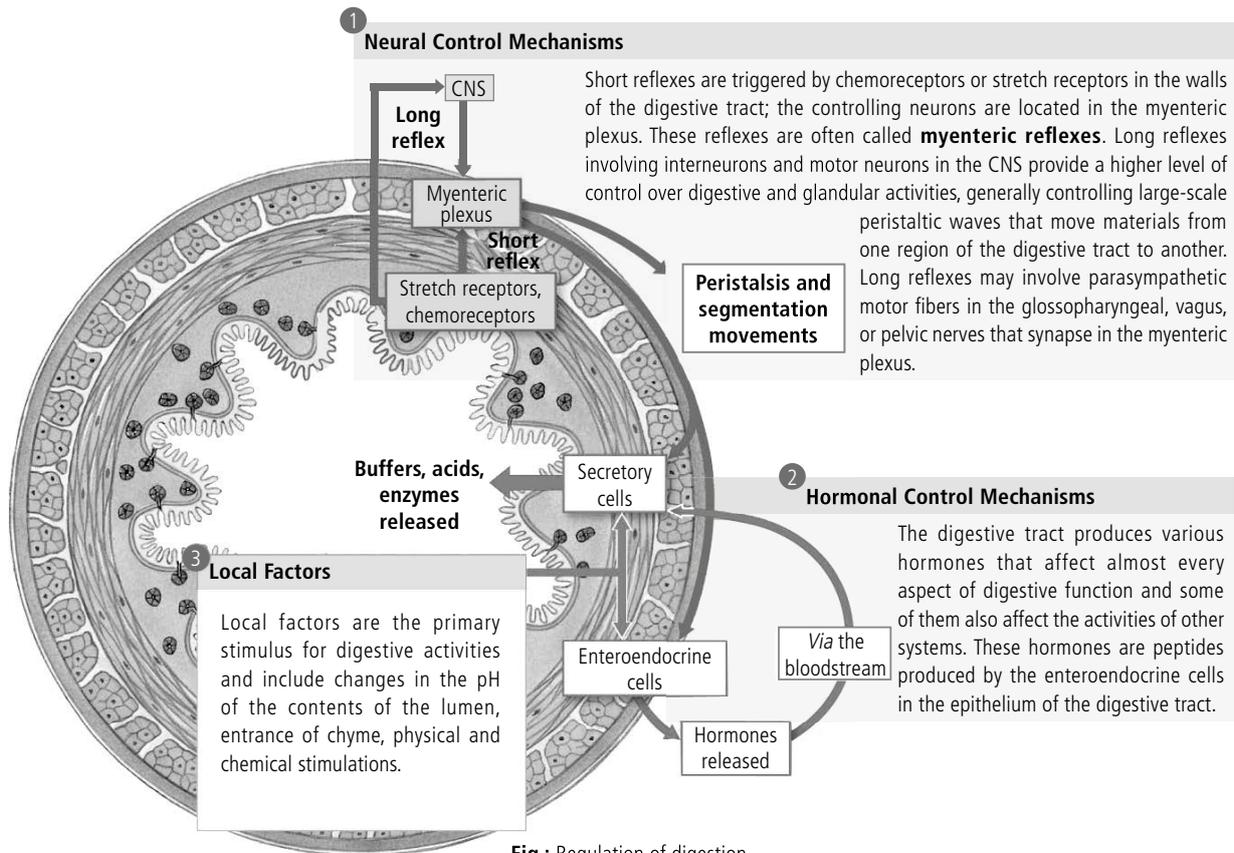


Fig.: Regulation of digestion

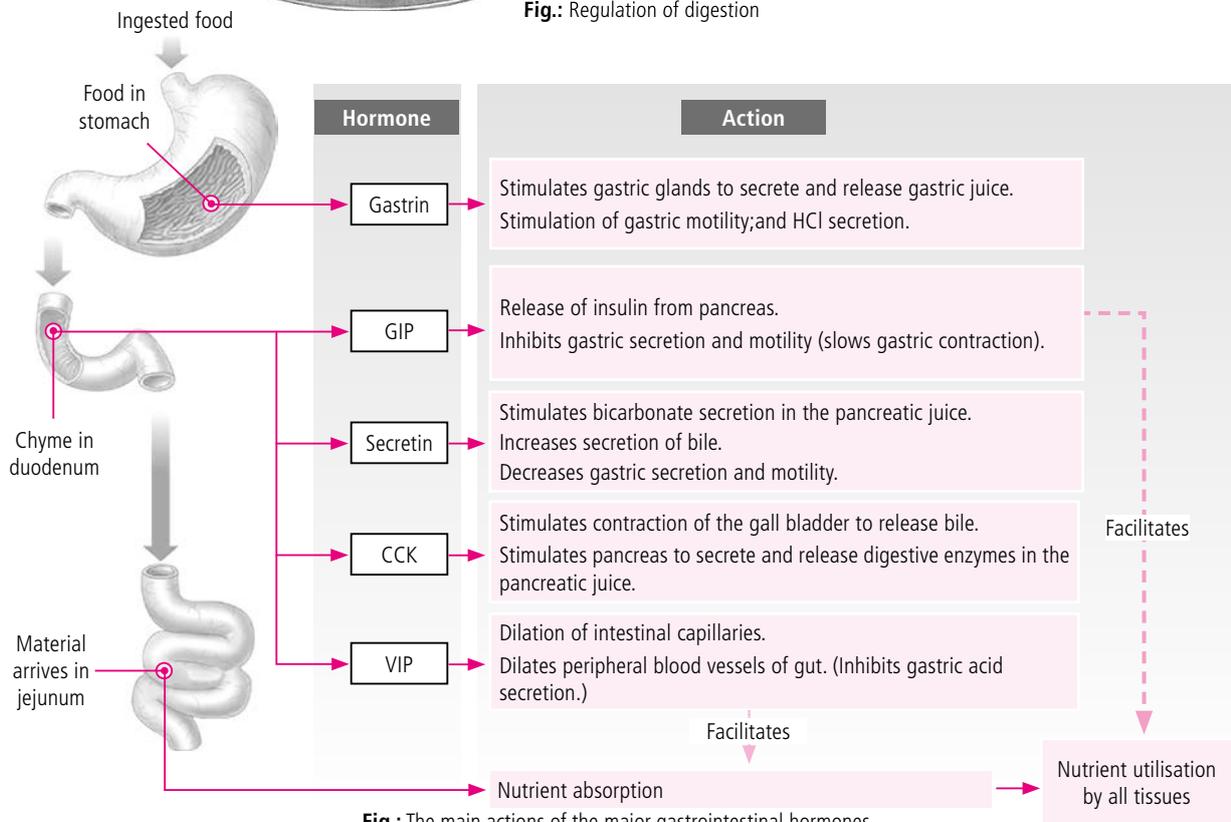


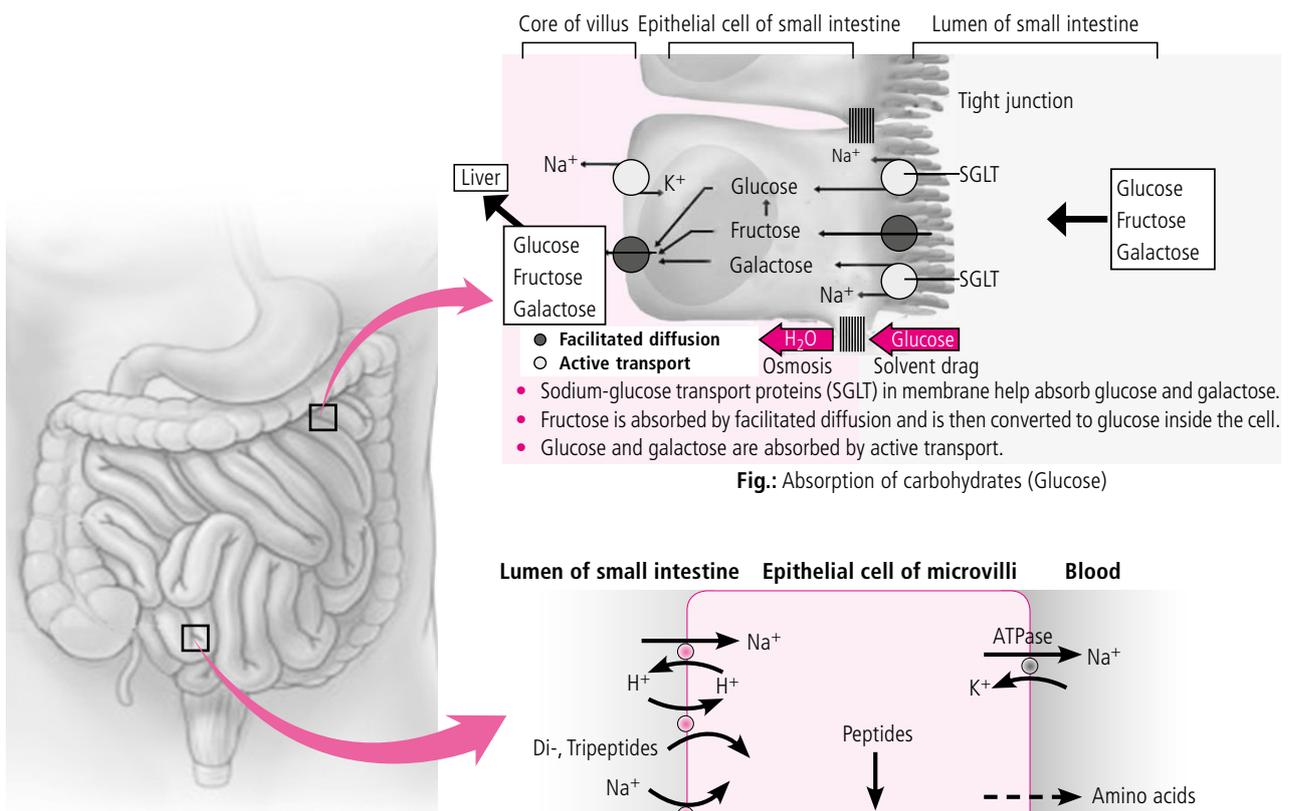
Fig.: The main actions of the major gastrointestinal hormones

**Table:** Summary of action of some other gastrointestinal hormones

	Hormone	Source	Target organ	Action
(i)	Duocrinin	Duodenum	Duodenum	Stimulates the Brunner's glands to release mucus and enzymes into the intestinal juice.
(ii)	Enterocrinin	Small intestine	Small intestine	Stimulates the Crypts of Lieberkuhn to release enzymes into the intestinal juice.
(iii)	Villikinin	Small intestine	Small intestine	Accelerates movements of villi.
(iv)	Somatostatin (SS)	Delta cells of islets of Langerhans of pancreas.	Pancreas, Gastrointestinal tract	Inhibits the secretion of glucagon by alpha cells and insulin by beta cells. It also inhibits absorption of nutrients from the gastrointestinal tract.
		Argentaffin cells of gastric and intestinal glands.	Gastrointestinal tract	Suppresses the release of hormones from the digestive tract.
(v)	Pancreatic Polypeptide (PP)	Pancreatic Polypeptide cells	Pancreas	Inhibits the release of pancreatic juice from the pancreas.

## ABSORPTION OF NUTRIENTS

Absorption is the process by which nutrients pass from the alimentary canal into the blood and lymph through its mucous membrane. About 90% of nutrients are absorbed in small intestine while the rest 10% absorption occurs in stomach and large intestine.



**Fig.: Absorption of amino acids**

## Absorption of Fats

Fatty acids and glycerol are absorbed via simple diffusion. Fatty acids and glycerol are insoluble in water, therefore, they cannot reach the blood stream directly. They are first incorporated into small, spherical, water soluble droplets called **micelles** with the help of the bile salts and phospholipids in the intestinal lumen. A micelle is an aggregate of many molecules. From the micelles fatty acids, glycerides, sterols and fat soluble vitamins are absorbed into the intestinal cells by diffusion where they are resynthesised in the ER and converted into very small fat molecules (droplets) called chylomicrons. The latter are released from the intestinal cells into the lymph present in the lymphatic capillaries, the **lacteals**.

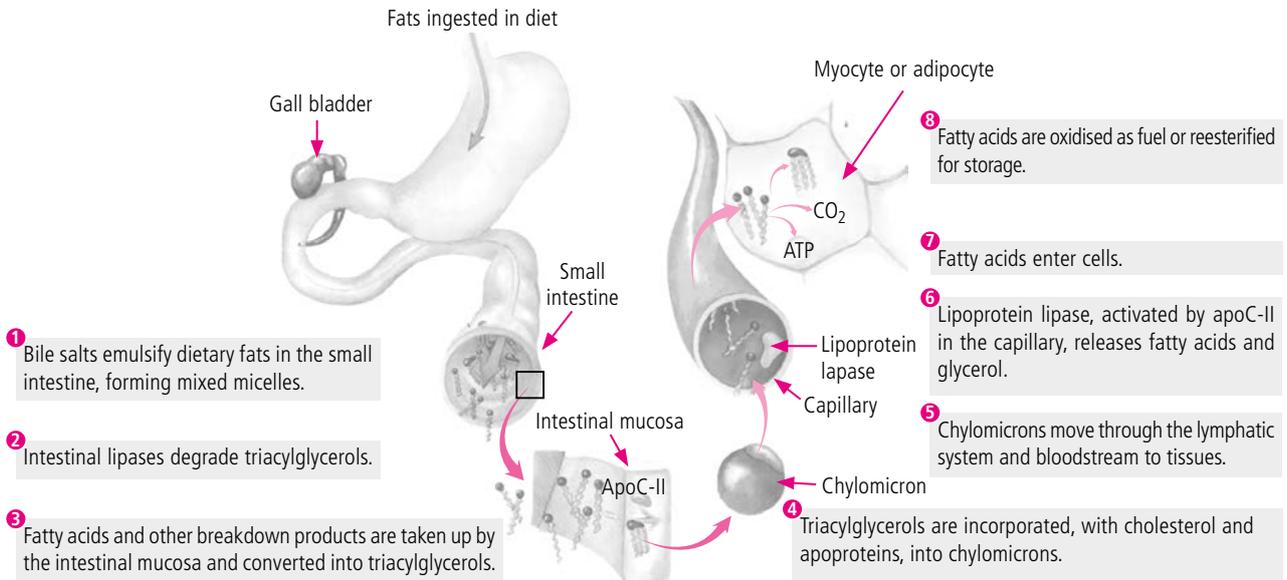


Fig.: Absorption of fats

## UNSCRAMBLE ME

Unscramble the words given in column I and match them with their explanations in column II.

### Column I

- CETIULC
- YORAOPGM
- MZOYLESY
- ILNATSALO
- MUGAM
- NMENCOIY
- EXOPREOIMS
- MLTULICEL
- NIRITXPAO
- EDHCIRTA

### Column II

- The condition when the pollen tube in a seed plant enters the ovule through the micropyle.
- A sac-like structure which arises from the gut of the embryo near the yolk sac.
- An antibiotic which inhibits interaction between tRNA and mRNA during bacterial protein synthesis.
- Small cytoplasmic organelle that contain several oxidative enzymes involved in a variety of metabolic reactions.
- An elongated water conducting cell in xylem that serve in the transport of water and mineral salts.
- A prominent circular band of glandular skin found from the 14<sup>th</sup> to 16<sup>th</sup> segments in earthworm.
- A non-cellular waxy layer which protects the surface, reduces water loss and exclusively synthesised by epidermal cells.
- The act of respiration takes place when the intrapulmonary pressure is higher than the atmospheric pressure.
- An enzyme found in tears and saliva that protect us from bacterial infection.
- A soft, rubbery tumour like growth resulting from the tertiary stage of syphilis.

Readers can send their responses at [editor@mtg.in](mailto:editor@mtg.in) or post us with complete address by 10<sup>th</sup> of every month. Winners' names will be published in next issue.

## Absorption of Water

Water is the most abundant substance in chyme. Approx. 8000 mL of ingested and secreted water enters the small intestine each day but only 1500 mL passes on to the large intestine because 80% of fluid is absorbed in small intestine. The absorption of water from the small intestine is associated with the absorption of electrolytes. If the chyme remains in the large intestine for a very long time, a lot of water is absorbed causing the faecal matter to become very hard. That is why regular bowel habits need to be generated since childhood. Certain bacteria inhabiting the large intestine synthesises vitamin K, which is also absorbed by the cells of the large intestine.

## Absorption of Salts

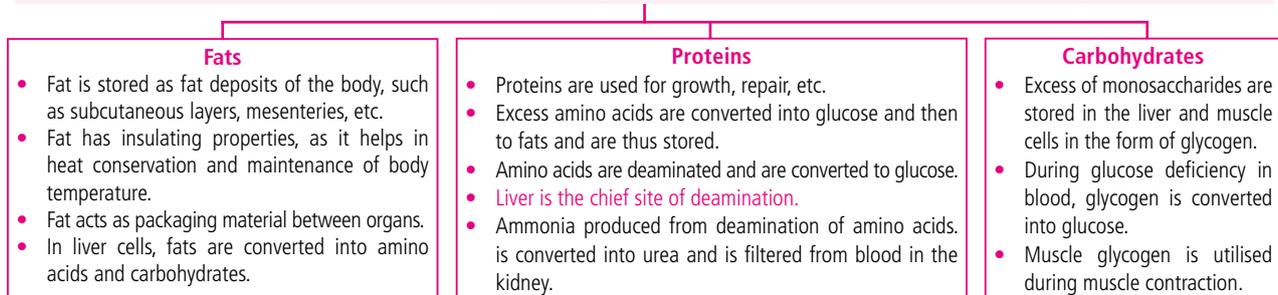
Sodium is absorbed from small intestine by active transport. Other ions like calcium, potassium, iron, magnesium and phosphate are absorbed by active transport. Most of the absorption of ions takes place through small intestine. Bile salts are absorbed in ileum.

## Absorption of Water Soluble Vitamins

Most of the water soluble vitamins such as **vitamin B complex, C** etc., are absorbed by **simple diffusion** into the blood capillaries. But reabsorption of **vitamin B<sub>12</sub>** requires combination with **Castle's intrinsic factor** produced by the stomach for its absorption.

### Assimilation of Nutrients

Assimilation is the absorption of nutrients into the body cells after digestion in the intestine and their transformation in biological tissues and fluids.

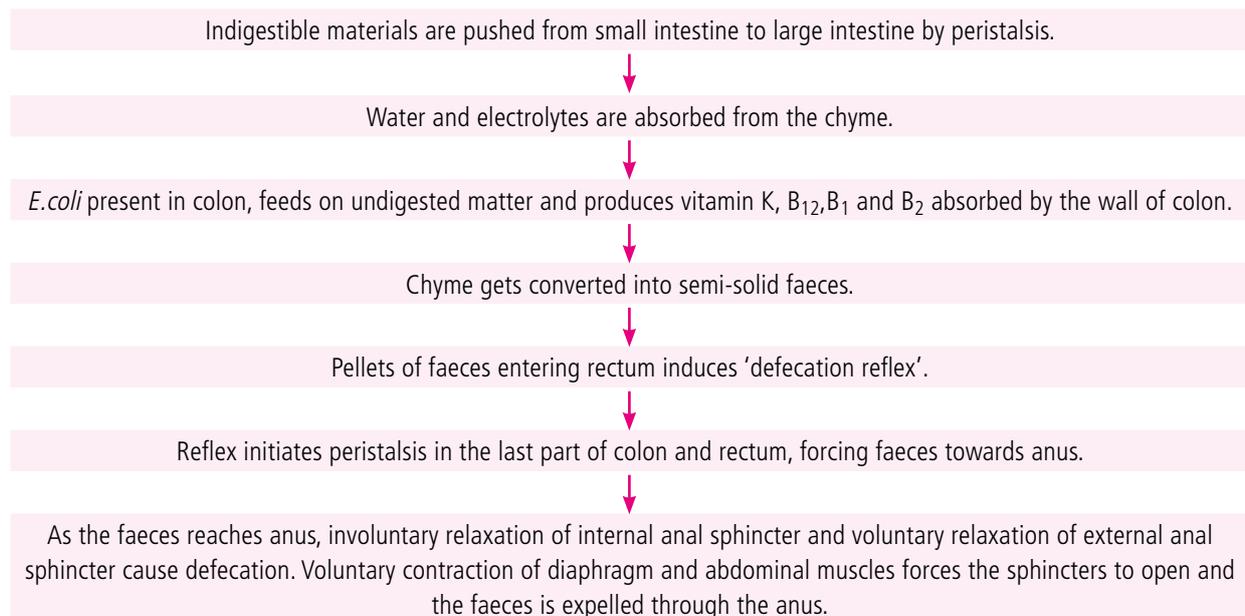


## EGESTION

The elimination of faeces from alimentary canal is called egestion or defecation.

**Faeces** comprises of about three fourth water and one fourth solid matter. **Brown colour of faeces is due to brown pigments, stercobilinogen and stercobilin, which are derivatives of bilirubin.**

## Mechanism of Egestion



# POWER EXERCISE

- Brown colour and fowl odour of faeces is due to
  - stercobilinogen
  - urea
  - HCl
  - ammonia.
- Absorption of amino acids takes place by
  - facilitated transport
  - active transport
  - osmosis
  - both (a) and (b).
- Identify A and B in the given equations.
  - Casein  $\xrightarrow{A}$  Paracasein
  - Calcium paracaseinate  $\xrightarrow{B}$  Peptones

<b>A</b>	<b>B</b>
(a) Pepsin	HCL
(b) Pepsin	Renin
(c) Rennin	Pepsin
(d) HCL	Rennin
- Read the following statements and select the correct option.
  - Lipase is present in the both pancreatic and intestinal juice.
  - Nucleic acids are digested in the stomach.
  - Elastase hydrolyses fats into fatty acids and glycerol.
  - Both (a) and (c).
- Lacteals absorb
  - amino acids
  - fatty acids and glycerol
  - glucose and fructose
  - amylose and maltose.

*(MH CET 2018)*
- Read the following statements and select the correct option.  
**Statement 1 :** Digestion of proteins does not occur in the oral cavity.  
**Statement 2 :** Saliva does not contain any protein digesting enzymes.
  - Both statements 1 and 2 are true and statement 2 is the correct explanation of statement 1.
  - Both statements 1 and 2 are true but statement 2 is not the correct explanation of statement 1.
  - Statement 1 is true and statement 2 is false.
  - Both statements 1 and 2 are false.
- Match the column I with column II and select the correct option.
 

Column I	Column II
A. Enterogastrone	(i) Increases bile secretion
B. Secretin	(ii) Inhibits glucagon secretion
C. Somatostatin	(iii) Dilates blood vessels of gut
D. Vasoactive intestinal peptide	(iv) Gastric inhibitory peptide

  - A-(iv); B-(i); C-(ii); D-(iii)
  - A-(iii); B-(ii); C-(i); D-(iv)
  - A-(ii); B-(iv); C-(iii); D-(i)
  - A-(ii); B-(iv); C-(i); D-(iii)
- Which of the following options best represents the enzyme composition of pancreatic juice?
  - Amylase, Pepsin, Trypsinogen, Maltase
  - Peptidase, Amylase, Pepsin, Rennin
  - Lipase, Amylase, Trypsinogen, Procarboxypeptidase
  - Amylase, Peptidase, Trypsinogen, Rennin *(NEET 2017)*
- Select the correct match.
 

(a) Pancreatic juice	–	Nucleosidases
(b) Intestinal juice	–	Pepsin
(c) Salivary juice	–	Elastase
(d) Gastric juice	–	Rennin
- Absorption of water occurs in the
  - small intestine
  - stomach
  - large intestine
  - all of these.
- Which of the following enzyme is not present in intestinal juice?
  - Ribonucleases
  - Aminopeptidases
  - Enterokinase
  - Dipeptidases
- Which hormones do stimulate the production of pancreatic juice and bicarbonate?
  - Angiotensin and epinephrine
  - Gastrin and insulin
  - Cholecystokinin and secretin
  - Insulin and glucagon *(NEET Phase-II 2016)*
- Select the incorrect statements.
  - The intestinal lipase converts emulsified fats into diglycerides.
  - Secretin releases bicarbonates in the pancreatic juice.
  - Vilikin accelerates the movement of villi.
  - Both (a) and (c).
- Reabsorption of vitamin B<sub>12</sub> requires
  - simple diffusion only
  - active transport only
  - combination of simple diffusion and Castle's intrinsic factor
  - none of these.
- The process by which nutrients pass from alimentary canal into the blood and lymph is called

## AIIMS New Delhi topped the medical college ranking: NIRF Ranking 2019

This year, All India Institute of Medical Sciences (AIIMS) New Delhi has clinched the first spot followed by Post Graduate Institute of Medical Education and Research (PGIMER Chandigarh) and Christian Medical College. Second time in a row, All India Institute of Medical Sciences (AIIMS) New Delhi has topped in the medical category in the National Institutional Ranking Framework (NIRF 2019). Last year, the NIRF ranking in medical, law and architecture was introduced and AIIMS New Delhi clinched the first spot with 90.71 per cent.

**Rank 1:** All India Institute of Medical Sciences (AIIMS, New Delhi)

**Rank 2:** Post Graduate Institute of Medical Education and Research (PGIMER Chandigarh)

**Rank 3:** Christian Medical College, Vellore

**Rank 4:** Sanjay Gandhi Postgraduate Institute of Medical Sciences

**Rank 5:** Amrita Vishwa Vidyapeetham

This year too, Post Graduate Institute of Medical Education and Research (PGIMER) Chandigarh and Christian Medical College, Vellore have retained their positions. However, the rankings of Kasturba Medical College and King George's Medical University, who were number 4 and 5 last year, have gone down to number 7 and 10 this year, respectively.

# CONCEPT MAP

# REGULATION OF GENE EXPRESSION IN PROKARYOTES

Gene expression is the mechanism at molecular level by which a gene is able to express itself in the phenotype of an organism. The control over the functioning of genes is called regulation of gene expression that has been extensively studied in prokaryotes. It is of three types - (i) **inducible** is the regulation that is switched on in response to the presence of substrate, (ii) **repressible** is the regulation in which the product of gene activity, if already present, stops the activity of the said gene and (iii) **constitutive** where regulation is absent, hence the gene and their enzymes remain operational throughout. Here, we will discuss about the inducible and repressible types. Regulated genes are called **operons**. Regulation may be under either negative or positive control. Under negative control, gene expression occurs unless its shut off by some regulator molecule. In contrast, under positive control, transcription occurs only if a regulator molecule directly stimulate RNA production.

## OPERON SYSTEM

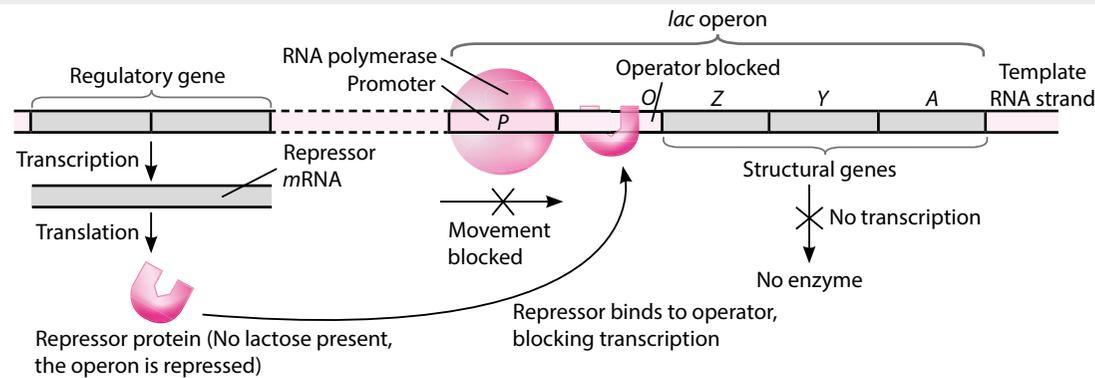
An operon is a functional unit of transcription and genetic regulation. It consists of **structural genes** that code for enzymes involved in metabolic pathway. These genes are located contiguously on stretch of DNA and are under control of **promoter**, a short segment of DNA to which RNA polymerase binds to initiate transcription. Regulation is carried out by **regulator protein** that binds to **operator region**, a short segment of DNA present between promoter and structural genes.

### INDUCIBLE OPERON SYSTEM

- Lac operon in *E.coli* is an example of inducible operon system. It has - **Structural gene** (Z, Y and A) those actually synthesise mRNAs ; **Operator gene** which directly controls the synthesis of mRNAs over the structural gene; **Promoter gene** functions as recognition center and **Regulator gene** produces inhibitor or repressor. These structural genes produce three enzymes :  $\beta$ -galactosidase for hydrolysis of lactose; permease facilitates the entry of lactose into the bacterial cell (*E. coli*) and transacetylase which may be involved in the removal of toxic byproducts of lactose digestion from the cell.

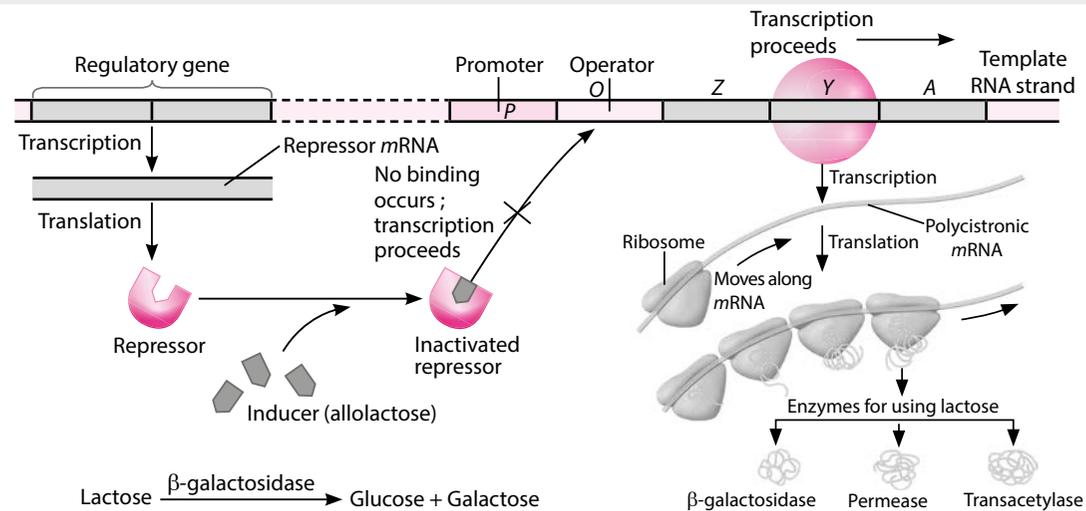
#### (a) In Absence of Lactose

The *lac* repressor is innately active and in the absence of lactose it switches off the operon by binding to the operator. The enzymes for using lactose are not made.



#### (b) In Presence of Lactose

Allolactose, an isomer of lactose, binds to the repressor, inactivating it and derepressing the operon. The inactive repressor cannot bind to the operator therefore, the genes of the *lac* operon are transcribed and the enzymes for using lactose are made.

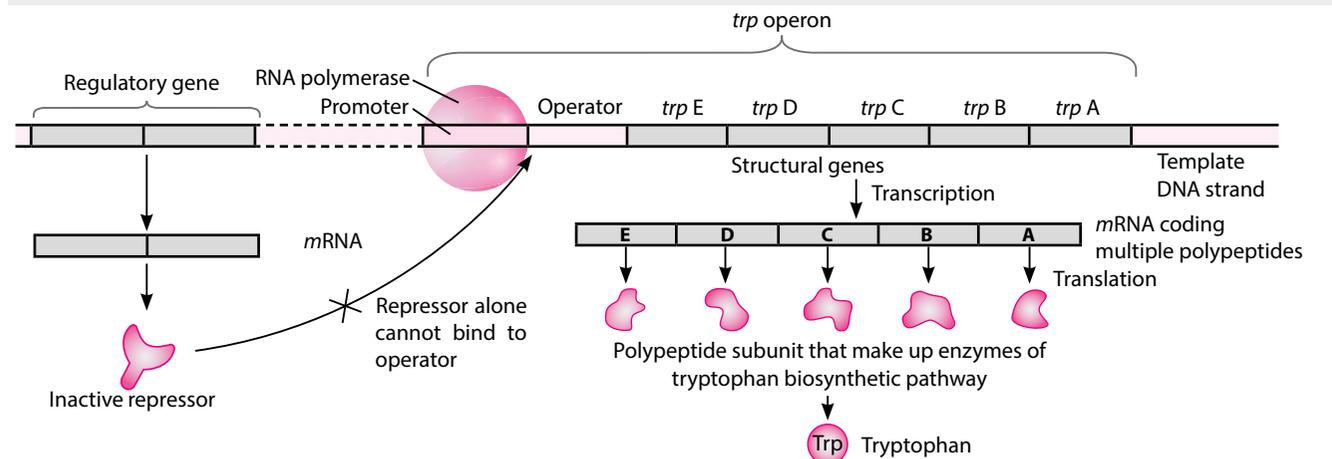


### REPRESSIBLE OPERON SYSTEM

- Tryptophan operon in *E.coli* is an example of repressible operon system by which tryptophan is synthesised. It has - structural genes *trp E, D, C, B* and *A*, forming enzymes for tryptophan biosynthesis; operator gene; promoter gene; leader attenuator complex (between operator and structural genes) which slows down the activity of polymerase enzyme; and regulator gene. The leader sequence is involved in controlling attenuator. The attenuator helps in reducing tryptophan synthesis when it is present in sufficient amount without switching off the operon.

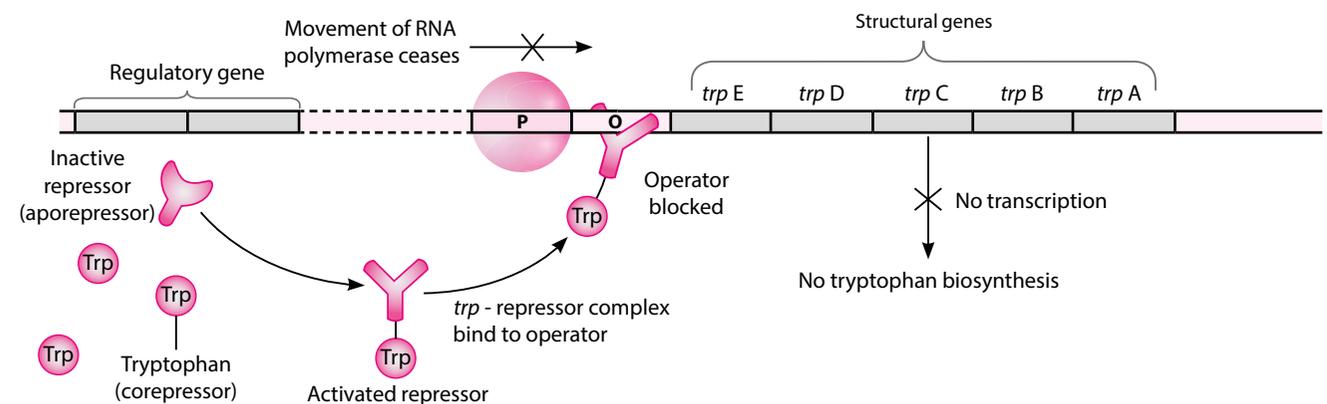
#### (a) In Absence of Tryptophan

RNA polymerase attaches to the DNA at the promoter and transcribes the operon genes. Enzymes for tryptophan synthesis are made. The five genes encoding the polypeptide subunits of the enzymes in this pathway are grouped.



#### (b) In Presence of Tryptophan

Accumulation of tryptophan, the end product of the pathway, represses transcription of the *trp* operon, thus blocking synthesis of all the enzymes in the pathway and shutting down tryptophan production.



- (a) egestion (b) absorption  
(c) assimilation (d) regulation.

16. Match the column I with column II and column III. Choose the correct option.

Column I (Substrate)	Column II (Enzyme)	Column III (Product)
1. Lactose	A. Lipase	I. Galactose
2. Monoglycerides	B. Trypsin	II. Maltose
3. Starch	C. Lactase	III. Fatty acid
4. Peptones	D. Amylase	IV. Dipeptides

(a) 1- A-I; 2-C-II; 3-B-III; 4-D-IV  
(b) 1-D-I; 2-A-II; 3-B-III; 4-C-IV  
(c) 1-C-I; 2-A-III; 3-D-II; 4-B-IV  
(d) 1-C-I; 2-A-II; 3-D-III; 4-B-IV  
(e) 1-B-I; 2-D-II; 3-C-III; 4-A-IV

(Kerala PMT 2014)

17. Which one of the following is the correct reaction?

- (a) Triglyceride  $\xrightarrow{\text{Bile}}$  Fatty acid + Glycerol  
(b) Maltose  $\xrightarrow{\text{Isomaltase}}$  Glucose + Glucose  
(c) Prorennin  $\xrightarrow{\text{HCl}}$  Rennin  
(d) Emulsified fats  $\xrightarrow[\text{lipase}]{\text{Intestinal}}$  Fatty acid + Monoglyceride

18. Maximum digestion and absorption of food takes place in

- (a) small intestine (b) large intestine  
(c) oral cavity (d) stomach.

19. Select the correct match of the digested products in humans given in column I with their absorption site and mechanism in column II.

Column I	Column II
(a) Glycerol, fatty acids	Duodenum, move as chylomicrons
(b) Cholesterol, maltose	Large intestine, active absorption
(c) Glycine, glucose	Small intestine, active absorption
(d) Fructose, Na <sup>+</sup>	Small intestine, passive absorption

(NEET 2013)

20. \_\_\_\_\_ stimulates crypts of Lieberkuhn to release enzymes into the intestinal juice.

- (a) Villikinin (b) Somatostatin  
(c) Duocrinin (d) Enterocrinin

### ANSWER KEY

1. (a) 2. (d) 3. (c) 4. (a) 5. (b)  
6. (a) 7. (a) 8. (c) 9. (d) 10. (d)  
11. (a) 12. (c) 13. (a) 14. (c) 15. (b)  
16. (c) 17. (c) 18. (a) 19. (c) 20. (d)



## What is a GMO?

GMOs are the product of a specific type of plant breeding where precise changes are made to a plant's DNA to give it characteristics that cannot be achieved through traditional plant breeding methods.

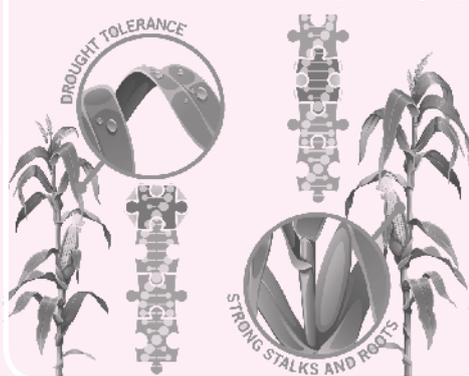
### SELECTIVE BREEDING

Plant breeders look for, select and cross-breed the best performing plants in the field, similar to how farmers have naturally improved the crops they grow since farming began.



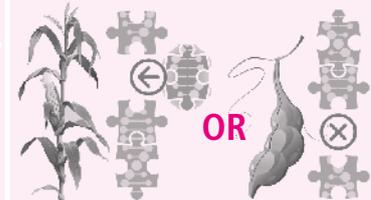
### ADVANCED BREEDING

Breeders identify and tag desirable characteristics (traits) within a plant genome. They use this information to pick which plants to cross-breed and create better performing crops.

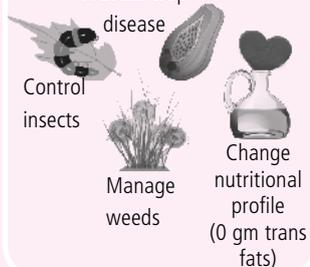


### GM PLANT BREEDING

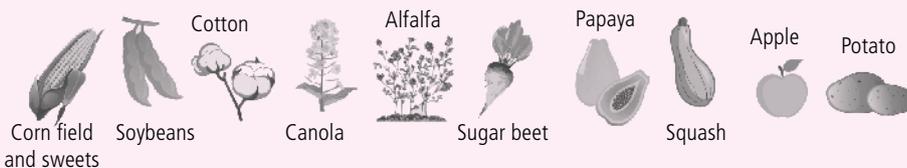
If a plant needs a trait that cannot be achieved through advanced breeding, a gene can be turned off or moved, or a gene from another source can be inserted.



GMOs can help farmers...  
Prevent crop



There are eight GMO crops available in the U.S. today with two more approved and coming to market soon





# BIO Digest

This article covers high yield facts of the given topic.

## Sexual Reproduction in Flowering Plants

- Reproduction is the process in which organisms produce offspring similar to themselves. In flowering plants, reproduction is of two types - **asexual** and **sexual**.
- The process of development of new organisms through the formation and fusion of gametes is called **sexual reproduction**.
- The events taking place during sexual reproduction can be classified into – pre-fertilisation, fertilisation and post-fertilisation events.
- Sepals and petals are called **non-essential floral organs** because they have only a supportive role.

### PRE-FERTILISATION : STRUCTURES AND EVENTS

- In angiosperms, the organs specialised to perform sexual reproduction are **flowers** that are modified condensed reproductive shoots.
- A typical flower has a broad base called **thalamus** over which four whorls of floral leaves, *i.e.*, sepals (calyx), petals (corolla), stamens (androecium) and carpels (gynoecium) are borne.
- Stamens and carpels represent male and female reproductive structures of flowers respectively. They are called **essential floral organs**.

#### Homologies of flower parts

- |                            |   |                             |
|----------------------------|---|-----------------------------|
| • Carpel                   | : | Megasporophyll              |
| • Ovule                    | : | Integumented megasporangium |
| • Embryo sac               | : | Female gametophyte          |
| • Egg                      | : | Female gamete               |
| • Stamen                   | : | Microsporophyll             |
| • Pollen or pollen grain   | : | Microspore                  |
| • Germinating pollen grain | : | Male gametophyte            |

#### Stamen-The Male Reproductive Organ

- Stamen consists of two parts-**filament** and **anther**.
- Filament is long and slender stalk attached proximally to thalamus, petal or tepal. It bears an anther distally.
- Anther is bilobed, knob-like fertile part of the stamen. The two anther lobes separated by a deep groove in the anterior side and attached to each other by a sterile parenchymatous tissue called **connective** on the posterior side.

- Each anther lobe has two chambers which possess **pollen sacs** or **microsporangia**. A bilobed anther is **tetrasporangiate**.
- A microsporangium or pollen sac is a cylindrical sac which appears circular in transverse section. It consists of two parts : outer wall and central homogeneous sporogenous tissue.
- The outer wall has four types of layers; epidermis, endothecium, 1-3 middle layers and tapetum.
- The outer three layers protect the young anther and take part in the mechanism of dehiscence in the ripe anther.
- The endothecium is also called **fibrous layer** due to the presence of fibrous thickenings.
- The tapetal cells enlarge and become filled with dense protoplasmic content as well as nutrients.
- Two types of tapetum are present: **amoeboid** and **secretory**.
- Tapetum provides nourishment to the developing microspore mother cells and pollen grains either by forming a plasmodium (amoeboid type) or through diffusion (secretory type).
- It produces lipid rich Ubisch granules containing sporopollenin for exine formation.
- It secretes enzymes like **callose** responsible for degradation of callose wall around pollen tetrad.

### Microsporogenesis

- The process of formation of pollen grains through meiosis in pollen mother cells is termed as **microsporogenesis**.
- Sporogenous tissue within the anther grow and transform into **pollen mother cells (PMC)** which in turn produce

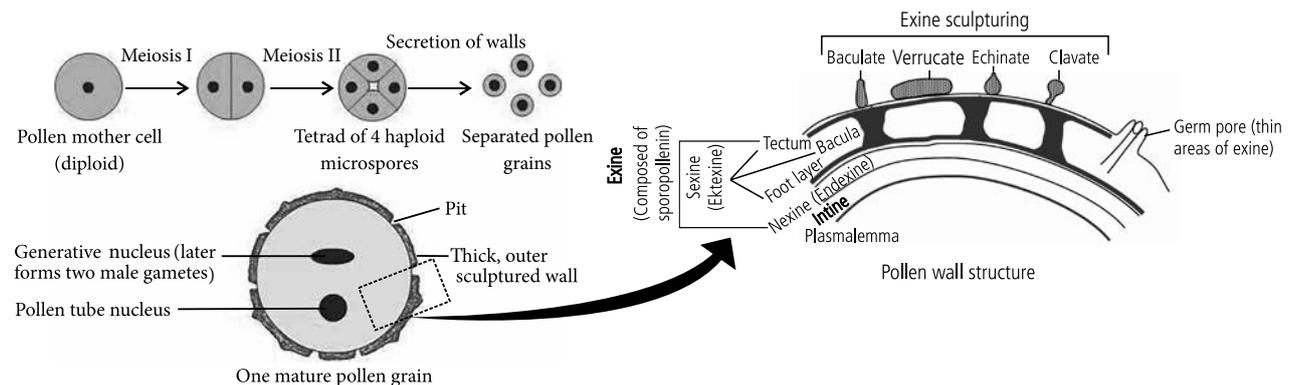


Fig. : Microsporogenesis and section of mature pollen grain containing 2-celled male gametophyte

### Structure and development of male gametophyte

- Development of male gametophyte is precocious, *i.e.*, it begins inside the microsporangium or pollen sac.
- Young pollen grain has a centrally placed nucleus embedded in dense cytoplasm covered by plasma membrane.
- It grows in size with the inflow of nutrients and eventually

tetrads of haploid **microspores** or **pollen grains**.

- The pollen grains of a tetrad grow and separate from one another.
- Usually the arrangement of microspores in a tetrad is tetrahedral or isobilateral. However, decussate, linear and T-shaped tetrads are also found.

### Structure of pollen grain

- Mature anther has two cavities, therefore, it is called **ditheous**.
- Pollen grain is commonly globular in outline though several other shapes are found.
- Covering of pollen grain is called sporoderm consisting of two layers, outer **exine** and inner **intine**.
- Intine is pecto-cellulosic in nature while exine is made of a highly resistant fatty substance called **sporopollenin**. Because of sporopollenin, pollen grains are well preserved as microfossils as sporopollenin is not affected by any enzyme, high temperature, strong acid or strong alkali.
- Exine is further differentiated into outer ektexine (sexine) and inner endexine (nexine). Ektexine is made up of an inner continuous **foot layer**, middle discontinuous **baculate** layer and outermost discontinuous **tectum**.
- Pollen grain is uninucleate in the beginning but at the time of liberation from anther it is 2-3 celled.

### Exine Sculpturing

The exposed surface details of the pollen wall constitute the exine sculpturing. Some of the important types of exine sculpturing are: baculate (rod-like elements), verrucate (warty), echinate (spiny), clavate (club-shaped swollen tip), punctuate (minute perforations), etc.

protoplast divides mitotically to form two unequal cells—small **generative cell** and large **tube** or **vegetative cell**.

- The generative cell is spindle shaped to spherical in outline with thin dense cytoplasm surrounding a prominent nucleus.
- The tube cell has a vacuolate cytoplasm rich in the food reserves and cell organelles. Its nucleus is large and irregular.

- In some species the generative cell divides into two non-motile male gametes prior to the dehiscence of anther and release of the pollen grains.
- Therefore, at the time of pollination, the pollen grain is either 2-celled (tube cell + generative cell) or 3-celled (tube cell + two male gametes).
- On the stigma the compatible pollen grain absorbs water and nutrients from the stigmatic secretion through its germ pores.
- The tube or vegetative cell enlarges and comes out of the pollen grain through one of the germ pores to form a **pollen tube** covered over by intine.
- The tube nucleus along with generative cell descend to the tip of the pollen tube.
- The generative cell soon divides into two non-motile male gametes if it is not already divided.
- Each male gamete has a large nucleus surrounded by a thin sheath of cytoplasm and is considered to be one cell.
- The tube nucleus may degenerate completely.
- A pollen grain with pollen tube carrying male gametes represent mature male gametophyte and is 3 celled (1 tube cell and 2 male gametes) and 3 nucleated structure.

### Pistil - The Female Reproductive Organ

- Gynoecium represents the female part of a flower.
- The free unit of gynoecium is called pistil and it has three parts-**stigma**, **style** and **ovary**.
- Stigma is the terminal receptive part of the pistil which functions as landing platform for the pollen grains. The style is the elongated slender part beneath the stigma that connects stigma with the ovary. The basal bulged part of the pistil is the ovary.
- Inside the ovary lies the **ovarian cavity (locule)**. The placenta is located inside the locule.
- From the placenta megasporangia arises, commonly called **ovules**.
- The number of ovules in an ovary may be one (wheat, paddy, mango) to many (papaya, watermelon, orchids).

### Structure of ovule

- A typical angiosperm ovule is a small structure attached to the placenta by means of stalk called **funicle**. The body of the ovule fuses with funicle and the point of attachment is called **hilum**.
- The body of the ovule consists of a mass of parenchymatous cells named **nucellus**.
- Nucellus is surrounded by one (unitegmic ovule, *e.g.*, higher dicots) or two (bitegmic ovule, *e.g.*, monocots and primitive dicots) multicellular integuments.
- The integuments leave a narrow passage known as **micropyle** at one end of the ovule.
- The place of origin of the integuments usually lies at the opposite end of micropyle, termed as **chalaza**.

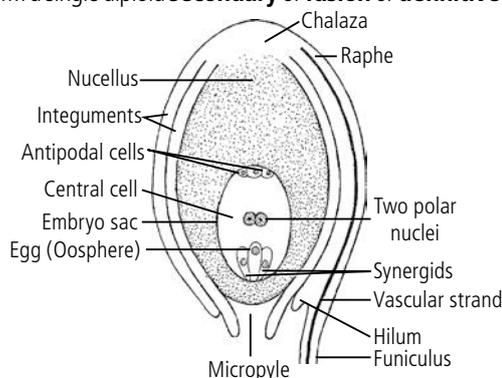
- Embryo sac or female gametophyte is present in the micropylar half of nucellus.
- Depending upon the configuration and orientation of the body of ovule in relation to funiculus there are six types of ovules in angiosperms - orthotropous (erect), anatropous (inverted), hemitropous (half-inverted), campylotropous (body curved), amphitropous (both body and embryo sac curved), circinotropous (funiculus coiled around the ovule).

### Megasporogenesis

- The process of formation of haploid megaspores from the diploid megaspore mother cell is called **megasporogenesis**.
- Generally, a single megaspore mother cell (MMC) differentiates in the micropylar region of the nucellus.
- The megaspore mother cell undergoes meiotic division which results in the production of four haploid **megaspores**.
- In majority of angiosperms, only one of the megaspores is functional while the other three degenerate.

### Megagametogenesis

- The functional megaspore develops into the female gametophyte (embryo sac).
- The formation of embryo sac from a single megaspore is called monosporic development.
- The female gametophyte or embryo sac contains 8 nuclei 7 cells (3 micropylar, 3 chalazal and one central).
- The three micropylar cells are known as **egg apparatus**. The middle cell of the egg apparatus is called **egg** which is larger with a central vacuole and a nucleus towards the chalazal end while the remaining two cells are called **synergids**.
- Each of the synergids bears a filiform apparatus in the micropylar region which is a mass of finger-like projections of the wall into the cytoplasm.
- The three chalazal cells of the embryo sac are called **antipodal cells**.
- The central cell is the largest cell of the embryo sac.
- The central cell contains two polar nuclei which often fuse to form a single diploid **secondary or fusion or definitive** nuclei.



**Fig.:** Structure of a typical ovule (anatropous ovule) prior to fertilisation.

**Table :** Major contributions of scientists in plant reproduction

S.No.	Scientist	Year of discovery	Contribution
(i)	Camerarius	1694	Sexual reproduction in angiosperms
(ii)	G.B. Amici	1822	Discovery of pollen tube
(iii)	S.G. Nawaschin	1898	Double fertilisation in angiosperm
(iv)	Schnarf	1929	Organogenic development of four-celled stage of embryo
(v)	Johansen	1945	Embryo development
(vi)	Panchanan Maheshwari	1950	Embryo development

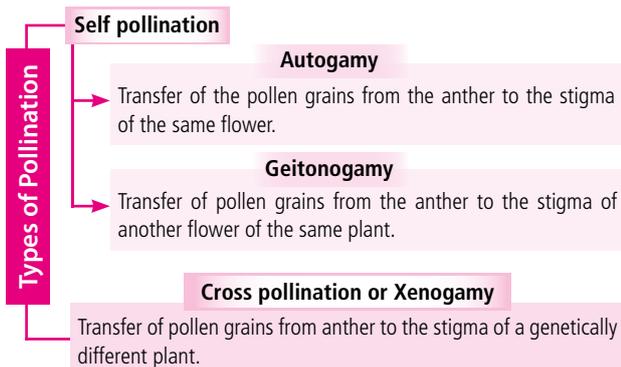


## INTEXT PRACTICE QUESTIONS

1. Define connective with respect to stamen.
2. How many cells constitute male gametophyte?
3. What are the components of an egg apparatus?

## POLLINATION

- The transfer of pollen grains from the anther to the stigma is called **pollination**.



- Some plants such as *Oxalis*, *Viola* and *Commelina* produce two types of flower - **chasmogamous** flowers with exposed anthers and stigma and **cleistogamous** flowers which do not open at all.
- Cleistogamous flowers are invariably autogamous as there is no chance of cross-pollen landing on the stigma.

### Agents of Pollination

- Xenogamy** or **cross pollination** is performed with the help of an external agency which may be abiotic (wind, water) or biotic (animals).
- Cross pollination is named after the agency that assists it, e.g., anemophily (wind pollination), hydrophily (water pollination), entomophily (insect pollination), ornithophily (bird pollination), chiropterophily (bat pollination) and malacophily (snail pollination). Cross pollinating flowers with different agencies have different characteristic features.

### Characteristics of cross pollinating flowers

#### Anemophilous flowers

- Flowers are small and inconspicuous.
- Pollen grains are dry, light and non sticky.
- Well exposed stamens.
- Large, often feathery stigma to trap air-borne pollen grains.
- Single ovule in each ovary and numerous flowers packed into an inflorescence.
- Common in grasses.

#### Hydrophilous flowers

- Flowers are small and inconspicuous.
- Pollen grains are long, ribbon-like and protected from wetting by a mucilaginous covering.
- Stigma is long, sticky but unwettable.
- Observed in *Vallisneria*, *Zostera*, *Ceratophyllum*.

#### Entomophilous flowers

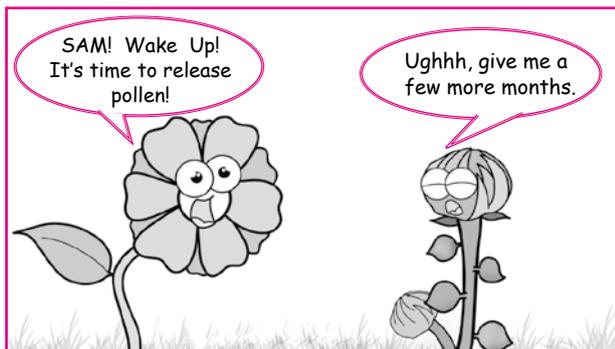
- Flowers are large, colourful, fragrant and rich in nectar.
- The flowers produce an odour which may be pleasant or foul.
- When the flowers are small, a number of flowers are clustered together into an inflorescence to make them conspicuous.
- Observed in jasmine, *Rosa*, *Magnolia*, etc.

### Outbreeding Devices or Contrivances to Ensure Cross Pollination

- Continuous self-pollination** results in inbreeding depression. Therefore, angiosperms have developed many devices to discourage self-pollination and encourage cross-pollination.
- Dichogamy** - Pollen release and stigma receptivity are not synchronised in some species. Either the pollen is released before the stigma becomes receptive or stigma becomes receptive much before the release of pollen. In protandry,

anthers mature earlier than stigma of the same flower, *e.g.*, sunflower; in protogyny stigma mature earlier, *e.g.*, *Mirabilis*.

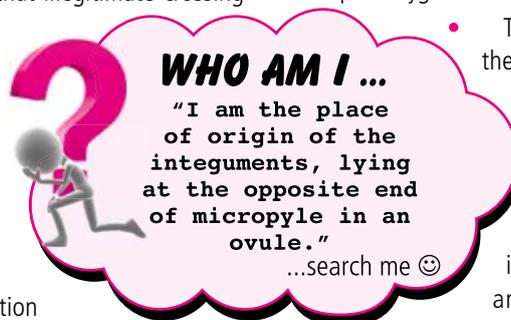
- **Heterostyly** - In some species, the anther and stigma are placed at different positions so that the pollen cannot come in contact with the stigma of the same flower, *e.g.*, *Primula*, *Lythrum*.
- **Self incompatibility** - This is a genetic mechanism that prevents self-pollen (from the same flower or other flowers of the same plant) from fertilising the ovules by inhibiting pollen germination or pollen tube growth in the pistil, *e.g.*, tobacco, potato.



- **Dicliny** - Flowers are unisexual so that self-pollination is not possible. The plants may be monoecious (bearing both male and female flowers, *e.g.*, maize) or dioecious (bearing male and female flowers on different plants, *e.g.*, mulberry, papaya).
- **Prepotency** - Pollen grains of another flower germinate more rapidly than the pollen grains of the same flower over the stigma, *e.g.*, apple, grape.
- **Herkogamy** - The different mechanical devices to prevent self-pollination and promote cross pollination, *e.g.*, stigma lies inside a flap in pansy, anthers occurs inside corolla pocket in *Kalmia*.

### Pollen - Pistil Interaction

- It is a dynamic process that occurs from the time of pollen deposition over the stigma to the time of pollen tube entry into ovule.
- It is a safety measure to ensure that illegitimate crossing do not occur.
- Pollen grains of a number of plants may settle over a stigma.
- Pollen - pistil interaction ensures that only the right pollen belonging to same species would germinate while others fail to do so.
- Knowledge of pollen-pistil interaction



is helpful to plant breeders in manipulating pollen growth even in incompatible cases.

### Artificial hybridisation

- Artificial hybridisation has been used by plant breeders for crop improvement programme.
- In artificial hybridisation, it is important to make sure that only the desired pollen grains are used for pollination and the stigma is protected from contamination.
- This is achieved by emasculation and bagging technique.
- **Emasculation** is removal of stamens from the floral buds of female parent (if the female parent bears bisexual flowers) so that chances of self-pollination are eliminated.
- **Bagging** is covering of emasculated flowers with a bag made of butter paper to prevent contamination of its stigma with unwanted pollens.
- When the stigma of bagged flower attains receptivity, mature pollen grains collected from the anthers of the male parent flower are dusted on the stigma and the flowers are rebagged and the fruits are allowed to develop.

### FERTILISATION

- Fertilisation is the fusion of male and female gametes. In seed plants, *i.e.*, gymnosperms and angiosperms, the male gametes are brought to the egg containing female gametophyte by a pollen tube (Strasburger, 1884). This phenomenon is called **siphonogamy**.
- The pollen tube carrying the male gametes enters the ovule either through its micropyle (porogamy, *e.g.*, lily), chalaza (chalazogamy *e.g.*, *Casuarina*) or the sides after piercing through the integuments or funicle *i.e.*, mesogamy (*e.g.*, *Cucurbita*).
- Usually the pollen tube enters the embryo sac by passing into one of the two synergids.
- The pollen tube releases the two male gametes into the cytoplasm of the synergid.
- One of the male gametes moves towards the egg cell and fuses with its nucleus resulting in the formation of diploid zygote.
- The other male gamete moves towards the two polar nuclei located in the central cell and fuses with them to produce a triploid primary endosperm nucleus.
- Since two types of fusion takes place (syngamy and triple fusion) in an embryo sac, the phenomenon is termed as **double fertilisation**, an event unique to angiosperms.

- The primary endosperm nucleus develops into the endosperm while the zygote develops into an embryo.

## POST-FERTILISATION : STRUCTURES AND EVENTS

- Following double fertilisation, events of endosperm and embryo development, maturation of ovule(s) into seed(s) and ovary into fruit, are collectively termed as **post-fertilisation events**.
- The development of endosperm precedes embryo development since the cells of endosperm are filled with reserve food materials that are used for the nutrition of developing embryo.
- In the most common type of endosperm development, the primary endosperm nucleus undergoes successive nuclear divisions to produce a large number of free nuclei without cell wall. This stage of endosperm development is called **free nuclear endosperm**.
- Cell wall formation occurs subsequently and the endosperm becomes cellular.
- The coconut water from tender coconut is free-nuclear endosperm and the surrounding white kernel is the cellular endosperm.
- Embryo develops at the micropylar end of the embryo sac where the zygote is situated.
- The early stages of embryo development are similar in both monocotyledons and dicotyledons.
- A typical **dicotyledonous embryo** consists of an **embryonal axis** and two **cotyledons**. The portion of the embryonal axis above the level of cotyledons is the **epicotyl**, which terminates with the **plumule** or stem tip. The cylindrical portion below the level of cotyledons is **hypocotyl** that terminates at its lower end in the **radicle** or root tip. The root tip is covered with a root cap.
- Only one cotyledon is present in embryos of **monocotyledons**. In the grass family, the cotyledon is called **scutellum**. At its lower end the embryonal axis has the radicle and root cap enclosed in an undifferentiated sheath called **coleorrhiza**.
- The portion of the embryonal axis above the level of attachment of scutellum is the epicotyl. Epicotyl has a shoot apex and a few leaf primordia enclosed in a hollow foliar structure, the **coleoptile**.
- The seed is the final product of sexual reproduction in angiosperms.
- Seeds are often described as fertilised ovules and are formed inside fruits.

- A seed typically consists of seed coat(s), cotyledon(s) and an embryo axis.
- As ovules mature into seeds, the ovary develops into a fruit.
- The wall of the ovary develops into the wall of fruit called **pericarp**.
- In most plants, by the time the fruit develops from the ovary, other floral parts degenerate and fall off.
- However, in few species such as apple, cashew, strawberry, etc., the thalamus also contributes to fruit formation. Such fruits are called **false fruits**.
- In contrast, **true fruits** develop only from the ovary.
- In few species, fruits develop without fertilisation. Such fruits are called **parthenocarpic fruits**, e.g., banana.

### Albuminous and non-albuminous seeds

- Mature seeds may be albuminous or non-albuminous. Albuminous seeds retain a part of endosperm as it is not completely used up during embryo development (e.g., wheat, maize, barley, castor, sunflower). Non-albuminous seeds have no residual endosperm as it is completely consumed during embryo development (e.g., pea, groundnut). Occasionally, in some seeds such as black pepper, remnants of nucellus are also persistent. This residual persistent nucellus is the perisperm.

## APOMIXIS AND POLYEMBRYONY

- A few flowering plants such as some species of asteraceae and grasses have evolved a mechanism to produce seeds without fertilisation called **apomixis**.
- There are several methods of apomictic development in seeds, two common methods are recurrent agamospermy and adventive embryony.
- **Agamospermy** is the formation of seed that has an embryo formed without meiosis and syngamy.

### Agamospermy

#### Non-recurrent agamospermy

- The embryo is haploid and therefore the seed having it is non-viable.

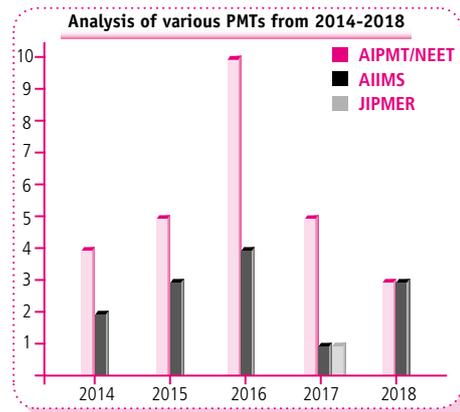
#### Recurrent agamospermy

- All the cells of the embryo sac are diploid as it is formed directly either from a nucellar cell (apospory) or diploid megaspore mother cell (diplospory).
- The diploid egg as well as other diploid cells of embryo sac can grow into normal embryos.

- Formation of embryo directly from diploid egg without fertilisation is called **diploid parthenogenesis**, e.g., apple, *Poa*.
- **Adventive embryony** - An embryo develops directly from a diploid cell other than egg like that of nucellus

and integument, e.g., *Citrus*, *Opuntia*. It gives rise to a condition called **polyembryony** or the phenomenon of having more than one embryo.

- In gymnosperms, polyembryony can also occur due to cleavage of growing embryo. It is called **cleavage polyembryony**.
- Occurrence of polyembryony due to fertilisation of more than one egg is called **simple polyembryony** while formation of extra embryos through sporophytic budding is called **adventive polyembryony**.
- Polyembryony is common in onion, groundnut, mango, lemon, orange.



## INTEXT PRACTICE QUESTIONS

4. What is the outbreeding device in *Mirabilis*?
5. Name the agents of cross pollination in *Magnolia*.
6. Define non-recurrent agamospermy.

## Watermelon



A great summer thirst quencher and so much more.

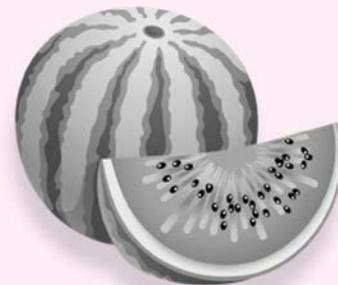
### One cup of watermelon contains:

- 43 calories,
- 0 gram of fat
- 1 gram of fibre
- 2 gram of sodium
- 11 gram of carbohydrate
- 17% of vitamin A
- 21% of vitamin C (RDA)
- 1% of calcium (RDA)
- 2% of iron (RDA)

Watermelons were first cultivated in Egypt. They were so revered there that they were placed in the tombs of many pharaohs.

### REMEMBER

Storing watermelons in room temperature increases the amount of lycopene and betacarotene.



They contain vitamin C (which gives your immune system a boost).  
Vitamin A (which is necessary for healthy eyes).  
and vitamin B6 (which improves brain function).

They have the highest concentration of lycopene of any fresh fruit or vegetable.

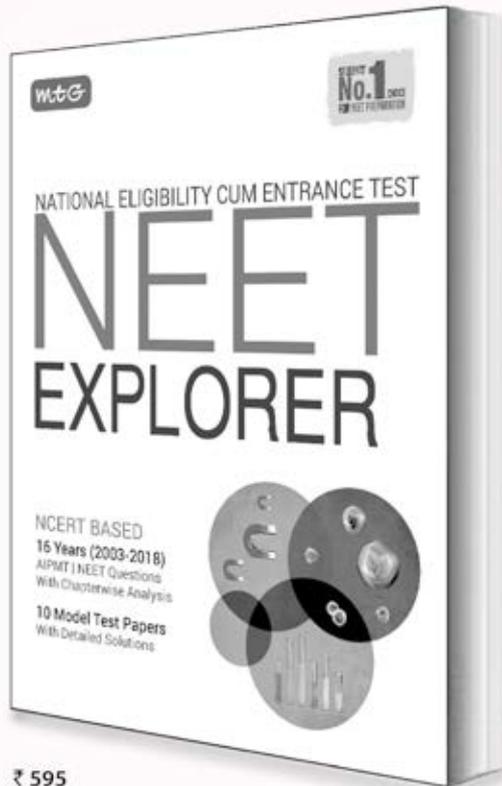
Watermelons are rich in electrolytes (sodium and potassium).

Choline in watermelons aids our bodies in sleep, muscle movement, learning and memory.

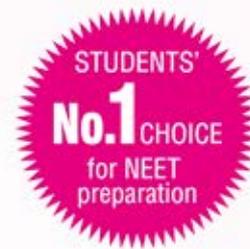
Research shows that watermelon extract may significantly reduce blood pressure.

Their high water and fibre content promotes regularity for a healthy digestive tract.

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## HIGHLIGHTS:

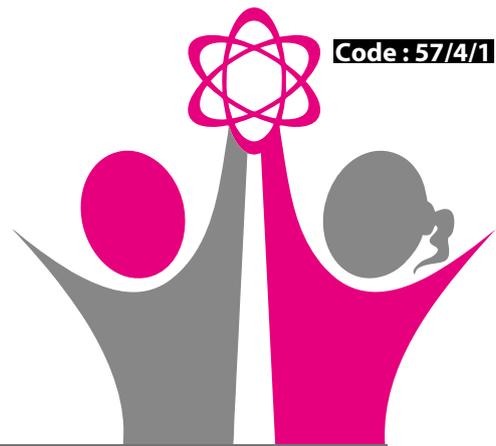
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Time Allowed : 3 hours

Maximum Marks : 70

### GENERAL INSTRUCTIONS

- (i) The entire set of questions and four sections in the question paper. All questions are compulsory.
- (ii) Section A contains questions numbered 1 to 5, very short-answer type questions of 1 mark each.
- (iii) Section B contains questions numbered 6 to 8, short-answer type questions of 2 marks each.
- (iv) Section C contains questions numbered 9 to 11, short-answer type II questions of 3 marks each.
- (v) Section D contains questions numbered 12 to 14, long-answer type questions of 5 marks each.
- (vi) There is no overall choice in the question paper, however, an internal choice is provided in two questions of 1 mark, two questions of 2 marks, four questions of 3 marks and all the three questions of 5 marks. In these questions, an examinee is to attempt any one of the two given alternatives.  
Whenever a choice is given, the drawing should be taken as a guide to the proper labeling.

### SECTION - A

1. State from where do the signals for parturition originate in human females.
2. Name the pattern of inheritance where  $F_1$  phenotype  
(a) resembles only one of the two parents.  
(b) does not resemble either of the two parents and is in between the two.
3. According to the Hardy-Weinberg principle, the allele frequency of a population remains constant. How do you interpret the change of frequency of alleles in a population?

OR

Coelacanth was caught in South Africa. State the significance of discovery of Coelacanth in the evolutionary history of vertebrates.

4. State the functions of mast cells in allergy response.

OR

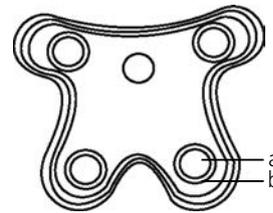
State the function of interferons.

5. What is the cell that receives a recombinant gene called?

### SECTION - B

6. Name a disorder a human suffers from as a result of monosomy of the sex chromosome. Give the karyotype and write the symptoms.

7. In the T.S. of a mature anther given below, identify "a" and "b" and mention their functions.



OR

What is cleistogamy? Write one advantage and one disadvantage of it, to the plant.

8. State the role of thymus as a lymphoid organ. Name the cells that are released from it and mention their function.
9. "Artificial insemination helps overcome several problems of normal mating in cattle". Do you agree? Support your answer with any three reasons.
10. Name and explain the interaction, that is seen between clownfish and sea anemones.
11. Write the relationship between productivity, gross primary productivity, net primary productivity and secondary productivity.

12. Justify the need for signing 'Montreal Protocol' by the participating nations in 1987.

OR

Write the effective remedy found by Ahmed Khan of Bengaluru for the efficient use of the plastic waste generated by big cities.

### SECTION - C

13. Emasculation and bagging are the two important steps carried during artificial hybridisation to obtain superior varieties of desired plants. Explain giving reasons, in which types of flowers and at what stages are the two processes carried out.

OR

State what is apomixis. Write its significance. How can it be commercially used?

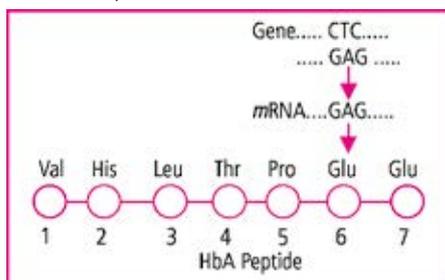
14. (a) Draw a sectional view of human ovary. Label the following parts:  
 (i) Primary follicle (ii) Secondary oocyte  
 (iii) Graafian follicle (iv) Corpus luteum

- (b) Name the hormones influencing follicular development of corpus luteum.

OR

- (a) Draw an L.S. of pistil showing pollen tube entering into the embryo sac. Label the following.  
 (i) Nucellus (ii) Antipodals  
 (iii) Synergids (iv) Micropyle
- (b) Write the functions of the following.  
 (i) Synergids  
 (ii) Micropyle

15. Given below is the representation of a relevant part of amino acid composition of the  $\beta$ -chain of haemoglobin, related to the shape of human red blood cells.



- (a) Is this representation of the sequence of amino acids indicating a normal human or a sufferer from a certain blood related genetic disease? Give reason in support of your answer.
- (b) Why is the disease referred to as Mendelian disorder? Explain.

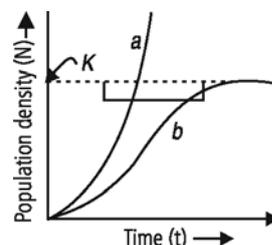
OR

Name the kind of diseases/disorders and any two symptoms that are likely to occur in humans if

- (a) Mutation in the gene that codes for an enzyme phenylalanine hydroxylase occurs.  
 (b) The karyotype is XXY.

16. Name the technique and the property of plant cells that can help to grow somaclones of certain desired variety of apple. Explain how somaclones of apple can be obtained in the lab so as to get the desired variety on a large scale.

17. Study the graph given below and answer the questions that follow:



- (a) The curve 'b' is described by the following equation:

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

What does 'K' stand for in this equation? Mention its significance.

- (b) Which one of the two curves is considered a more realistic one for most of the animal populations?
- (c) Which curve would depict the population of a species of deer if there are no predators in the habitat? Why is it so?
18. "A very small sample of tissue or even a drop of blood can help determine paternity". Provide a scientific explanation to substantiate how it is possible.
19. Explain the phenomena of dominance, multiple allelism and co-dominance taking human ABO blood group as an example.
20. Name the genus to which baculoviruses belong. Describe their role in the integrated pest management programmes.
21. Give reasons why:  
 (a) DNA cannot pass into a host cell through the cell membrane.  
 (b) Proteases are added during isolation of DNA for genetic engineering.  
 (c) Single cloning site is preferred in a vector.
22. State the medicinal value and the bioactive molecules produced by *Penicillium notatum*, *Monascus purpureus* and *Trichoderma polysporum*.

23. Describe the roles of (a) high temperature, (b) primers, and (c) bacterium *Thermus aquaticus* in carrying the process of polymerase chain reaction.

OR

How does  $\beta$ -galactosidase coding sequence act as a selectable marker? Why is it a preferred selectable marker to antibiotic resistance genes? Explain.

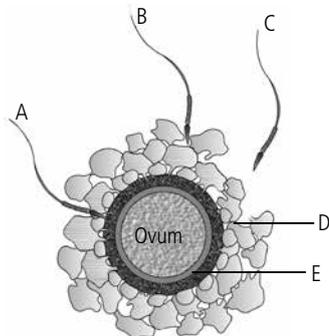
24. Answer the following questions based on Meselson and Stahl's experiment on *E.coli*:
- Write the name of the chemical substance used as the only source of nitrogen in the experiment.
  - Why did they allow the synthesis of the light and the heavy DNA molecules in the organism?
  - How did they distinguish the heavy DNA molecules from the light DNA molecules? Explain.
  - Write the conclusion the scientists arrived at, at the end of the experiment.

#### SECTION - D

25. Describe the process of megasporogenesis upto fully developed embryo sac formation in an angiosperm.

OR

Given below is the diagram of a human ovum surrounded by a few sperms. Study the diagram and answer the following questions:



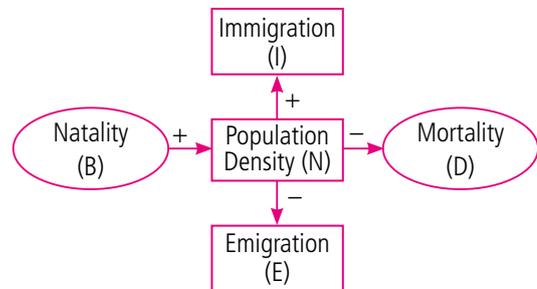
- Which one of the sperms would reach the ovum earlier?
  - Identify 'D' and 'E'. Mention the role of 'E'.
  - Mention what helps the entry of sperm into the ovum and write the changes occurring in the ovum during the process.
  - Name the specific region in the female reproductive system where the event represented in the diagram takes place.
26. Study the schematic representation of the genes involved in the *lac* operon given below and answer the questions that follow:



- Identify and name the regulatory gene in this operon. Explain its role in 'switching off' the operon.
- Why is the *lac* operon's regulation referred to as negative regulation?
- Name the inducer molecule and the products of the genes 'z' and 'y' of the operon. Write the functions of these gene products.

OR

- How does the Hardy-Wienberg equation explain genetic equilibrium?
  - Describe how this equilibrium is disturbed that may lead to founder effect.
27. (a) Study the flow chart given below and complete the equation that follows by identifying 1, 2, 3 and 4.



$$N_{t+1} = N_t + \{(1 + 2) - (3 + 4)\}$$

- Mention the different ways by which the population density of different species can be measured.

OR

- 'The pyramid of energy is always upright'. Explain.
- Explain with the help of labelled diagrams, the difference between an upright pyramid of biomass and an inverted pyramid of biomass.

#### SOLUTIONS

- The signals for parturition originate from the fully developed fetus and the placenta which induce mild uterine contractions called fetal ejection reflex.
- Complete dominance
  - Incomplete dominance
- Change of frequency of alleles in a population will result in natural selection leading to the evolution.

OR

- Coelacanth (lobe-fin) is considered to be the connecting link between fishes and the first four-limbed animals (amphibians). These were the ancestors of modern day frogs and salamanders.
- In allergy response, mast cells release histamine that causes dilation of arteries.

OR

Interferons are the low molecular weight proteins produced by virus infected cells. They protect non-infected cells from further viral infections.

5. Genetically modified cell or recombinant cell

6. Turner's syndrome is caused due to the absence of one of X (sex) chromosomes (monosomy). The individual has 22 pairs of autosomes and XO sex chromosomes *i.e.*, 45 chromosomes. So, the karyotype is  $44 + XO$ .

Symptoms are sterile females, rudimentary ovaries, underdeveloped breasts, etc.

7. In the given figure, 'a' represents sporogenous tissue and 'b' represents tapetum. Sporogenous tissue (a) fills the whole interior of the microsporangium. Its cells divide with the growth of anther and increase their number. Ultimately, they are transformed into microspore or pollen mother cells (PMC). Microspore mother cells undergo meiosis to produce haploid microspores or pollen grains.

Tapetum (b) helps in nourishment of the developing microspore mother cells and pollen grains. It also produces lipid rich Ubisch granules containing sporopollenin for exine formation.

OR

Cleistogamy is the condition where pollination occurs in closed flowers, that do not open at all. In such flowers, the anthers and stigma lie close to each other.

Advantage – seed setting is assured even in the absence of pollinators as pollen on maturity will always reach the stigma due to their close placement.

Disadvantage – it does not allow cross pollination, thereby restricting chances of genetic variability.

8. Thymus is a primary lymphoid organ where the maturation of T-lymphocytes takes place. Thymus is quite large in size at the time of birth but it atrophies with age.

T-lymphocytes are released from thymus. These cells provide cell-mediated immunity and defend against pathogens including protists and fungi that enter the cells.

9. Yes, artificial insemination helps us overcome several problems of normal matings in cattle. It involves insemination of semen from superior bulls of exotic or indigenous breeds into the reproductive tract of the selective cow.

The three reasons are as follows–

(i) It increases the rate of conception and considerably fewer sperms are required to achieve conception.

(ii) It controls the spread of certain diseases and also ensures good quality of progeny.

(iii) It is very economical as it excludes the need for importing and maintaining the bulls.

10. Commensalism is the interaction between clownfish and sea anemone. The clownfish lives among the stinging tentacles of sea anemone and gets protection from its predators which stay away from the stinging tentacles. The sea anemone does not appear to derive any benefit by hosting the clownfish.

11. Productivity is the rate of biomass production per unit area in unit time at any trophic level. It can be divided into gross primary

productivity and net primary productivity.

Gross primary productivity (GPP) is the total organic matter synthesised by producers, in the process of photosynthesis per unit time and area. While net primary productivity (NPP) is the weight of the organic matter stored by the producers in a unit area/volume per unit time. It is equal to the rate of organic matter synthesised during photosynthesis, *i.e.*, gross primary productivity minus the rate of respiration and other losses, *i.e.*,  $NPP = GPP - R$

Secondary productivity is the rate of formation of new organic matter by consumers. It depends upon the loss while transferring energy containing organic matter from the previous trophic level plus the consumption due to respiration and predation.

12. Recognising the deleterious effects of ozone depletion, 27 industrialised countries signed an international treaty, known as the Montreal Protocol in 1987. The aim of this protocol was to limit the emission of chlorofluorocarbons and other ozone depleting substances to half the level of 1986.

OR

Ahmed Khan of Bengaluru in collaboration with R.V. college of Engineering and the Bengaluru City Corporation came up with a remedy for efficient use of plastic waste. He developed polyblend, a fine powder of recycled modified plastic. This mixture is mixed with bitumen that is used to lay roads. He proved that blends of polyblend and bitumen, when used to lay roads, enhanced the bitumen's water repellent properties and helped to increase road life by a factor of three. The raw material for creating polyblend is any plastic film waste. Using Khan's technique, by the year 2002, more than 40 kms of road in Bengaluru has already been laid. At this rate, Khan will soon be running short of plastic waste in Bengaluru, to produce polyblend.

13. Emasculation is removal of stamens from the floral buds of female parent. A breeder needs to emasculate a bisexual flower to eliminate the chances of self pollination. Breeder needs to remove anthers from the flower bud before the anther dehisces using a pair of forceps. Bagging is the covering of flowers by butter paper or polythene. Both unisexual and bisexual flowers must be kept covered by bags to protect them from contamination by unwanted pollen grains. The female flower buds are bagged before the flowers open.

OR

Apomixis is a mode of asexual reproduction that does not involve formation of zygote through gametic fusion and in which seeds are produced without fertilisation. It is common in grasses and species of Family Asteraceae.

Significance of apomixis :

(a) It helps in the enormous amount of seed production which are exact replicas of mother plant.

(b) It has an advantage of producing individuals with desired qualities in more numbers.

The commercial use of apomixis is as follows:

(i) Production of infection free embryos for development of plant.

(ii) Production of better clone as adventive embryos are better clones than cuttings.

(iii) Apomictic hybrid seeds can be used year after year which will

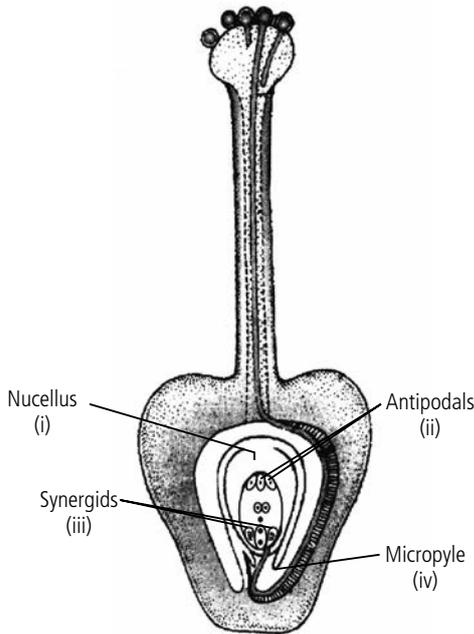
reduce the cost of purchasing hybrid seeds every year.

**14. (a)** Refer to answer 53, page no. 65, MTG CBSE Champion Biology.

**(b)** After ovulation, the remaining cells of the ovarian follicles are stimulated by LH to develop corpus luteum. Now, the corpus luteum secretes large amount of progesterone that is essential for the maintenance of the endometrium.

OR

**(a)** Longitudinal section of pistil showing growth of pollen tube is shown below:



**(b) (i)** Synergids help in obtaining nourishment from the outer nucellar cells, guide the path of pollen tube by their secretion and function as shock absorbers during the penetration of pollen tube into the embryo sac.

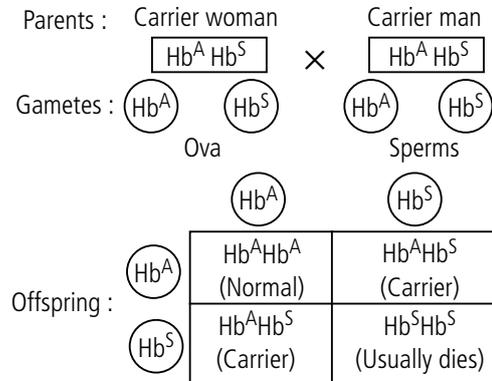
**(ii)** Micropyle plays an important role in fertilisation as the pollen tube enters the ovule through micropyle. It also helps in the germination of seed. The oxygen and water enters the seed at the time of germination through micropyle.

**15. (a)** Yes, this representation indicates a normal human because  $Hb^A$  is a normal peptide with glutamic acid at the sixth position of beta globin chain.

For example, in case of sickle cell anaemia the glutamic acid is replaced by valine due to substitution of T by A in the second position of the triplet codon CTC which is changed to CAC.

**(b)** The disease is called Mendelian disorder because it is transmitted to the offspring as per Mendelian principles. For example, sickle cell anaemia is a blood related Mendelian disorder. The gene for sickle-celled erythrocytes is represented by  $Hb^S$  while that of normal erythrocytes is written as  $Hb^A$ . The homozygotes for the two types are  $Hb^S Hb^S$  and  $Hb^A Hb^A$ . The heterozygotes are written as  $Hb^A Hb^S$ . When two sickle cell heterozygotes marry they produce three types of children:

homozygous normal, heterozygous carrier and homozygous sickle celled in the ratio of 1 : 2 : 1. However, homozygous sickle-celled individuals ( $Hb^S Hb^S$ ) die in childhood (before reproductive age) due to acute anaemia. Therefore, a ratio of one normal to two carriers is obtained.



OR

**(a)** Phenylketonuria is an inborn, autosomal recessive metabolic disorder in which the individual lacks the enzyme phenylalanine hydroxylase that converts the amino acid phenylalanine into tyrosine in liver. Lack of this enzyme is due to the abnormal autosomal recessive gene on chromosome 12. This is due to substitution.

Two symptoms of this disorder are—

- (i) Mental retardation due to accumulation of phenylalanine and phenyl pyruvate in brain.
- (ii) Decreased pigmentation of hair and skin and eczema.

**(b)** Klinefelter's syndrome occurs due to the trisomy of sex (X) chromosome. The individual has 47 chromosomes (44 + XXY).

Two symptoms of this disorder are —

- (i) Undeveloped testes and development of feminine characters like enlarged breasts, feminine pitched voice.
- (ii) Mental retardation.

**16.** The technique that can help to grow somaclones of certain desired variety of apple is known as micropropagation (a tissue culture technique). It produces thousands of plants and each of these plants will be genetically identical (somaclones) to the original plant. The property of plant cells that is used in the technique is totipotency *i.e.*, the capacity to generate a whole plant from any cell in *in vitro* conditions.

The micropropagation method by which somaclones of apples can be obtained involves the following steps :

- (i) Preparation of suitable nutrient medium and its storage into suitable containers.
- (ii) Selection of explants such as shoot tip of apple and sterilisation by disinfectants.
- (iii) Inoculation (transfer) of the explants into the suitable nutrient medium under sterile conditions.
- (iv) Growing the culture in the growth chamber or plant tissue culture room, having the appropriate physical conditions *i.e.*, artificial light (16 hours of photoperiod), temperature ( $-26^\circ\text{C}$ ) and relative humidity (50- 60%).
- (v) Regeneration of plants from cultured plant tissues and hardening.

(vi) Transfer of plantlets to the greenhouse or field conditions following acclimatisation of regenerated plants.

**17. (a)** In the given graph, 'a' represents exponential or J-shaped growth and 'b' represents logistic or sigmoid growth. The equation

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

represents logistic growth form and 'K' represents carrying capacity for a particular species in the given habitat. In nature, a given habitat has resources to support a certain number of individuals of a population, beyond which no further growth is possible. This limit is called nature's carrying capacity (K) for that species in that habitat.

**(b)** The curve 'b' is considered to be more realistic growth model for most of the animal population because resources are limited in this type of growth curve. Whereas, in case of curve 'a', the resources (such as food, space, etc.) are unlimited.

**(c)** The curve 'a' would depict the population of a species of deer in absence of predators in the habitat as the population increases exponentially. In absence of predators, the resources will be unlimited for the deer population and it can reach high population densities in a short time. This type of growth pattern of a population results in J-shaped curve.

**18.** Refer to answer 186, page no. 180, MTG CBSE Champion Biology.

**19.** In humans, ABO system of blood group is a case of multiple allelism, co-dominance and dominance. In the ABO blood group system, there are four blood groups: A, B, AB and O.

ABO blood groups are controlled by the gene *I*. The plasma membrane of the red blood cells has sugar polymers that protrude from its surface. The kind of sugar is controlled by the gene *I*. The gene *I* has three alleles  $I^A$ ,  $I^B$  and *i*. The alleles  $I^A$  and  $I^B$  produce a slightly different form of the sugar while allele *i* does not produce any sugar. Each person possesses any two of the three *I* gene alleles. The alleles  $I^A$  and  $I^B$  are completely dominant over *i*, as  $I^A$  and  $I^B$  form antigen A and antigen B respectively but *i* does not form any antigen and are not dominant over each other. This shows dominance.

When  $I^A$  and  $I^B$  are present together they both express themselves and produce blood group AB ( $I^A I^B$ ) by forming antigens A and B. This phenomenon is known as co-dominance.

Multiple allelism is the presence of more than two alleles of a gene. They occur on the same gene locus of the same chromosome or its homologue and are responsible for multiple phenotypic expression. The ABO system of blood groups in humans are determined by three different allelic forms  $I^A$ ,  $I^B$  and *i* showing multiple allelism.

**20.** Chemical pesticides used in agricultural fields are toxic and biocides. They kill even useful organisms along with harmful ones, harm human beings and animals, pollute soil and water and crop plants. It is estimated that despite the use of chemical pesticides 30% of the agricultural produce is lost to pathogens and pests because these continue to develop resistance against various pesticides. On the other hand biopesticides are the biological agents that control the growth of weeds, insects and pathogens in an agricultural field.

They have targeted actions and are harmless to the crop plants, other beneficial field animals and humans. Therefore, nowadays biopesticides are preferred over chemical pesticides. Baculoviruses belong mostly to the genus *Nucleopolyhedrovirus*. They are useful in controlling many insects and other arthropods. They are species specific narrow spectrum bioinsecticides with no side effects on plants, mammals, birds, fish and non-target insects. Beneficial insects are conserved. Baculoviruses are, therefore, an important component of integrated pest management (IPM) programme and are dealing with ecological sensitive areas.

**21. (a)** DNA is a hydrophilic molecule, so it cannot pass into a host cell through cell membrane. The cell membrane consists of lipid bilayers that are generally impermeable to hydrophilic molecules.

**(b)** DNA is intertwined with proteins like histones and RNA. To obtain purified DNA, proteases are added during isolation of DNA, convert proteins into amino acids. The purified DNA finally precipitates out after the addition of chilled ethanol.

**(c)** In order to link the alien DNA, the vector needs to have very few, preferably single, recognition sites for the commonly used restriction enzymes. Presence of more than one recognition sites within the vector will generate several fragments, which will complicate the gene cloning process.

**22.** Penicillin is an antibiotic obtained from *Penicillium notatum*. It helps in curing rheumatic fever, tonsillitis, sore throat, gonorrhoea and some pneumonia types.

Statin obtained from *Monascus purpureus*, inhibits cholesterol synthesis and is therefore, used in lowering blood cholesterol e.g., lovastatin, pravastatin, simvastatin.

Cyclosporin A is obtained from *Trichoderma polysporum*. This chemical has antifungal, anti-inflammatory and immunosuppressive properties. It inhibits activation of T-cells and therefore, prevents rejection reactions in organ transplantation.

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**23.** In the process of PCR (polymerase chain reaction), the role of high temperature, primer and *Thermus aquaticus* is as follows:

**(a)** High temperature : During high temperature denaturation step takes place. In this step, the target DNA is heated to a high temperature (94° to 96°C) resulting in the separation of two strands.

**(b)** Primer : During annealing, the two oligonucleotide primers anneal to each of the ssDNA template since the sequence of the primers is complementary to the 3' ends of the template DNA. Presence of primer is important for polymerisation to take place. Temperature (40°C – 60°C) is kept low depending on the length and sequence of primers.

**(c)** *Thermus aquaticus* : During the final step called polymerisation, the enzyme DNA polymerase synthesises the DNA segment between the primers. Usually, *Taq* DNA polymerase, isolated from a thermophilic bacterium *Thermus aquaticus* synthesises. This helps in synthesis of DNA region between the primers, using deoxynucleoside triphosphates and Mg<sup>2+</sup>.

**OR**

Some genes called selectable markers help in selecting those host cells which contain the vectors and eliminating the non-transformants.  $\beta$ -galactosidase is an alternative selectable marker developed to differentiate recombinants and non-recombinants on the basis of their ability to produce colour in the presence of a chromogenic substance. A recombinant DNA is inserted in the coding sequence of an enzyme  $\beta$ -galactosidase. This causes inactivation of the enzyme which is called insertional inactivation. If the plasmid in the bacterium does not have an insert, the presence of a chromogenic substrate gives blue coloured colonies. Presence of insert results into insertional inactivation of the  $\beta$ -galactosidase and, therefore, the colonies do not produce any colour, these colonies are marked as recombinant colonies.

$\beta$ -galactosidase is preferred as selectable marker to antibiotic resistance genes because due to inactivation of antibiotics, selection of recombinants becomes burdensome process as it requires simultaneous plating on two plates having different antibiotics. But by using  $\beta$ -galactosidase as selectable marker, we can select recombinants and non-recombinants in a single plate.

**24.** Refer to answer 71, page no. 163, MTG CBSE Champion Biology.

**25.** Refer to answer 73, page no. 32, MTG CBSE Champion Biology.

**OR**

**(a)** Sperm 'A' would reach the ovum earlier than both 'B' and 'C'.

**(b)** In the given diagram, 'D' is corona radiata that is formed of radially elongated follicular cells.

'E' is zona pellucida that is present outside the perivitelline space. The function of the zona pellucida is to prevent the implantation of the blastocyst at an abnormal site. It does not expose the sticky and phagocytic cells of the trophoblast till the blastocyst reaches the proper implantation site. As the blastocyst is formed, zona pellucida becomes thinner and finally disappears.

**(c)** The sperms in the female genital tract are made capable of fertilising the egg by secretions of the female genital tract. These secretions remove coating substances deposited on the surface

of sperm, mainly on acrosome and exposes its receptor sites. The phenomenon of sperm activation in mammals is known as capacitation. The capacitated sperms undergo acrosomal reaction and release various chemicals contained in the acrosome. These chemicals are collectively called sperm lysins. Important sperm lysins are: hyaluronidase, corona penetrating enzymes and zona lysine or acrosin. Due to acrosomal reaction, plasma membrane of the sperm fuses with the plasma membrane of the secondary oocyte so that the sperm contents enter the oocyte.

The changes occurring in the ovum are as follows:

**(i)** During fertilisation, binding of the sperm to the secondary oocyte induces depolarization of the oocyte plasma membrane. Depolarization prevents polyspermy. Thus, it ensures that only one sperm can fertilise an ovum.

**(ii)** The cortical granules present beneath the plasma membrane of the secondary oocyte fuse with the plasma membrane and release their contents including cortical enzymes. These enzymes harden the zona pellucida which also prevents polyspermy.

**(iii)** The secondary oocyte forms a projection termed fertilisation cone which receives the sperm.

**(iv)** Sperm entry stimulates the metabolism in the fertilised ovum (zygote). As a result, the rates of cellular respiration and protein synthesis increase greatly.

**(d)** It takes place in the ampullary isthmic junction of the Fallopian tube.

**26. (a)** The given schematic representation is of *lac* operon. In *lac* operon, the regulatory gene is called *i*-gene because it produces an inhibitor or repressor. The repressor binds to operator gene and stops the operator from working.

In the absence of an inducer (*i.e.*, lactose), the repressor binds to the operator gene making it non-functional. RNA polymerase enzyme cannot move over it to reach the structural genes. Thus, structural genes are inactivated and transcription cannot take place.

**(b)** As regulatory gene exerts a negative control over the working of structural genes, therefore regulation of *lac* operon is called negative regulation.

**(c)** 'Inducer' for the given operon is 'lactose'. Its role is to bind with repressor, change the latter into non-DNA binding state so as to free the operator gene and switch on the *lac* operon.

The products of the genes 'z' and 'y' of the *lac* operon are  $\beta$ -galactosidase and permease respectively.  $\beta$ -galactosidase brings about hydrolysis of lactose to form glucose and galactose. Galactoside permease is required for entry of lactose into the bacterium.

**OR**

**(a)** In a given population one can find out the frequency of occurrence of alleles of a gene. This frequency is supposed to remain fixed and even remain the same through generations. Hardy-Weinberg principle stated it using algebraic equation which says that allele frequencies in a population are stable and are constant from generation to generation. The gene pool *i.e.*, total genes and their alleles in a population remains constant. This is called genetic equilibrium. Sum total of all the allelic frequencies is 1. Individual frequencies, for example, can be named 'p', 'q', etc. In a diploid, 'p' and 'q' represent the frequency of allele 'A' and allele 'a'. The frequency of 'AA' individuals in a population is simply p<sup>2</sup>. This can be stated in

another ways *i.e.*, the probability that an allele A with a frequency of 'p' appears on both the chromosomes of a diploid individual is the product of the probabilities, *i.e.*, 'p<sup>2</sup>'. Similarly of 'aa' is 'q<sup>2</sup>', of 'Aa' '2pq'. Hence,  $p^2 + 2pq + q^2 = 1$ . This is a binomial expansion of  $(p + q)^2$ . When the measured frequency differs from expected values, the difference (direction) indicates the extent of evolutionary change. Disturbance in genetic equilibrium, or Hardy-Weinberg equilibrium, *i.e.*, change of frequency of alleles in a population would then be interpreted as resulting in evolution.

(b) When a few individuals or a small group of individuals called founders from some large population invade a new or isolated geographical region, they carry a limited portion of the parental gene pool. Their gene pool may contain certain alleles in a very low frequency or may lack a few alleles. The descendants of the founder will tend to have ratios similar to the founders rather than the source population. This formation of different genotype in new settlement is called founder effect and is an important example of genetic drift in human population.

27. (a) In the given equation 1, 2, 3 and 4 are B, I, D and E respectively. Therefore, the equation will be:

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

(b) Population density is defined as number of individuals of a species per unit area or per unit volume of environment. Population density may be measured by:

(i) Numerical density calculated by number of individuals per unit area or volume. For example, if in a pond there were 20 lotus plants last year and through reproduction 8 new plants are added, taking the current population to 28, the birth rate will be calculated as  $8/20 = 0.4$  offspring per lotus per year.

(ii) Biomass density calculated as biomass per unit area or volume. For example if in an area, there are 200 *Parthenium* plants but only a single huge banyan tree, then the percent cover or biomass is more meaningful measure of the population size.

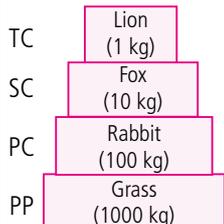
(iii) Abundance or absolute number of population. For ecological investigations, population density is measured as absolute population

densities or relative densities. For example, the tiger census in our National parks and tiger reserves is often based on pug marks and fecal pellets.

OR

(a) The pyramid of energy is always upright in shape as there is always a gradual decrease in the energy content at successive trophic levels from producers to various consumers. This is because some energy is used at each trophic level for various metabolic activities and some energy is lost as heat, so only 10% of the energy is available to the next trophic level (Lindeman's 10% law).

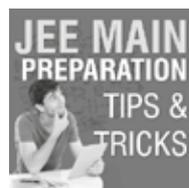
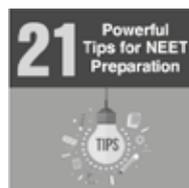
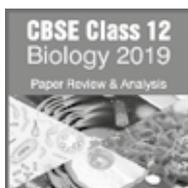
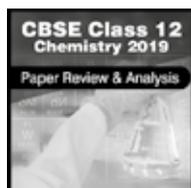
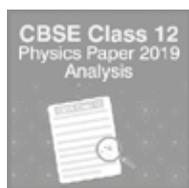
(b) Pyramid of biomass is a graphical representation of biomass present sequence-wise per unit area of different trophic levels with producers at the base and top carnivores at the apex. Pyramid of biomass may be upright or inverted.

S. No.	Upright pyramid of biomass	Inverted pyramid of biomass
(i)	The biomass of producers is more than that of consumers.	The biomass of producers is less than that of consumers.
(ii)	<p>Pyramid of biomass in grassland ecosystem is always upright.</p>  <p>TC SC PC PP</p> <p>Fig.: Upright pyramid of biomass</p>	<p>Pyramid of biomass in aquatic ecosystem is always inverted.</p>  <p>SC PC PP</p> <p>Fig.: Inverted pyramid of biomass</p>



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# Rapid Fire - Revision

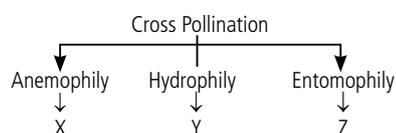
The questionnaire contains multiple choice questions from different topics covered in this issue for effective recapitulation.

- Ancestral characters and derived characters are the traits used in
  - numerical taxonomy
  - cladistic taxonomy
  - chemotaxonomy
  - cytotaxonomy.
- Select the correct sequence of development of ovule.
  - Primordium → Primary sporogenous cell → Megasporeocyte → Megaspores
  - Primordium → Megasporeocyte → Primary parietal cell → Megaspores
  - Primordium → Primary parietal cell → Megasporeocyte → Megaspores
  - Primordium → Primary sporogenous cell → Megaspores → Megasporeocyte
- A mature embryo sac is
  - 7 – celled and 8 nucleate
  - 8 – celled and 7 nucleate
  - 6 – celled and 7 nucleate
  - 7 – celled and 6 nucleate.
- The Z gene in *lac* operon
  - increases the permeability of cell to  $\beta$  – galactosidase
  - encodes a transacetylase
  - is primarily responsible for the hydrolysis of the disaccharide, lactose
  - codes for the repressor of *lac* operon.
- How many of the following characters belong to Kingdom Monera?
 

Eukaryotic, Non cellulotic, Cellular, Autotrophic

  - 3
  - 2
  - 1
  - 4
- Select the incorrect pair.
  - Viriods – RNA
  - Double stranded DNA–TMV
  - Syphilis–*Treponema pallidum*
  - Deuteromycetes–*Helminthosporium*

- Refer to the given chart and select the option that correctly identifies X, Y and Z.



- |                        |                  |                  |
|------------------------|------------------|------------------|
| <b>X</b>               | <b>Y</b>         | <b>Z</b>         |
| (a) <i>Vallisneria</i> | <i>Cannabis</i>  | <i>Acacia</i>    |
| (b) <i>Cannabis</i>    | <i>Zostera</i>   | <i>Euphorbia</i> |
| (c) <i>Zostera</i>     | <i>Euphorbia</i> | <i>Cannabis</i>  |
| (d) <i>Euphorbia</i>   | <i>Zostera</i>   | <i>Cannabis</i>  |
- Which fungal organism is often referred to as '*Drosophila* of plant kingdom'?
    - Aspergillus*
    - Neurospora*
    - Yeasts
    - Penicillium*
  - Refer to the given figure and select the incorrect statement regarding A and B.
 




    - In A, the sporophylls are aggregated to form cones.
    - In B, the sporophylls are aggregated to produce flowers.
    - In A, stigma and style are present while in B, the two are absent.
    - In A, ovules are sessile while in B ovules are borne on a stalk or funiculus.
  - The correct combination of water pollinated flowers are
    - Vallisneria* and *Yucca*
    - Vallisneria* and *Hydrilla*
    - Hydrilla* and *Yucca*
    - Pinus* and *Agave*.
  - trp R* is a
    - regulator gene
    - promoter gene
    - operator gene
    - structural gene.
  - Haploid male gametophytic generation in flowering plants is represented by
    - pistil
    - pollen grains
    - embryo sac
    - gametocyte.

13. Coralloid roots, which have a symbiotic association between blue-green algae and host plants are attribute of  
(a) *Cycas* (b) *Araucaria*  
(c) *Pinus* (d) *Cedrus*.
14. The type of cycle exhibited by all pteridophytes is  
(a) diplontic (b) haplodiplontic  
(c) haplontic (d) both (a) and (c).
15. In *Marchantia*, asexual reproduction takes place by  
(a) the formation of specialised structures called gemmae  
(b) budding in the secondary protonema  
(c) formation of different type of spores  
(d) biflagellate zoospores that are pear shaped.
16. Five kingdom classification was proposed by  
(a) Whittaker (b) Linnaeus  
(c) Haeckel (d) Woese.
17. What kind of contrivances for cross pollination is found in sunflower?  
(a) Dicliny (b) Protandry  
(c) Protogyny (d) Prepotency
18. Which of the following constitute Kingdom Protista?  
(a) Phycomycetes, Ascomycetes, Basidiomycetes  
(b) Chrysophytes, Dinoflagellates, Euglenoids  
(c) Bryophytes, Chrysophytes, Pteridophytes  
(d) *Chlamydomonas*, Algae, Mycoplasma
19. Angiosperms exhibit double fertilisation as  
(a) syngamy and double fusion  
(b) syngamy and triple fusion  
(c) xenogamy and triple fusion  
(d) syngamy and xenogamy.
20. Which of the following statements is not the animal characters of *Euglena*?  
(a) Presence of stigma and paraflagellar body  
(b) Presence of longitudinal binary fission  
(c) Holophytic nutrition  
(d) Presence of contractile vacuole
21. A phenomenon which results in the formation of seeds without fertilisation found in some angiosperms, particularly in grasses is called as  
(a) emasculation (b) parthenogenesis  
(c) apomixis (d) polyembryony.
22. *Adiantum caudatum* is also called as  
(a) male shield fern (b) walking fern  
(c) sorrow of Kashmir (d) terror of Bengal.
23. X is a bilobed, dithecous oblong knoblike fertile part of stamen. Select the incorrect statement regarding X.  
(a) X comprises megasporangia in 4 lobules.  
(b) X is a part of male sex organ.  
(c) Two lobes of X are joined by connective.  
(d) X produces pollen grains.
24. *Lac* operon in *E. coli* is a type of \_\_\_\_\_ gene regulation.  
(a) constitutive (b) repressible  
(c) inducible (d) both (a) and (c)
25. Following table summarises the difference between cilia and flagella. Pick up the wrong pair of differences.

	Cilia	Flagella
(a)	They are smaller in size.	They are larger in size.
(b)	They usually occur throughout or major parts of the surface of a cell.	They are commonly found at one end of the cell.
(c)	They beat oar-like and in a coordinated rhythm.	They beat whip-like and independently.
(d)	Example : <i>Euglena</i>	Example : <i>Paramecium</i>

26. In Kingdom Animalia, mode of nutrition is  
(a) heterotrophic (b) autotrophic  
(c) homotrophic (d) both (b) and (c).
27. A type of pollination in which pollen grains of one flower are transferred to the stigma of another flower belonging to either the same plant or genetically similar plant is  
(a) bud pollination (b) geitonogamy  
(c) cleistogamy (d) homogamy.
28. When the female *Anopheles* mosquito bites a healthy person, \_\_\_\_\_ are injected in his/her blood along with saliva.  
(a) cryptozoites (b) sporozoites  
(c) merozoites (d) trophozoite
29. The inducer for *lac*-operon in *Escherichia coli* is  
(a) galactose (b) lactose and glucose  
(c) lactose (d) galactose and lactose.
30. In *trp* operon, tryptophan functions as  
(a) repressor (b) corepressor  
(c) aporepressor (d) promoter.

**ANSWER KEY**

1. (b) 2. (a) 3. (a) 4. (c) 5. (a)  
6. (b) 7. (b) 8. (b) 9. (c) 10. (b)  
11. (a) 12. (b) 13. (a) 14. (b) 15. (a)  
16. (a) 17. (b) 18. (b) 19. (b) 20. (c)  
21. (c) 22. (b) 23. (a) 24. (c) 25. (b)  
26. (a) 27. (b) 28. (b) 29. (c) 30. (b)

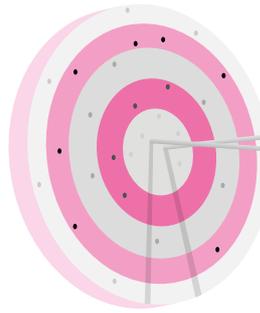


What *z* it?

SOLUTION  
APRIL 2019

Orthotropous Ovule

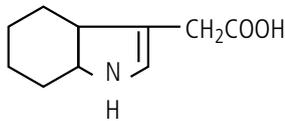
Winner: Dhibin Vikash (Vellore)



# AIM for AIIMS

EXAM ON  
25<sup>th</sup> and 26<sup>th</sup>  
MAY 2019

- Which of the following is not an exotic breed of *Capra* sp.?  
(a) Angora (b) Bhadawari  
(c) Toggenberg (d) Alpine
- Select the incorrect option regarding the phytohormone to which the given molecular structure belongs.



- The hormone increases storage of solutes inside the cells.
  - The hormone enhances sweetening of fruits.
  - The hormone promotes feminising effect on some plants.
  - The hormone can be employed for breaking seed and bud dormancy.
- Dehang Debang biosphere reserve is found in  
(a) Assam (b) Kerala  
(c) Arunachal Pradesh (d) Sikkim.
  - Select the alga which is source of antifungal and antibacterial extract sarganine and is used both as manure and fodder.  
(a) *Laminaria* (b) *Macrocystis*  
(c) *Sargassum* (d) *Fucus*
  - Ecdysis in frog is affected by the secretions of two ductless glands  
(a) pituitary and thyroid  
(b) thyroid and adrenal cortex  
(c) adrenal medulla and hypothalamus  
(d) pituitary and hypothalamus.
  - A person having antigen A on surface of red blood corpuscles and antibody 'b' in blood plasma, can give blood to  
(a) A and AB (b) B and O  
(c) A only (d) all of these.
  - Which of the following combinations of characters are true for cyanobacteria?  
(a) Oxygenic photosynthetic prokaryotes, cyanophycean starch as reserve food  
(b) Oxygenic photosynthetic eukaryotes, glycogen as reserve food  
(c) Chemosynthetic eukaryotes, cyanophycean starch as reserve food  
(d) Chemosynthetic prokaryotes, glycogen as reserve food
  - Which of the following is not a synovial joint?  
(a) Radioulnal joint (b) Intervertebral disc  
(c) Interphalangeal joint (d) Carpometacarpal joint
  - Which one of the following cause is not included in 'the evil quartet'?  
(a) Co-extinctions  
(b) Forestry  
(c) Habitat loss and fragmentation  
(d) Over exploitation
  - Match column I (antibiotic) with column II (effect) and select the correct option given below.
 

Column I	Column II
A. Rifampicin	(i) Inhibits initiation of translation and causes misreading.
B. Neomycin	(ii) Inhibits RNA synthesis by inhibiting RNA polymerase.
C. Streptomycin	(iii) Inhibits interaction of tRNA with mRNA.
D. Erythromycin	(iv) Inhibits binding of aminoacyl-tRNA to ribosome.
E. Tetracycline	(v) Inhibits translocation of mRNA along ribosome.

    - A-(i), B-(ii), C-(iii), D-(iv), E-(v)
    - A-(v), B-(i), C-(iv), D-(iii), E-(ii)
    - A-(iii), B-(ii), C-(iv), D-(v), E-(i)
    - A-(ii), B-(iii), C-(i), D-(v), E-(iv)
  - An anther has 2400 pollen grains. How many pollen mother cells (PMCs) must have been there to produce them?  
(a) 2400 (b) 600  
(c) 1200 (d) Either (b) or (c)
  - Refer to the given figure of human kidney.

Identify A, B, C and D and select the correct option regarding them.

- (a) A-Renal fascia – Outer fibrous membrane  
 (b) B-Minor calyces – 7-13 in number  
 (c) C-Medullary pyramid – Fibrous connective tissue  
 (d) D-Renal column of Bertin – Medullary extension of renal cortex in between the renal pyramids

13. Which of the given metal is not used as catalysts in catalytic converters?

- (a) Rhodium (b) Palladium  
 (c) Platinum (d) Lead

14. Structural genes are those genes that code for any RNA or protein product other than a regulatory protein. Which of the following statements is correct about structural genes?

- (a) They are the binding site for RNA polymerase.  
 (b) An operon has one or more structural gene.  
 (c) They exerts a negative control over the working of operator gene.  
 (d) They are made up of 27 base pairs.

15. Match column I with column II and select the correct option from the given codes.

- | Column I<br>(Organisms) | Column II<br>(Respiratory organs) |
|-------------------------|-----------------------------------|
| A. <i>Planaria</i>      | (i) Tracheae                      |
| B. <i>Terebella</i>     | (ii) Body surface                 |
| C. <i>Limulus</i>       | (iii) Lungs                       |
| D. <i>Peripatus</i>     | (iv) Gills                        |
| E. <i>Python</i>        | (v) Book gills                    |
- (a) A-(iii), B-(ii), C-(iv), D-(i), E-(v)  
 (b) A-(ii), B-(iv), C-(v), D-(i), E-(iii)  
 (c) A-(iii), B-(v), C-(iv), D-(ii), E-(i)  
 (d) A-(v), B-(i), C-(iii), D-(iv), E-(ii)

16. Read the following statements and select the correct option given below.

- (i) The basal metabolic rate (BMR) is generally high in men due to higher proportion of lean body mass.  
 (ii) Sertoli cells are elongated and found in between the seminiferous tubules.  
 (iii) Cryptorchidism is a collection of fluid, usually in tunica vaginalis of testis.  
 (iv) Vasa deferentia arises from the cauda epididymis and are only 2 in number.  
 (v) Epididymis, vasa deferentia and testes are secondary sex organs.
- (a) (i), (ii) and (iii) (b) (i) and (iv) only  
 (c) (iii) and (iv) only (d) (ii), (iv) and (v)

17. Select the mismatched pair out of the following.

- (a) Conjoint vascular – Xylem and phloem on the same radii  
 (b) Bicolateral vascular – Central position is occupied by xylem

- (c) Radial vascular – Xylem and phloem on different radii  
 (d) Amphicribral vascular – Xylem surrounds phloem bundle

18. Which of the following statements is correct?

- (a) RQ helps in knowing the type of respiration being performed.  
 (b) The net gain of energy in glycolysis is equal to 24 molecules of ATP.  
 (c) Ribulose biphosphate is the first acceptor of CO<sub>2</sub> in C<sub>4</sub> plants.  
 (d) Malic acid is an intermediate compound which links glycolysis with Krebs's cycle.

19. Study the given table and identify A, B, C and D.

Cell organelle	Site for
Golgi apparatus	<b>A</b>
<b>B</b>	Synthesis of rRNA
Smooth ER	<b>C</b>
<b>D</b>	Storage of starch

- (a) A-Synthesis of fatty acids, B-Rough ER, C-Synthesis of glycoprotein, D-Mitochondria  
 (b) A-Synthesis of glycoprotein, B-Nucleolus, C-Chloroplast, D-Synthesis of lipid  
 (c) A-Synthesis of glycoprotein, B-Microtubules, C-Plasmodesmata, D-Synthesis of lipids  
 (d) A-Synthesis of lipids, B-Nucleolus, C-Plastid, D-Synthesis of glycoprotein

20. Assimilation efficiency is represented by

- (a)  $\frac{\text{Ingested food energy}}{\text{Assimilated food energy}} \times 100$   
 (b)  $\frac{100 \times \text{Ingested food energy}}{\text{Assimilated food energy}}$   
 (c)  $\frac{\text{Assimilated food energy}}{\text{Ingested food energy}} \times 100$   
 (d) none of these.

21. Match column I with column II and select the correct option from the given codes.

**UNSCRAMBLED WORDS**

**APRIL 2019**

1-f- FILARIASIS	2-e- APICULTURE
3-j- POLYPLOIDY	4-g- NATALITY
5-h- CLONING	6-c- PSAMMOSERE
7-a- SYNAPSIS	8-i- ISOMERASE
9-b- IMBIBITION	10-d- PHOTOLYSIS

**Winner : Chaitanya Vishnu (Andhra Pradesh)**

**Column I**

(Animals)

- A. *Euchlora rubra*  
 B. *Tubifex*  
 C. *Hemidactylus*  
 D. *Echiurus*

**Column II**

(Characteristics)

- (i) Annelid without internal and external segmentation  
 (ii) Nematocyst on tentacles  
 (iii) Exhibits the phenomenon of autotomy  
 (iv) Feeds on organic matter found in sewage

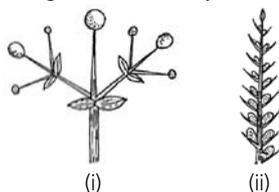
- (a) A-(i), B-(ii), C-(iii), D-(iv)  
 (b) A-(iv), B-(iii), C-(ii), D-(i)  
 (c) A-(ii), B-(iv), C-(iii), D-(i)  
 (d) A-(iii), B-(i), C-(iv), D-(ii)

22. Which of the following hormones is secreted by the epithelium of entire small intestine and accelerates movements of villi?  
 (a) Enterocrinin (b) Villikin  
 (c) Duocrinine (d) Secretin
23. Which of the following options incorrectly distinguishes DPD and  $\Psi_w$ ?

	DPD	$\Psi_w$
(a)	Reduction in diffusion pressure of solvent.	Reduction in free energy of solvent.
(b)	Matric pressure is not considered.	Matric potential is considered whenever appreciable.
(c)	It has a negative value.	It has a positive value.
(d)	$DPD = OP - WP (= TP)$	$\Psi_w = \Psi_s + \Psi_p$

24. Which among these is not an advantage of vegetative propagation?  
 (i) Rapid multiplication in plants  
 (ii) Good qualities of the plants can be preserved for long time  
 (iii) Production of disease - free plants through micropropagation  
 (iv) Genetically similar  
 (v) Production of seedless plants  
 (a) (i), (ii) and (v) only (b) (i) and (iv) only  
 (c) (v) only (d) (iii) only

25. Study the given figures and identify the kind of inflorescence.



- (i) (ii)  
 (a) Racemose Cymose  
 (b) Cymose Racemose  
 (c) Cymose Cymose  
 (d) Racemose Racemose

26. 'X' is a mixture of fatty materials having condensation products of glycerol and phellonic acid or its derivatives and functions as a barrier to movement of solutes and water. Identify 'X'.

- (a) PUFA (b) Cutin  
 (c) Suberin (d) Prostaglandins

27. Some functions of a nutrient element are given below.

- (i) Nodule formation in legumes  
 (ii) Formation of nucleic acids  
 (iii) Produce pectates of middle lamella  
 (iv) Minimise the toxic effect of heavy metals

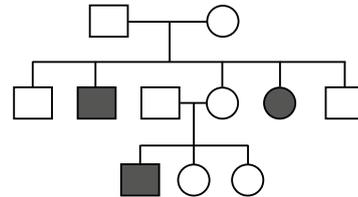
The concerned nutrient is

- (a)  $Mn^{2+}$  (b)  $Cu^{2+}$  (c)  $Cl^-$  (d)  $Mg^{2+}$ .

28. Which of the following is a hormone releasing IUD?

- (a) LNG-20 (b) Multiload 375  
 (c) Lippes loop (d) All of these

29. Study the given pedigree chart and select the most appropriate option.



- (a) It shows the inheritance of sickle cell anaemia as an autosomal recessive trait.  
 (b) It shows the inheritance of sickle cell anaemia as recessive X-linked trait.  
 (c) It shows the inheritance of myotonic dystrophy as an autosomal recessive trait.  
 (d) It shows the inheritance of sickle cells anaemia as an autosomal dominant trait.

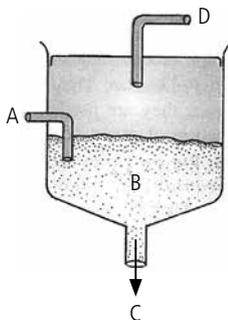
30. Following are the differences between humoral immunity and cell mediated immunity.

	Humoral immunity	Cell mediated immunity
(i)	Does not respond to transplants.	Reacts against transplants.
(ii)	Provides immunity against cancer.	Does not provide immunity against cancer.
(iii)	Consists of B-lymphocytes.	Consists of T-lymphocytes.
(iv)	Defends the body against all pathogens including protozoa and fungi.	Defends the body against viruses and bacteria only.

Select the option with correct pair of differences.

- (a) (i) and (iii) only (b) (iii) and (iv) only  
 (c) (i), (ii) and (iii) (d) (iv) only

31. In a biochemical step, PGA is phosphorylated by ATP and further gives rise to 1, 3-bisphosphoglyceric acid with the help of enzyme triose phosphate kinase. This process of photosynthetic carbon reduction cycle is included under  
 (a) regeneration of RuBP (b) carboxylation  
 (c) glycolytic reversal (d) photorespiration.
32. Which of the following disease results from the excess secretion of growth hormone after adolescence and characterised by unequal increase in size of bones of face, hand and feet?  
 (a) Cretinism (b) Acromegaly  
 (c) Simmond's disease (d) Myxoedema
33. The extinct human ancestor, who ate hard nuts and seeds and survived from late Miocene to Pliocene was  
 (a) *Dryopithecus* (b) *Homo habilis*  
 (c) *Ramapithecus* (d) *Australopithecus*.
34. Refer to the given figure of anaerobic sludge digester and identify A to D.



- (a) A is sludge inlet (b) C is methane vent  
 (c) B is spent sludge (d) D is air filter
35. In a pond, last year there were 35 lotus plants. 22 new lotus plants were added in one year through reproduction while 10 plants died. Select the correct option of death rate for the lotus population.  
 (a) 0.80 individuals per lotus per year  
 (b) 0.28 individuals per lotus per year  
 (c) 0.03 individuals per lotus per year  
 (d) 0.26 individuals per lotus per year
36. Satellite DNA is useful tool in  
 (a) sex determination (b) forensic science  
 (c) micropropagation (d) chromatography.
37. Which of the following receptors respond to air borne sound waves and acceleration and gravity respectively.  
 (a) Algesireceptors and olfactory receptors  
 (b) Nocireceptors and algesireceptors  
 (c) Phonoreceptors and statoreceptors  
 (d) Statoreceptors and phonoreceptors
38. Select the incorrect statement.  
 (a) *cry1 Ab* produce toxin that control cotton bollworms.  
 (b) Organic farming does not use pesticides and urea.

- (c) Autoradiography is a technique used to detect the DNA in a clone.  
 (d) The permanent cure of ADA deficiency in children is introduction of gene isolated from the bone marrow cells which produce ADA, into the cells of the patient at early embryonic stages.

39. Which of the following sequences is recognised by restriction enzyme *Alu* I?  
 (a)  $5' - G - G \downarrow C - C - 3'$   
 $3' - C - C \uparrow G - G - 5'$   
 (b)  $5' - A \downarrow A - G - C - T - T - 3'$   
 $3' - T - T - C - G - A \uparrow A - 5'$   
 (c)  $5' - G \downarrow G - A - T - C - C - 3'$   
 $3' - C - C - T - A - G \uparrow G - 5'$   
 (d) None of these
40. In *Curcubita* and *Populus*, the entry of pollen tube into the ovule occurs through the  
 (a) micropyle (b) chalaza  
 (c) integuments (d) ovary wall.

- Direction :** In the following questions, a statement of Assertion is followed by a statement of Reason. Mark the correct choice as :  
 (a) If both assertion and reason are true and reason is the 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 both assertion and reason are false.
41. **Assertion:** The exchange of gases between tissue blood capillaries and tissue cells is called internal respiration.  
**Reason :** The partial pressure of oxygen is lower in the capillaries than in the tissue cells during internal respiration.
42. **Assertion :** The principle of vaccination is based on the property of memory of the immune system.  
**Reason :** Vaccines generate memory B-cells and T-cells that recognise the pathogen quickly.
43. **Assertion :** Oral contraceptive pills are not recommended for women suffering from disorders of blood clotting, hypertension and heart disease  
**Reason :** Oral contraceptive pills increase the risk of intravascular clotting.
44. **Assertion :** The endomembrane system includes endoplasmic reticulum, Golgi complex, lysosomes and vacuoles.  
**Reason :** Plastids, peroxisomes and glyoxisomes are not included in endomembrane system because functions of these organelles are not coordinated with the above components.

- 45. Assertion :** Osteoporosis is common in women who have reached menopause.  
**Reason :** The hormone estrogen decreases sharply when women reach menopause.
- 46. Assertion :** Niche supports a single species.  
**Reason :** A single species may live in more than one niche in different stages of its life cycle.
- 47. Assertion :** In colourblindness, defect occurs in cone cell of retina.  
**Reason :** Colourblindness is a sex-linked recessive disease.
- 48. Assertion :** In cockroach, blood is not used for respiration.  
**Reason :** Being terrestrial, cockroach utilises atmospheric oxygen for respiration.
- 49. Assertion :** Over-exploitation of a species reduces the size of its population eventually leading to its extinction.  
**Reason :** Many marine fishes populations are declining around the world due to overharvesting.
- 50. Assertion :** Different tissues and organs respire at different rates.  
**Reason :** Germinating seeds exhibit aerobic respiration.
- 51. Assertion:** Chances of survival of young ones is higher in viviparous individuals.  
**Reason :** In viviparous animals, the zygote develops into young one inside the female body.
- 52. Assertion :** Angiosperms complete their life cycle in two phases.

**Reason :** In angiosperms, haploid plant body is sporophytic and diploid plant body is gametophytic.

- 53. Assertion :** Hydrocoele is a condition in which the testes do not descend into the scrotum.  
**Reason :** Hydrocoele is caused by deficient secretion of the hormone testosterone by fetal testes.
- 54. Assertion :** The Cro-Magnon man was the direct ancestor of the living modern man.  
**Reason :** Cro-Magnon man had slightly prognathous face.
- 55. Assertion :** Thermoacidophiles are able to tolerate high temperature and acidity.  
**Reason :** In thermoacidophiles, branched chain lipids are present in the cell membranes and special acid resistant enzyme are also present.
- 56. Assertion :** Pulses are deficient in methionine and cysteine.  
**Reason :** Methionine and cysteine are sulphur containing amino acids.
- 57. Assertion :** Root nodules of legumes are internally pinkish or red coloured.  
**Reason :** The legume root nodules contain leghaemoglobin in the cell.
- 58. Assertion :** Only restriction enzymes type II are used in the gene manipulation.  
**Reason :** Restriction enzyme type II cleaves both the strands of DNA molecule at specific palindromic sequences.
- 59. Assertion :** The sapwood is more durable than heartwood.  
**Reason :** The sapwood is rich in gums, resins, oils, tannins and other aromatic compounds.
- 60. Assertion :** *Pseudomonas* bacteria are not very efficient degraders but multiple genes may be needed to modify for efficient biodegradation.  
**Reason :** Efficient degraders have to be prepared through genetic engineering for efficient biodegradation.

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**ANSWER KEY**

- |         |         |         |         |         |
|---------|---------|---------|---------|---------|
| 1. (b)  | 2. (d)  | 3. (c)  | 4. (c)  | 5. (a)  |
| 6. (a)  | 7. (a)  | 8. (b)  | 9. (b)  | 10. (d) |
| 11. (b) | 12. (d) | 13. (d) | 14. (b) | 15. (b) |
| 16. (b) | 17. (d) | 18. (a) | 19. (b) | 20. (c) |
| 21. (c) | 22. (b) | 23. (c) | 24. (d) | 25. (b) |
| 26. (c) | 27. (d) | 28. (b) | 29. (a) | 30. (a) |
| 31. (c) | 32. (b) | 33. (c) | 34. (a) | 35. (b) |
| 36. (b) | 37. (c) | 38. (a) | 39. (d) | 40. (c) |
| 41. (c) | 42. (a) | 43. (a) | 44. (b) | 45. (a) |
| 46. (b) | 47. (b) | 48. (b) | 49. (b) | 50. (b) |
| 51. (a) | 52. (c) | 53. (d) | 54. (c) | 55. (a) |
| 56. (b) | 57. (a) | 58. (a) | 59. (d) | 60. (b) |



# NCERT Xtract

New

## Questions for NEET

### Principles of Inheritance and Variation

1. Which of the following pairs of contrasting traits studied in pea plant by Mendel constitutes recessive characters?
- White flower and yellow seed
  - Constricted pod and green seed
  - Green pod and dwarf plant
  - Yellow seed and yellow pod

2. Select the correct option for Filial<sub>1</sub> generation regarding Mendelian inheritance.
- It is the pure-breeding line.
  - It is a first hybrid generation.
  - Its phenotype is intermediate of both the parents.
  - Both (a) and (c)

3. What were the phenotype of F<sub>2</sub> generation plants obtained by selfing of heterozygous tall F<sub>1</sub> plants in Mendel's monohybrid cross?
- 1/4 tall and 3/4 dwarf
  - 1/4 dwarf and 3/4 tall
  - 1/4 tall, 2/4 intermediate and 1/4 dwarf
  - All tall

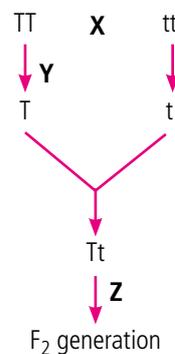
4. Alternate forms of a character are called
- genes
  - factors
  - traits
  - allelomorphs.

5. Homozygous allelic pair of genes for plant height is
- TT
  - Tt
  - tt
  - both (a) and (c).

6. Genotype of F<sub>1</sub> plant obtained by breeding the pureline pea plant with round (RR) and wrinkled (rr) seeds would be
- RR
  - rr
  - Rr
  - either (a) or (c).

7. Who gave graphical representation to calculate the probability of all possible genotypes of offspring in genetic cross?
- T.H. Morgan
  - Reginald C. Punnett
  - Sturtevant
  - Sutton and Boveri

8. Study the given flow chart and identify X, Y and Z.



- |     | X                | Y       | Z                   |
|-----|------------------|---------|---------------------|
| (a) | Monohybrid cross | Meiosis | Selfing             |
| (b) | Monohybrid cross | Mitosis | Cross fertilisation |
| (c) | Reciprocal cross | Meiosis | Hybridisation       |
| (d) | Test cross       | Mitosis | Selfing             |

9. In Mendel's monohybrid cross for pod shape, out of total 1186 F<sub>2</sub> plants obtained, 886 had inflated pods and 300 plants had constricted pods. What would be the monohybrid ratio?

- 1 : 2 : 1
- 3 : 1
- 1 : 1
- 1 : 4

10. A violet flower with unknown genotype is crossed with pure white (ww) flowers, resulting in all violet flowers (Ww). Predict the genotype of parent violet flower.

- WW
- Ww
- Either (a) or (b)
- None of these

11. What would be the ratio of cross between heterozygous dominant and homozygous recessive plant?

- 1 : 2
- 3 : 1
- 1 : 1
- 3 : 4

12. Which Mendelian law explains that individuals of  $F_1$  generation express trait of only one parent?
- Principle of paired factors
  - Law of segregation
  - Law of independent assortment
  - Law of dominance
13. Select the correct statement regarding law of segregation.
- Alleles do not show any blending and separate during gametogenesis.
  - This law can be studied only from dihybrid test cross.
  - Two factors of a character get non-randomly distributed to different gametes.
  - It is applicable only to factors that occur on different chromosomes.
14. The phenomenon in which expression of characters in  $F_1$  is intermediate of expression of two factors is known as
- co-dominance
  - incomplete dominance
  - multiple allelism
  - pleiotropy.
15. Identify the option where both genotypic and phenotypic ratios are equal to 1 : 2 : 1.
- AB blood groups in humans
  - Eye colour in *Drosophila*
  - Flower colour in *Antirrhinum*
  - Coat colour of rabbits
16. The person has alleles  $I^A$  and  $I^B$  and shows blood group AB. Name the phenomenon responsible for this.
- Co-dominance
  - Polygenic inheritance
  - Incomplete dominance
  - Dominance recessiveness

17. Study the given table and identify X, Y and Z.

Blood group phenotype	Genotype	Antigen	Antibody
O	X	–	a, b
B	$I^B i$	Y	a
AB	$I^A I^B$	A, B	Z

- X      Y      Z
- $I^A i$       b      a
  - $ii$       b      A
  - $ii$       B      Absent
  - $I^A i$       A      b
18. \_\_\_\_\_ is known as principle of purity of gametes.
- Principle of paired factors
  - Principle of segregation
  - Principle of dominance
  - Principle of independent assortment
19. In a dihybrid cross between yellow, round (YYRR) and green, wrinkled (yyrr) seeds, how many recombinant phenotypes would be present in  $F_2$  generation?
- 9
  - 4
  - 12
  - 6
20. Why *Drosophila melanogaster* was selected by T.H. Morgan for experimental verification of chromosomal theory of inheritance?
- Can be grown in laboratory on synthetic medium
  - Complete their life cycle in 2-3 days
  - Single mating produce large number of progenies
  - No sexual dimorphism
  - Exhibit many types of hereditary variations
- Select the correct option.
- (i), (ii) and (iv)
  - (ii), (iv) and (v)
  - (i), (iii) and (v)
  - (ii), (iii) and (iv)

21. Match column I with column II and select the correct option.

Column I (Sex determination type)	Column II (Example)
A. ZO-ZZ	(i) Grasshopper
B. XX-XY	(ii) Birds
C. ZW-ZZ	(iii) Butterflies
D. XX-XO	(iv) <i>Drosophila</i>

- A-(iv), B-(ii), C-(iii), D-(i)
  - A-(iii), B-(iv), C-(ii), D-(i)
  - A-(i), B-(iv), C-(iii), D-(ii)
  - A-(ii), B-(iii), C-(i), D-(iv)
22. Phenotypic dihybrid ratio of linked and unlinked genes respectively is
- 3 : 1; 9 : 3 : 3 : 1
  - 3 : 1; 1 : 1
  - 9 : 3 : 3 : 1; 1 : 1
  - 9 : 3 : 3 : 1; 1 : 1 : 1 : 1

## What's it?



Send your response at [editor@mtg.in](mailto:editor@mtg.in) or post to us with complete address by 10<sup>th</sup> of every month. Winners' name will be published in next issue.

23. Identify the mis-matched pair.

- (a) Polygenic inheritance – Human skin colour
- (b) Pleiotropism – Phenylketonuria
- (c) Multiple allelism – Colourblindness
- (d) Co-dominance – Sickle cell haemoglobin

24. Read the given passage and select the correct option.

The sex determination in honeybee is based on the number of sets of chromosomes an individual receives. A fertilised egg develops into (i) and an unfertilised egg develops into (ii) by (iii). Males are haploid with (iv) chromosomes and females are diploid with (v) chromosomes. This is known as haplo-diploid sex determination.

	(i)	(ii)	(iii)	(iv)	(v)
(a)	worker	drone	amphimixis	8	16
(b)	queen	drone	parthenogenesis	16	32
(c)	queen	worker	parthenogenesis	16	32
(d)	queen	drone	syngamy	8	16

25. Which of the following is an autosomal recessive disorder?

- (a) Colourblindness
- (b) Huntington's disease
- (c) Haemophilia
- (d) Sickle cell anaemia

26. It is a sex linked recessive disease which is transmitted from heterozygous carrier female to sons. Blood clotting protein gets affected, resulting in non-stop bleeding from small cut. Identify the disease.

- (a) Haemophilia
- (b) Thalassemia
- (c) Huntington's disease
- (d) Duchenne's muscular dystrophy

27. Identify the genotype of sickle cell anaemia that shows diseased phenotype.

- (a)  $Hb^S Hb^A$
- (b)  $Hb^A Hb^A$
- (c)  $Hb^S Hb^S$
- (d) Both (a) and (c)

28. Select an incorrect statement.

- (a) In sickle cell anaemia, mutant haemoglobin molecule undergoes polymerisation under low oxygen tension, resulting in sickle cell structure of RBCs.
- (b) Sex determination mechanism in grasshopper is an example of female heterogamety.
- (c) Increase in whole set of chromosomes due to failure of cytokinesis after telophase is called polyploidy.
- (d) Colourblindness shows criss-cross inheritance.

29. Find the odd one out in context of Down's syndrome.

- (a) Palm crease
- (b) Gynaecomastia
- (c) Mental retardation
- (d) Mongolian eyefold

30. Chromosomal constitution of individual with Turner's syndrome is

- (a)  $44 + XO$
- (b)  $44 + XXY$
- (c)  $45 + XX$
- (d)  $45 + XY$



## HIGHER ORDER THINKING SKILLS QUESTIONS (HOTS)

31. The allele for pea comb (P) in chickens is completely dominant to the allele for single comb (p). The alleles for black feather colour (B) and white feather colour (B') show incomplete dominance, so that BB' individuals possess grey feathers. If chickens heterozygous for both pairs of genes are mated, what proportion of offspring are expected to be single combed and grey feathered?

- (a) 9/16
- (b) 3/16
- (c) 1/16
- (d) 2/16

32. The horse (*Equus caballus*) has a diploid complement of 64 chromosomes including 36 acrocentric autosomes; the ass (*Equus asinus*) has 62 chromosomes including 22 acrocentric autosomes. Predict the number of chromosomes to be found in the hybrid offspring (mule) produced by mating ass (jack) to a female horse (mare).

- (a) 33
- (b) 63
- (c) 36
- (d) 64

33. Kernel colour in corn is a trait determined by two alleles. The dominant allele (P) produces a purple colour and the recessive allele (p) produces a yellow colour.

The yellow kernels can be best described as

- (a) homozygous dominant
- (b) hybrid
- (c) heterozygous
- (d) homozygous recessive.

34. Epistatic effect in which the dihybrid cross  $AaBb \times AaBb$  resulting in the ratio 12 : 3 : 1 is due to

- (a) interaction between two alleles of different loci
- (b) interaction between two alleles of the same locus
- (c) dominance of one allele on another allele of both loci
- (d) dominance of one allele on another allele of the same locus.

35. Human skin colour is controlled by several gene pairs. Let us assume here that there are just three gene pairs on different chromosomes and that for each pair there are two alleles— an incompletely dominant one that codes for melanin deposition. An incompletely very dark-skinned person mates with a very light-skinned person, what is the chance that their offsprings will have very dark skin?

- (a) zero
- (b) 1/4
- (c) 5/8
- (d) 9/64



# Scientist of the Month



**George Papanicolaou**  
(13 May 1883- 19 February 1962)

## Early life and Education

George Nicholas Papanicolaou was a pioneer in elucidating the physiology and cytologic characteristics of the female reproductive system. He was born on May 13, 1883, in the town of Kymi on the island of Euboea, Greece. In 1898, he attended University of Athens, majoring in music and the humanities and not in biology. On the urging of his physician-father, Papanicolaou pursued a career in medicine, eventually earning his medical degree in 1904. Later that year, he worked in the army as Assistant Surgeon for a short time. He arrived in Jena, Germany in 1907 to study under Ernest Haeckel, an early supporter of Darwin's theory of evolution. He also studied with August Weismann of Freiburg, a geneticist. Papanicolaou enrolled at the Zoological Institute in Munich and was awarded a PhD in 1910 for his thesis, "Sex differentiation of the daphnia." Shortly thereafter, Papanicolaou got married to Andromache Mavroyeni (Mary), who was from a famous military family. After their wedding, he accepted a position at the Oceanographic Museum of Monaco. He worked as the physiologist for a scientific expedition on an oceanographic research ship. In 1911, he took part in a scientific expedition on Prince Albert's oceanographic vessel L'Hirodelle. A year later, during the Balkan Wars (1912-1913), he was conscripted into the army as an Lieutenant and returned to Greece in 1912. Papanicolaou arrived in New York City on October 19, 1913. He was working at Weill Medical College of Cornell University from 1914 to 1961 under Charles Stockard, MD, chairman of the anatomy department. Papanicolaou decided to leave New York to develop and head the Cancer Institute of Miami. Three months after arriving in Miami, Papanicolaou died on 19 February 1962 from a heart attack.

## Contributions

- In 1916, while studying sex chromosomes, Papanicolaou deduced that reproductive cycles in the experimental animals could be timed by examining smears of their vaginal secretions. Papanicolaou used a nasal speculum to collect samples, and

examined the smears under his microscope. What he saw was diverse cell forms and a sequence of distinctive cytologic patterns. He was able to chart the cyclic ovarian and uterine changes each day, allowing him to predict ovarian status. He could then harvest the oocytes at the appropriate time. He had published his research on the cytologic patterns in guinea pigs in the American Journal of Anatomy in 1917.

- Papanicolaou performed the first Pap test on his wife. Upon examination of a slide made from a smear of the patient's vaginal fluid, he discovered that abnormal cancer cells could be plainly observed under a microscope.
- Papanicolaou was appointed assistant in the Pathology Laboratory at the New York Hospital. In 1928 he presented his work "New Cancer Diagnosis" to the third race betterment conference (Battle Creek, Michigan). But the work was met with scepticism.
- In 1943, Dr. Papanicolaou and Dr. Herbert Traut published their findings and conclusions in the famous monograph. "Diagnosis of uterine cancer by the vaginal smear". During this time, he developed his method of preservation of these cells by wet fixation and precise staining. This diagnostic procedure was named the Pap test.
- Papanicolaou described the importance of a distinct cellular pattern corresponding to cervical intraepithelial neoplastic lesions.
- In 1954, Papanicolaou wrote a book detailing all of his methods and observations, called Atlas of Exfoliative Cytology which contained a compendium of cytological findings in health and disease involving multiple organ systems of the human body.
- In 1961, Papanicolaou became director of the Cancer Research Institute of Miami in Miami, Florida.

## Awards and Honours

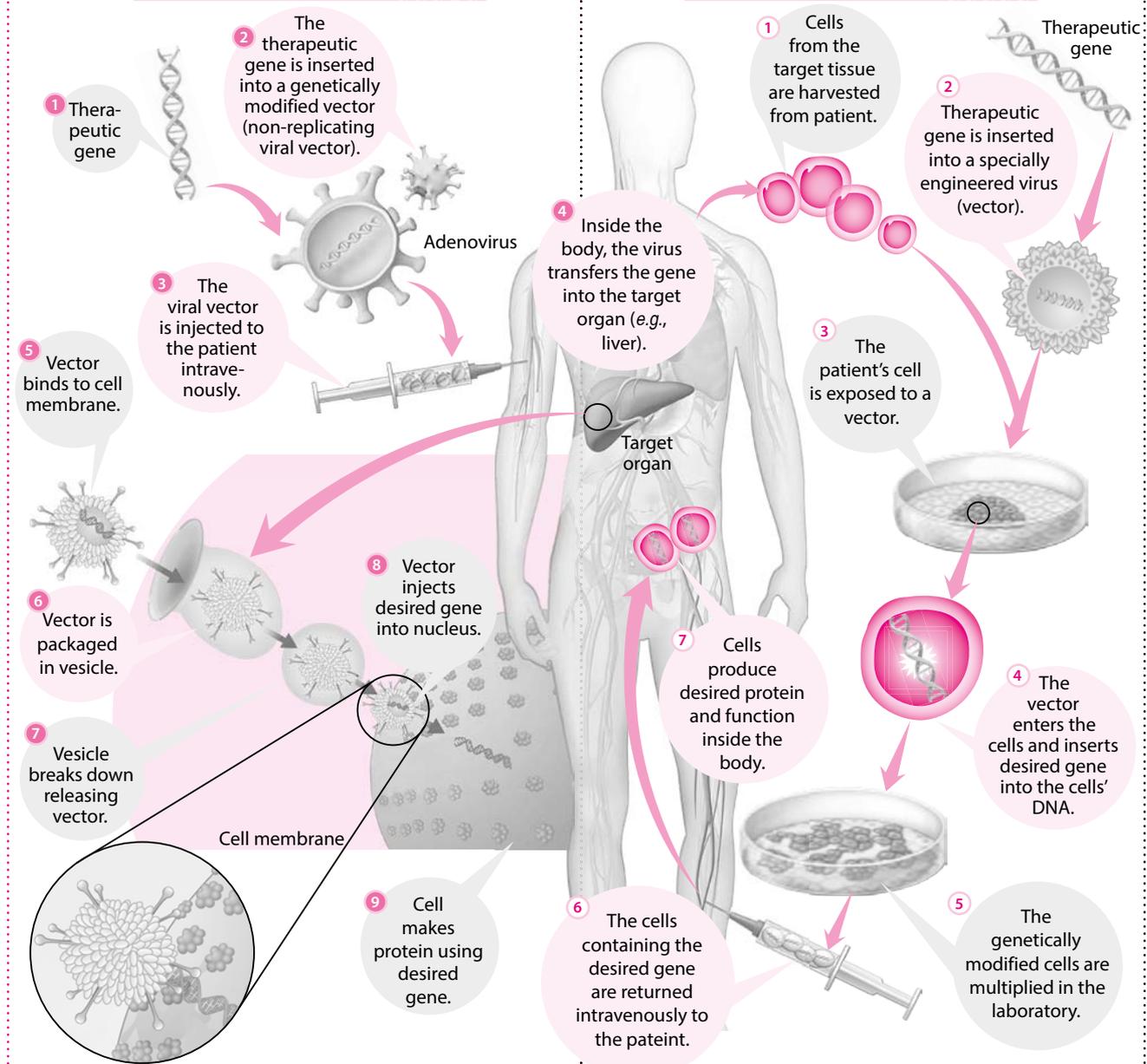
- Papanicolaou received many accolades for his contributions to the detection of cervical cancer.
- Papanicolaou received the Albert Lasker Award for Clinical Medical Research from American Public Health Association in 1950.
- In 1955, he was a recipient of the Bertner Award conferred to him by University of Texas in Houston, Texas, for cancer related research.
- Several countries have created postage stamps honoring him, and the 10,000 drachma note in Greece bears his face.
- The Miami Cancer Institute honored his life by renaming the institution, the Papanicolaou Cancer Research Institute in November of 1962.
- In 1978 his work was honored by the U.S. Postal Service with a 13-cent stamp for early cancer detection. 😊😊

# Somatic Gene Therapy

Gene therapy is a technique that allows the insertion of therapeutic genes into an individual's cells and tissues to treat diseases in which a defective mutant allele is replaced with a functional one. The first clinical therapy was successfully accomplished on 14<sup>th</sup> September, 1990, at the National Institutes of Health (NIH), under the direction of William French Anderson. The patient was a four year old Ashanti De Silva who received treatment for adenosine deaminase (ADA) deficiency. All gene therapy till date on humans has been directed at somatic cells, whereas germline gene therapy in humans remains controversial. Somatic gene therapy can be broadly categorised as *ex vivo* (where cells are modified outside the body and then returned back into body) and *in vivo* (where genes are changed in cells, inside the body). Although, this technology is still in its infancy, it has been used with some success.

## *in vivo* gene therapy

## *ex vivo* gene therapy

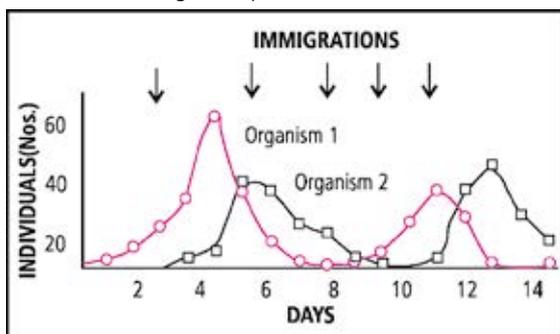


# BIOLOGY

## OLYMPIAD PROBLEMS

### INBO

- Consider a diploid organism with  $2n$  value of 4. How many chromosomes and DNA molecules respectively are present in the  $G_1$  and  $G_2$  phases of a somatic cell of this organism? (consider only nuclear DNA)
  - $G_1$ : 4 and 4;  $G_2$ : 4 and 4
  - $G_1$ : 4 and 4;  $G_2$ : 4 and 8
  - $G_1$ : 4 and 4;  $G_2$ : 8 and 4
  - $G_1$ : 4 and 4;  $G_2$ : 8 and 8
- In the following diagram, the interaction between two organisms 1 and 2 is shown in laboratory culture. At different intervals, individuals of both the species were introduced into culture to maintain their population density (like natural immigration process).



Which of the following statement/s is/are true for this interrelationship?

- If immigration is not there, population of both species will get exhausted within 6 to 10 days.
  - Organism 1 is most likely the predator of organism 2.
  - The graph shows normal curve of prey – predator relationship. Therefore, in this experiment, immigration of species from external source is not essential for coexistence of species.
  - Organism 1 and 2 share a mutualistic relationship with each other.
- (i) and (ii)
  - (iii) and (iv)
  - (i) only
  - (iv) only

### NSO

- Two species of *Amoeba* X and Y were kept in freshwater and got adapted. Species X developed contractile vacuole.

When both the species were transferred to sea water and got adapted both X and Y lost the contractile vacuole. The conclusion that can be drawn is that

- both X and Y are marine species
- both X and Y are freshwater species
- X is marine species and Y is a freshwater species
- Y is a marine species and X is a freshwater species.

(Second Level)

- Your favorite house plant's younger leaves, not the older leaves, are yellowing. You recall that the cause of plant sickness can be diagnosed by which leaves are yellowing. What is the most likely cause of your plant's plight?
  - Too much shade
  - Lack of nitrogen-fixing *Rhizobium* bacteria
  - A deficiency in a mobile mineral nutrient
  - A deficiency in a non-mobile mineral nutrient

(Fifth Level)

### CANADIAN BIOLOGY OLYMPIAD

- The excessive use of antibiotics is a concern to the medical community. The concern is that antibiotics will no longer be as effective in treating disease because:
  - humans are evolving a resistance to some antibiotics
  - viruses are not killed by antibiotics
  - some bacteria are evolving resistance to antibiotics
  - antibiotics are very expensive
  - antibiotics cause mutations.
- Which organism would be the most severely affected by the presence of pesticides that can become biologically magnified in a given ecosystem?
  - Primary consumers, such as grasshoppers
  - Primary producers, such as plants
  - Top predators, such as hawks
  - Secondary consumers, such as mice that feed on insects
  - Decomposers, such as earthworms

(Sixth Level)

(Tenth Level)

### AUSTRALIAN BIOLOGY OLYMPIAD

- The main reason for some neurons being myelinated is to
  - protect the nerve against physical damage
  - increase the diameter of the axon to slow the speed of the action potential
  - increase the speed of the action potential

- (d) decrease the possibility of false triggering from nearby muscle activity  
 (e) increase metabolic activity to maintain nerve function. (Third Level)

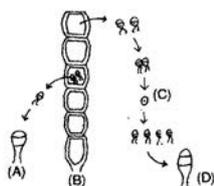
8. Two different animals are classified into the same family. This means that they would be classified in  
 (a) the same phylum but different class  
 (b) the same class but different species  
 (c) a different kingdom and different phylum  
 (d) a different class and different order  
 (e) the same genus but different phylum (Fourth Level)

### NSEB

9. If the blood groups of the parents are O Rh+ve and AB Rh+ve, the child with a normal genotype cannot show a blood group :  
 (a) A Rh +ve (b) AB Rh +ve  
 (c) O Rh +ve (d) Both (b) and (c).

(Second Level)

10. Life cycle of *Ulothrix* is shown in the diagram. The correct ploidy levels at the four stages A, B, C and D are



- (a) A: n B: n C: 2n D: n  
 (b) A: n B: n C: 2n D: 2n  
 (c) A: 2n B: n C: 2n D: n  
 (d) A: n B: n C: n D: n.

(Fourth Level)

### SOLUTIONS

1. (b) : During mitosis, chromosomes are divided and get separated in late metaphase and anaphase, sister chromatids move towards opposite poles and eventually two cells are formed with one set of (2n) chromosomes each. Considering a diploid organism with 2n value of 4, in G<sub>1</sub> (gap 1) phase of cell cycle, chromosome number will be same i.e., 4. Each chromosome have a single DNA molecule. So in G<sub>1</sub> phase, the chromosome number and DNA molecules number both will be 4. In the S phase (synthesis phase) of interphase, the chromosomes replicate and the DNA molecules get doubled as a result duplicate set of genes are formed. We know that in G<sub>2</sub> phase synthesis of DNA stops, therefore the G<sub>2</sub>, number of chromosome will remain same, i.e., 4 but the number of DNA molecule will be 8 in G<sub>2</sub> phase.
2. (c) : The given graph shows predator-prey relationship between two organisms. Here, organism 2 is the predator and organism 1 is prey. It can be seen that, at the point

of introduction of organism 2 in the culture, population of organism 1 gradually decreased. Population of organism 2 also decreased due to unavailability of food. After the immigration, population of organism 1 is increased which again decreased by the immigration of organism 2 in the culture. Thus, we can conclude that immigration of species from external source is essential for coexistence of these species, otherwise the whole population will get exhausted within 6 to 10 days as per the graph.

3. (c) : A contractile vacuole is a sub-cellular structure involved in osmoregulation. Its function is to regulate the water content of the cell. *Amoeba* excretes excess water and waste through it. Marine *Amoeba* are isotonic to water and therefore, have no contractile vacuole. Freshwater *Amoeba* develops contractile vacuole as the surrounding environment is hypertonic and without the contractile vacuole, it may burst.

In the given experiment when X and Y *Amoeba* were kept in fresh water, species X developed contractile vacuole which means X is a marine species of *Amoeba* that did not have contractile vacuole before. When X and Y were transferred to sea water, both of them lost contractile vacuole, which means species Y already had contractile vacuole, that implies Y is a fresh water species of *Amoeba*.

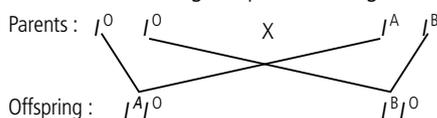
4. (d) : Each essential element has one or more specific structural and functional roles in plants and its deficiency results in appearance of abnormal signs called deficiency symptoms. In the given example, younger leaves are yellowing and not the older leaves (chlorosis). Deficiency symptoms appear first in young leaves and young tissues when the element is immobile inside the plant, e.g., Ca, S (chlorosis). In case, the element is mobile, the sign appear first in older leaves as the element is mobilised from senescing regions for supply to young tissues, e.g., N, P, Mg, etc.
5. (c) : Excessive use of antibiotics exerts a threat to medical system because some bacteria are evolving resistance to antibiotics through horizontal gene transfer. These antibiotic resistance genes are present in plasmids of bacteria. Plasmids are capable of horizontal gene transfer from one bacterium to another. Thus, antibiotic resistance spreads very fast from one species to another.
6. (c) : Biomagnification occurs when heavy metals and persistent pesticides pass into food chain and increase in amount per unit weight of organism with the rise in trophic level due to their accumulation in tissue. So, the highest amount will be found in top predators and will be affected most such as hawks, etc.

7. (c) : Myelin is an insulating layer or sheath that forms around nerves. It is made up of protein and fatty substances. The main function of myelin is to increase the speed at which electrical impulses propagate along the myelinated fibre. Propagation *via* saltatory conduction is faster than propagation in non-myelinated fibers of the same axon diameter. This is because less charge leaks out through the myelin-covered sections of the membrane, more charge arrives at the node adjacent to the active node and an action potential is generated sooner than if the myelin were not present. Myelinated axons are therefore metabolically more efficient than non-myelinated. Thus, myelin adds speed, reduces metabolic cost, saves room in the nervous system because the axons can be thinner.

8. (b) : If two animals are classified under same family, it means their genus can be different or same, species are different but their order, class, phylum and kingdom are same. For example, dog (*Canis familiaris*) and wolf (*Canis lupus*) have the following common taxonomy:

Kingdom	–	Animalia
Phylum	–	Chordata
Class	–	Mammalia
Order	–	Carnivora
Family	–	Canidae
Genus	–	<i>Canis</i>

9. (d) : Blood groups of the parent given are, O Rh + ve and AB Rh + ve. On crossing the parents, we get :



So, the offspring will be A Rh + ve or B Rh + ve only.

AB Rh + ve and O Rh +ve blood groups cannot be possible in offspring.

10. (a) : *Ulothrix* is a filamentous green algae. Its plant body is haploid and shows haplontic life cycle. *Ulothrix* reproduces asexually by zoospores, aplanospores hypnospores and akinetes whereas sexually by biflagellate gametes. Sexual reproduction is isogamous type. Zygote is produced after the fusion of haploid gametes and is the only diploid (2n) structure in the life cycle of *Ulothrix*. In the given figure, 'A' is the young plant body produced by the germination of zoospores. Therefore, 'A' is haploid (n) structure. 'B' is the mature alga, which is again a haploid (n) structure. 'C' is zygote produced by the fusion of isogametes, hence, it is diploid (2n). Zygote produces meiospores through meiosis, meiospores germinate to form new plant body, 'D' which is again haploid (n) structure.



# mcq's

## MEMORY CONTEST

### 1 Who can participate

If you have taken any of the exams given below and possess plenty of grey cells, photographic memory then you are the right candidate for this contest. All you have to do is write down as many questions (with all choices) you can remember, neatly on a paper with name of the exam, your name, address, age, your photograph and mail them to us.

### 2 The Exams

**PMT:** AIIMS, JIPMER, .... etc.

**Engineering:** VITEEE, UPSEE, SRMJEEE, BITSAT, COMED-K.... etc.

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Plenty! Each complete question with answer will make you richer by Rs. 100\*. More the questions, the merrier it will be. We will make you famous by publishing your name (photo if possible). Also you can derive psychological satisfaction from the fact that your questions will benefit thousands of readers.

### 4 And Lastly The Pitfalls

Don't send incomplete question. Our panel of experts will cross-check your questions. You have to send it within a month of giving the particular exam.

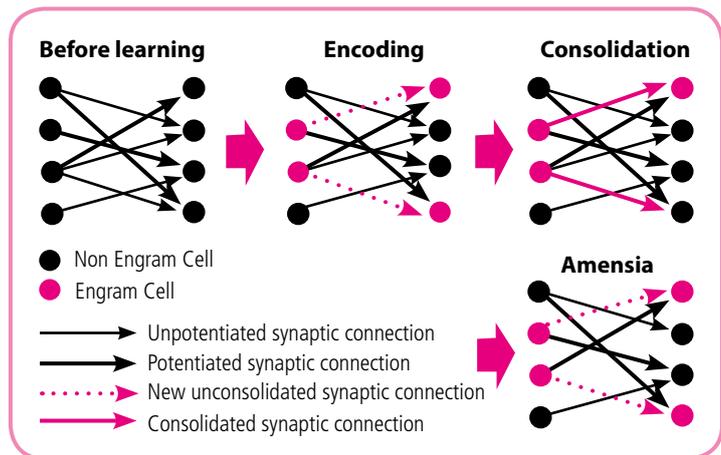
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- Kindly note that each question should be complete.
- Payment will be made only for complete questions.
- Preference will be given to the reader sending the maximum complete and correct questions. Other conditions apply. The decision of the Editor, MTG shall be final and binding.

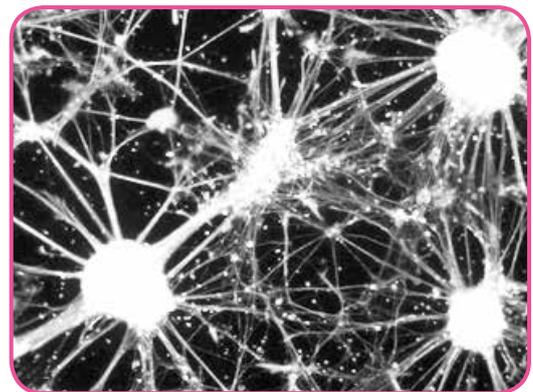
## MEMORY ENGRAM CELLS

What happens to memories as years go by has long been a fundamental question in neuroscience and psychology. For decades, researchers have attempted to identify the brain regions in which memory is formed and to follow its changes across time. The theory of systems consolidation of memory (SCM) suggests that changes in circuitry and brain networks are required for the maintenance of a memory with time. Various mechanisms by which such changes may take place have been hypothesised. Recent studies in neuroscience, reveal that memory storage and recall are closely related to the activities in discrete memory engram (trace) neurons within the dentate gyrus (DG) region of hippocampus and the layer 2/3 of neocortex. More strikingly, optogenetic (light-sensitive response) reactivation of those memory engram cells is able to trigger the recall of naturally encoded memory. Memory engram technology allows the labelling and subsequent manipulation of components of specific memory engrams in particular brain regions and it has been established that cell ensembles labelled by this method are both sufficient and necessary for memory recall.



## STEM CELLS FROM HUMAN BLOOD CELL: A REPROGRAM APPROACH

Stem cells can multiply indefinitely and if they are pluripotent embryonic stem cells, they can generate all conceivable cell types. Stem cells have enormous potential both for basic research and for the development of regenerative therapies that aim to restore diseased tissue in patients. Scientists have recognised that such stem cells could also be produced in the laboratory from mature body cells which made a major breakthrough in stem cell research. These are called induced pluripotent stem cells (iPSC). Four genetic factors are sufficient to reverse the course of development and produce iPSC that have identical properties to embryonic stem cells. Recently, scientists have succeeded in reprogramming different human cells like, connective tissue cells of the skin or pancreas as well as peripheral blood cells. They report the direct reprogramming of both adult human fibroblasts and blood cells into “induced neural plate border stem cells” (iNBSCs) by ectopic expression of four neural transcription factors. These self-renewing iNBSCs generate functional cell types of neural crest and central nervous system lineages. This study gives insights into neural development and provide a neural stem cell source for applications in regenerative medicine.





The questionnaire contains multiple choice questions based on current affairs and recent developments worldwide. Various facts are presented in question form to enable the students to develop knowledge as well as to test their general awareness skills and equip them with all essentials to crack various PMTs (AIIMS, etc.). This will also help them to excel in other competitive exams like Banking and various Government recruitment exams.

- Which Indian music record label bagged the spot of No. 1 YouTube Channel recently?
  - T-Series
  - Universal music (India)
  - Saregama India Ltd.
  - Tips industries Ltd.
- Who won the men's singles title at the Yonex-Sunrise India Open badminton tournament?
  - Kento Momota
  - Viktor Axelsen
  - Ricky Karanda
  - Lee Yang
- The United Nations has appointed Nicholas Koumjian as the investigation head for which nation?
  - North Korea
  - Myanmar
  - Syria
  - Yemen
- Yoshua Bengio, Geoffrey Hinton and Yann LeCun were on March 27, 2019 awarded with the 2018 ACM A.M. Turing Award for their work in which field?
  - Genome Editing
  - Internet of Things
  - Artificial Intelligence
  - Gene Therapy
- Which Miniratna category Central Public Sector Enterprise on March 29, 2019 came out with the Initial Public Offering (IPO)?
  - Rail Vikas Nigam Ltd.
  - Airline Allied Services Ltd.
  - Nuclear Power Corporation of India Ltd.
  - Solar Energy Corporation of India Ltd.
- Garampani Sanctuary is located at
  - Rewa, MP
  - Diphu, Assam
  - Kohima, Nagaland
  - Kalimpong, West Bengal.
- Which nation has become the 4<sup>th</sup> largest space power?
  - Italy
  - China
  - India
  - France
- Under the newly announced minimum income guarantee scheme by a leading opposition party, how much annual income has been proposed for 20 per cent of India's poorest families?
  - ₹ 70,000
  - ₹ 72,000
  - ₹ 74,000
  - ₹ 75,000
- What is the theme for 'World Tuberculosis Day'?
  - It's time
  - Unite to end TB
  - Gear up to end TB
  - Wanted: Leaders for a TB-free world
- Which Indian artist has been chosen as the Glenfiddich Emerging Artist of the Year 2019?
  - Biplap Sarkar
  - Raju Baraiya
  - Subhir Hati
  - Sitaram Swain
- Which film has won the best film at 64<sup>th</sup> filmfare award 2019?
  - Raazi
  - Padmaavat
  - Sanju
  - Badhai ho
- Fitch Ratings has recently cut India's GDP growth forecast for FY20 from 7.0% to \_\_\_\_\_.
  - 6.8
  - 6.6
  - 6.5
  - 6.4
- Who has been elected as the female President of Slovakia?
  - Lucia Monika
  - Zuzana Caputova
  - Maria Horvath
  - Martina Vanessa
- The 'black flag' signifies
  - peace
  - harmony
  - protest
  - revolution.
- Which IIT has successfully converted petroleum waste toluene into benzoic acid?
  - IIT Madras
  - IIT Bombay
  - IIT Kharagpur
  - IIT Ahmedabad
- Goa Shipyard Limited (GSL) was established in
  - 1955
  - 1956
  - 1957
  - 1958.
- Which fictional superhero will be the first inductee into Comic-Con Museum's Character Hall of Fame?
  - Batman
  - Spiderman
  - Superman
  - Ironman
- Which country's team has won the 2019 Sultan Azlan Shah Hockey tournament?
  - North Korea
  - South Africa
  - South Korea
  - Italy
- J. Mahendran was the veteran filmmaker of which regional cinema?
  - Tamil
  - Punjabi
  - Bengali
  - Telugu
- The slogan "You can change friends but not neighbours" was given by
  - Atal Bihari Vajpayee
  - Lal Krishna Advani
  - APJ Abdul Kalam
  - Swami Dayanand.

21. Which of the following Indian institutes has developed an anti-cancer, anti-inflammatory drug conjugated to the human serum albumin?  
 (a) Sree Chitra Tirunal Institute  
 (b) AIIMS  
 (c) VIT  
 (d) IISc
22. Kandhamal Haldi with GI tag now, is produced in which of the following states?  
 (a) Odisha (b) Karnataka  
 (c) Uttar Pradesh (d) Uttarakhand
23. Which country has successfully launched second generation data relay Tianlian II-01 satellite?  
 (a) Japan (b) China  
 (c) Canada (d) UK
24. Who has become the first batsman to score 5,000 runs in IPL history?  
 (a) Suresh Raina (b) MS Dhoni  
 (c) Virat Kohli (d) Rohit Sharma
25. What is the India's rank in the 2019 WEF Global Energy Transition Index?  
 (a) 76<sup>th</sup> (b) 74<sup>th</sup> (c) 75<sup>th</sup> (d) 78<sup>th</sup>
26. Who is the author of the book 'Every Vote Counts-The Story of India's Elections'?  
 (a) Navin Chawla (b) Kiran Desai  
 (c) Arundhati Roy (d) V.S. Naipaul
27. Which country won the ICC test championship mace for the third year in a row?  
 (a) New Zealand (b) Australia  
 (c) India (d) England
28. COMCASA agreement was recently in news. What is the full form of COMCASA?  
 (a) Complementation, Communications and Security Agreement  
 (b) Communications, Complementation and Security Agreement  
 (c) Communications, Compatibility and Security Agreement  
 (d) Compatibility, Communication and Security Agreement
29. Which of the following bank becomes the 3<sup>rd</sup> largest bank after it merged with Dena Bank and Vijaya Bank?  
 (a) Bank of Baroda (b) Bank of India  
 (c) Union bank of India (d) Allahabad Bank
30. The freshwater species that, has been recently added in the critically endangered list by IUCN is  
 (a) Kokopu (b) Tor remadevii  
 (c) Shrimp (d) Wels catfish.

**ANSWER KEY**

1. (a) 2. (b) 3. (b) 4. (c) 5. (a)  
 6. (b) 7. (c) 8. (b) 9. (a) 10. (b)  
 11. (a) 12. (a) 13. (b) 14. (c) 15. (a)  
 16. (c) 17. (a) 18. (c) 19. (a) 20. (a)  
 21. (a) 22. (a) 23. (b) 24. (a) 25. (a)  
 26. (a) 27. (c) 28. (c) 29. (a) 30. (b)



## NEW SPECIES OF ANCIENT HUMAN DISCOVERED IN PHILIPPINES CAVE

Researchers digging in the Philippine's Callao Cave found teeth and bones that they say belong to a distinct species of ancient human previously unknown to science. The history of human evolution might be getting yet another rewrite. The specimen, named *Homo luzonensis*, was excavated from Callao cave on Luzon island in the northern Philippines and has been dated to 50,000-67,000 years ago. The tiny teeth suggest the human would have been shorter than 4ft tall – possibly even shorter than another ancient species, *Homo floresiensis*. The small fossils' curves and grooves reveal an unexpected mix of both ancient and more advanced traits. Five of the seven teeth attributed to *Homo luzonensis* have small sizes and relatively simple shapes, but one premolar has three roots, which is uncommon among modern humans. "The discovery of *H. luzonensis* underscores the complexity of the evolution, dispersal and diversity of the Genus *Homo* outside of Africa", said author.



# MIND BOGGLERS

- ☺ The hydrochloric acid secreted by the stomach is so potent that the entire stomach lining is replaced every three days to avoid digesting itself.
- ☺ Bacterial cells outnumber human cells by a ratio of around 10 : 1.
- ☺ The brain is much more active at night than during the day. When we turn off our brain turns on. Scientists don't yet know why this is but one can thank the hard work of our brain while we sleep for all those pleasant dreams.
- ☺ A moderate sunburn can do long-term damage to the blood vessels in our skin, making it more difficult for the affected skin to heal and stay healthy. It can actually take four to fifteen months for these capillaries and small arteries and veins to return to a normal condition depending on the severity of our burn.
- ☺ An adult human body is made up of  $\pm$  100 trillion cells. These cells can be differentiated into 200 different types with diverse forms.
- ☺ Elephants can hear through their feet. Sensitive nerve endings in their feet and trunks allow elephants to pick up underground or infrasonic messages.
- ☺ Plants can recognise their siblings by using chemical signals secreted from their roots.
- ☺ Caffeine evolved as a natural insecticide. It paralyzes and kills insects that attempt to feed on the plants containing the chemical.
- ☺ Borborygmi is the stomach growling or rumbling sounds caused by hunger and gas moving through intestines.
- ☺ Figs are not always considered vegan. When pollinated by a fig-wasp, the fig's inward facing flowers trap the wasp and the corpse is digested by enzymes in the fig.
- ☺ The average tree is made up of 99% dead cells. The only living parts are the leaves, root tips and phloem, which is a thin layer of under bark that acts as a food delivery system.
- ☺ The life of an eyelash is no more than 5 months.
- ☺ Speaking of cells - for the first time, researchers captured insane footage of a bacterium using its appendages to fish for little bits of DNA from its dead friends. It's just as incredible as it sounds.
- ☺ Human bone is an excellent example of a perfect architecture. The femur that supports the weight of our body during walking is more powerful when compared to a solid concrete of the same weight.
- ☺ Thirst not only occurs when the body loses a lot of fluids but also occurs due to increased levels of salt in the blood. The reason being salt tends to bind water.
- ☺ The jaw is one of the strongest parts of the human body in terms of exerting force.
- ☺ Taste buds cannot be seen with naked eyes, the little bumps seen on a human tongue are papillae.
- ☺ Alligators give birth to females in cold temperatures and to males when it's hot.
- ☺ Coco de mer is the biggest seed in the world that weighs up to 18 kg (40 pounds).
- ☺ Clownfish are all born males and the dominant male of a clownfish school will turn female when the female of that group dies.
- ☺ The building blocks of all life is DNA and it is capable of holding a huge amount of data.
- ☺ The relation between our thumb and our nose is - the length of our thumb is equal to the length of our nose.
- ☺ Superior canal dehiscence is a rare medical condition that affects the inner ear and amplifies all internal sounds. It gets to the point where the sound of the eyeballs moving in their sockets sounds like "sandpaper on wood." ☺☺

# WORD GRID

Readers are requested to send their responses of word grid to be the winner.

Find and encircle the words in the given grid, running in one of the possible directions; horizontally, vertically or diagonally by reading the clues given below.

## Clues

- Natural cytokinin present in corn kernels and coconut milk.
- Macronutrient that constituent ring structure of chlorophyll.
- Stage of Prophase I which comes after leptotene.
- Leucoplast in which proteins are stored.
- Bacteria living in hot springs.
- Plants produced by tissue culture that are genetically identical to the original plant from which they are grown.
- Chemical obtained from *Cannabis sativa*.
- A unit of polycistronic structural genes which is regulated by a common promoter and regulatory genes.
- Genus of calcareous sponges that have syconoid canal system.
- Scientist who established chromosomal theory of inheritance.
- Group of virus to which the pathogen of AIDS belong.
- Largest part of brain to which a deep cleft divides into two parts.
- Hormone secreted by posterior pituitary that stimulates reabsorption of water and electrolytes by distal tubules.
- A part of flowering plant which is developed by mature ovary after fertilisation in flowering plants.
- Sequence of nucleic acids of DNA/RNA that is same when read from 5' to 3' on one strand and 5' to 3' on the other complementary strand.
- An outgrowth which developed on parenchyma cells of xylem vessels, when the plant is stressed with drought or infection.
- A nitrogenous base found only in RNA.
- A type of inflorescence in which the first formed flower limits the growth of flowering shoot.
- Plant disease caused by pathogenic fungi of Order Pucciniales.
- Type of life cycle with dominant haploid stage.



T	P	Z	C	A	N	N	A	B	I	N	O	I	D	H
A	H	Z	Y	G	L	E	N	T	I	C	E	L	S	A
N	Y	E	F	G	C	E	R	E	B	R	U	M	V	P
R	L	A	R	O	O	V	U	L	E	A	N	I	A	L
E	U	T	U	M	L	T	U	R	E	A	S	T	S	O
T	C	I	I	E	O	T	E	E	O	P	E	R	O	N
R	Y	N	T	I	S	P	I	N	E	P	A	G	P	T
O	M	L	H	R	T	S	H	I	E	E	L	G	R	I
V	O	E	O	U	R	O	Y	I	A	R	A	A	E	C
I	S	A	A	S	O	M	A	C	L	O	N	E	S	T
R	E	F	K	T	E	O	F	E	O	E	I	S	S	T
U	R	A	C	I	L	R	E	N	I	N	S	O	I	L
S	U	T	T	O	N	G	V	I	R	O	I	D	N	O
N	I	C	H	E	P	A	L	I	N	D	R	O	M	E
L	I	C	M	A	G	N	E	S	I	U	M	O	S	S



\*Please send entries of solutions both with words and scanned copy of the grid.

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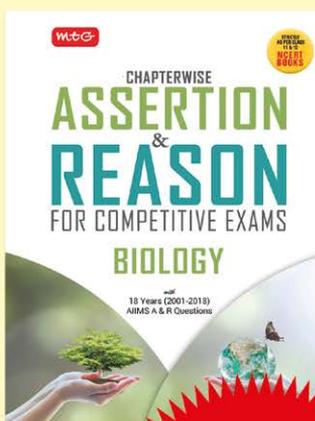
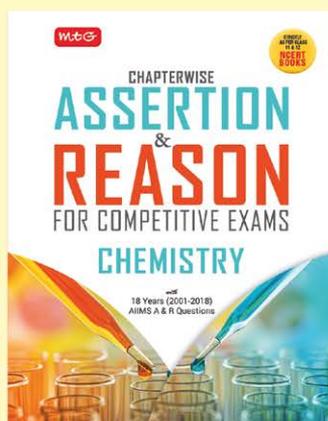
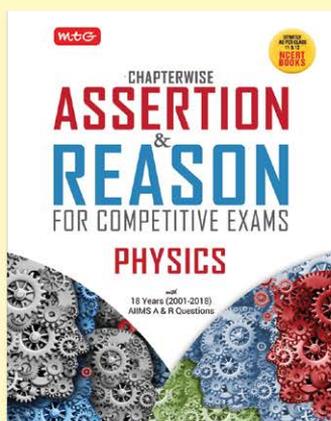
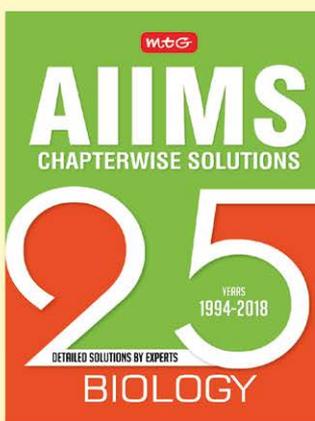
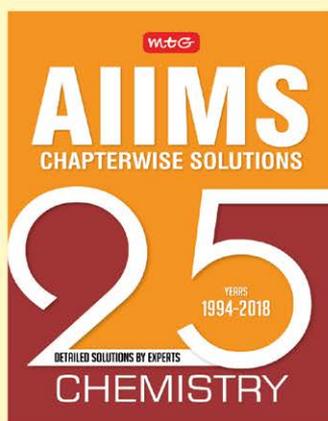
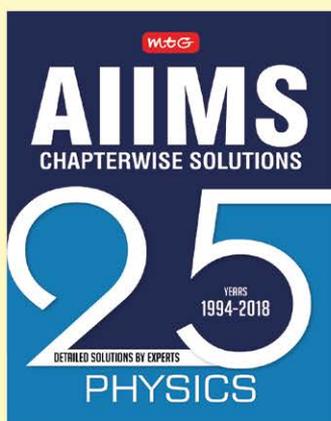
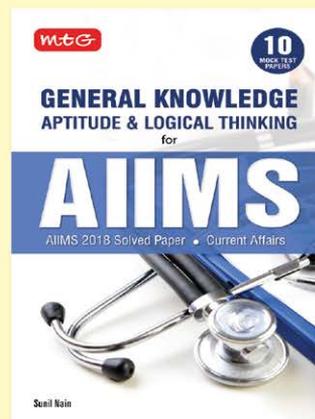
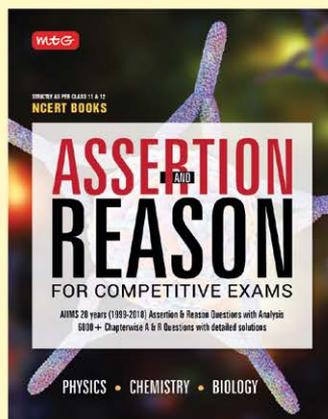
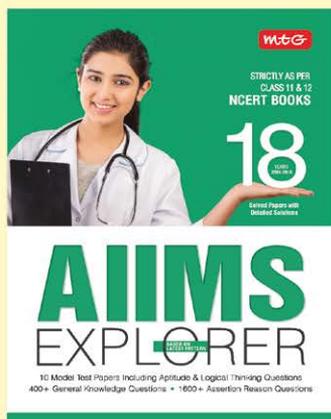
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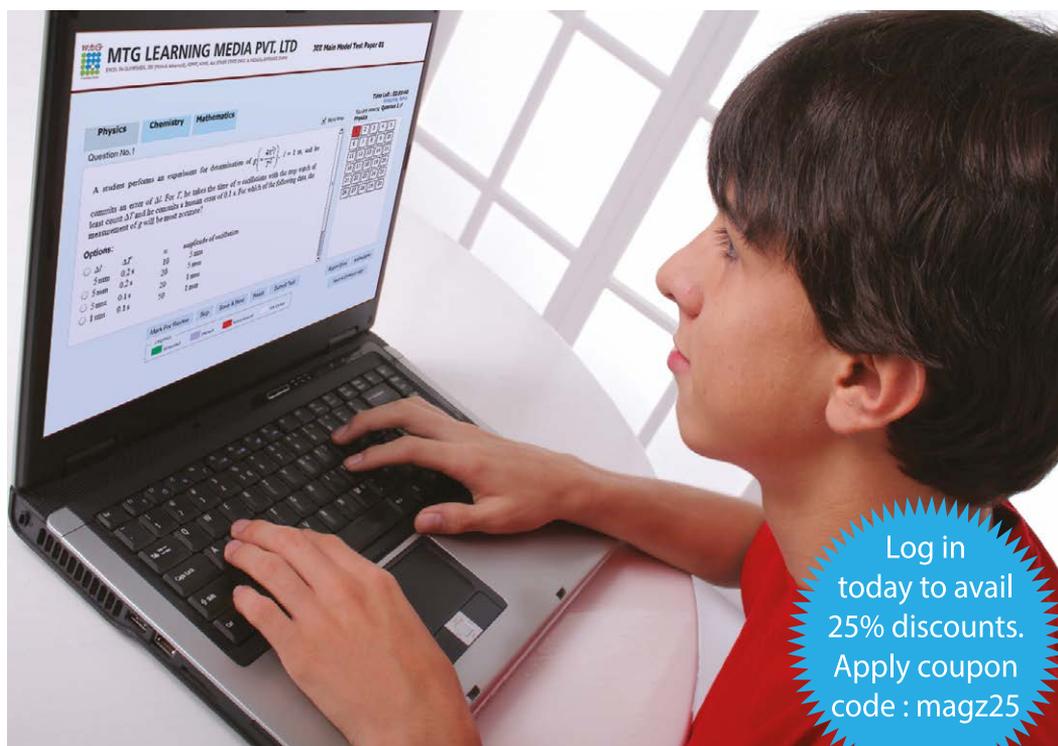
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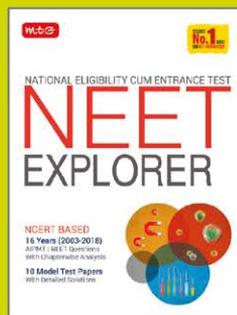
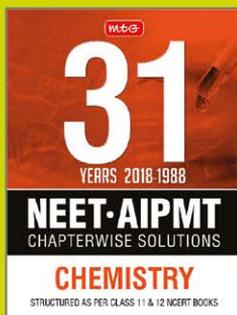
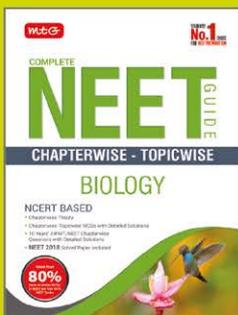
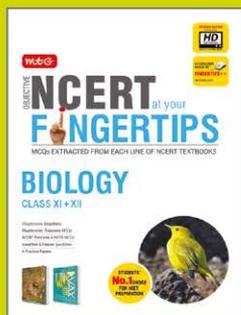
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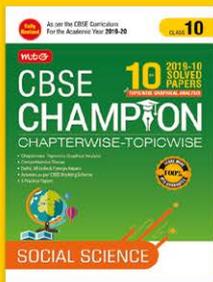
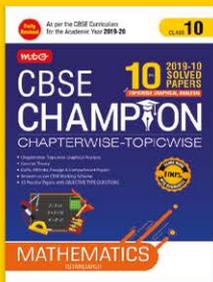
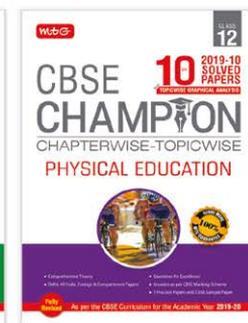
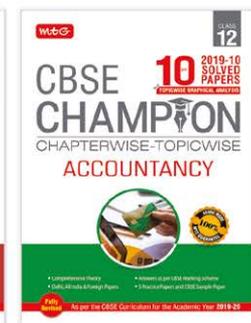
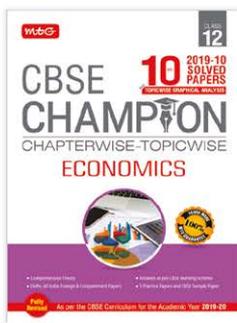
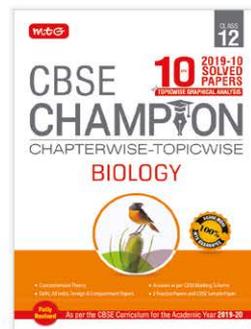
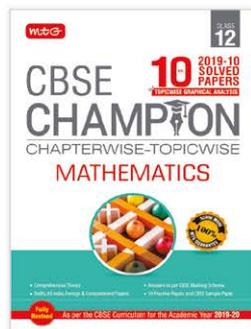
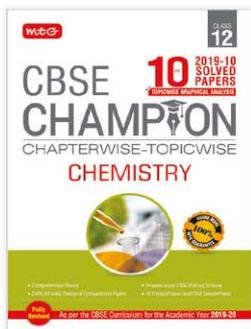
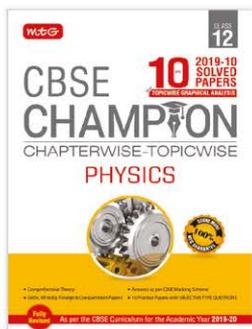
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