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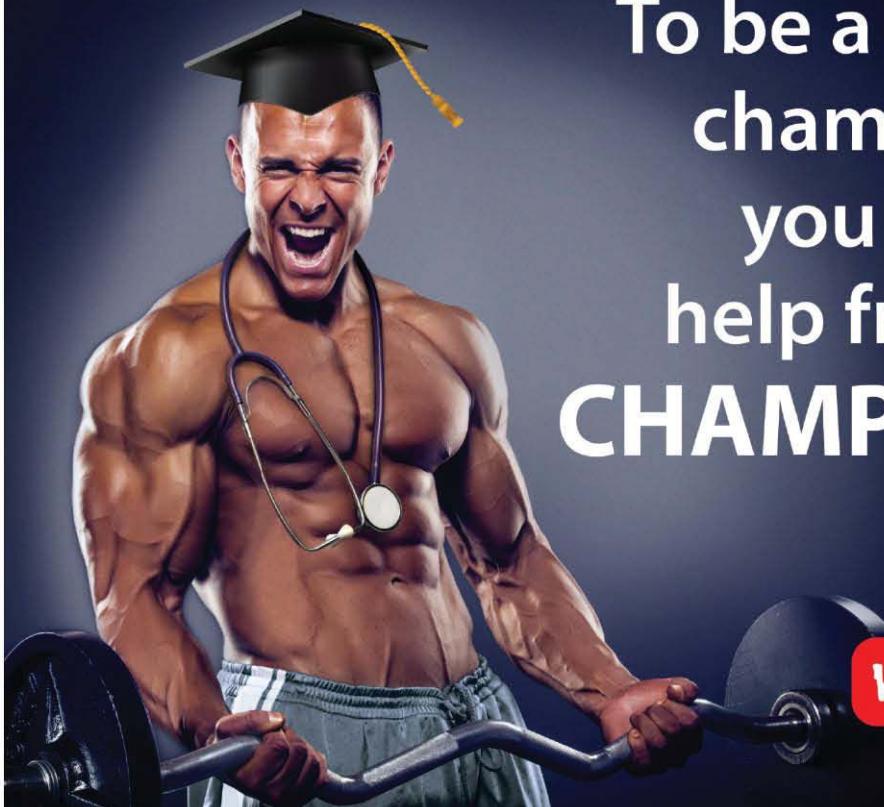
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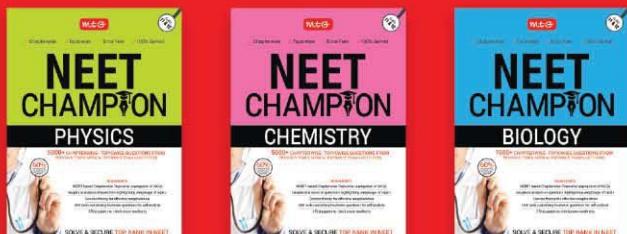
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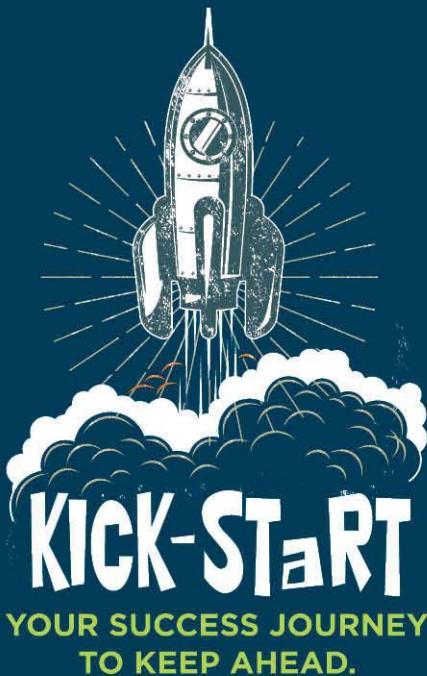
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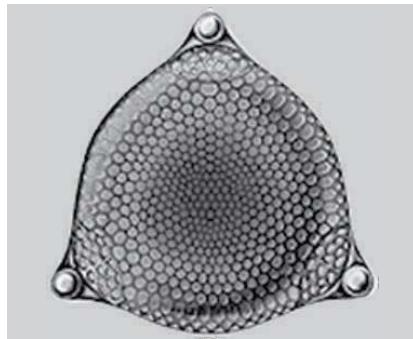
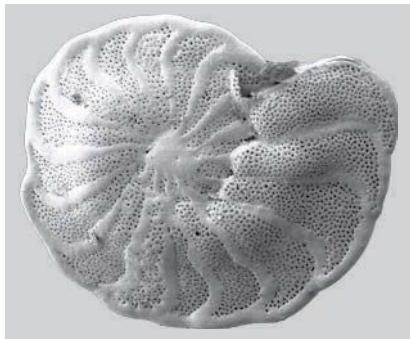
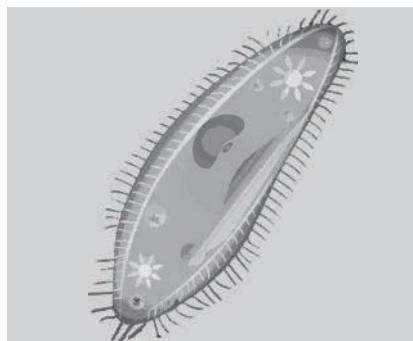
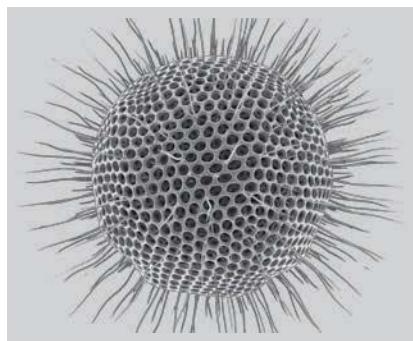
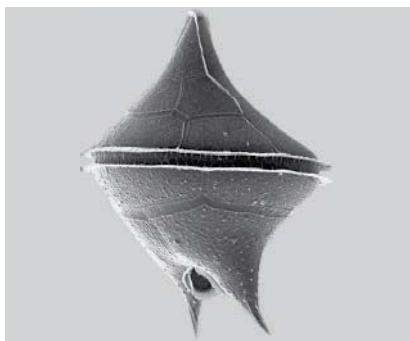
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# NEET ESSENTIAL

## KINGDOM PROTISTA

If we look around us one can notice the vast array of life forms inhabiting the earth. With time we encounter an incredible diversity of life forms, hence there arises a need to group or classify them. There have been many attempts to classify living organisms and it has constantly been evolving to fit all the species or organisms discovered so far. Therefore, the biological classification refers to as the scientific procedure of arranging organisms into groups and sub-groups on the basis of their similarities and dissimilarities and finally placing them in a hierarchy of categories.

As per the most prevalent Whittaker's classification, organisms have been divided on the basis of cell structure, type of nucleus, mode of nutrition, reproduction, etc., into 5 kingdoms - Monera, Protista, Fungi, Plantae and Animalia.

The Kingdom Protista was proposed by **Ernst Haeckel** to include those non-multicellular organisms which are neither plants nor animals in nature. Phylogenetically, the Protista acts as a connecting link between the prokaryotic Kingdom Monera and the complex multicellular kingdoms.

Protists may be defined as microscopic, unicellular eukaryotic organisms with no definite nucleus. This is not a natural group as it includes organisms that cannot be completely grouped as plants or animals. It includes a variety of life forms ranging from algae that resemble plants, e.g., diatoms, the protozoan resembling animals, e.g., *Amoeba*, *Paramecium* and some having characteristics of both plants and animals, e.g., *Euglena*.

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

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## GENERAL CHARACTERISTICS OF PROTISTS

### Habitat

Most of the protists are aquatic organisms, i.e., found in sea, freshwater and moist soil, some are found in water bodies in the form of plankton. However, some being parasites are also found inside bodies of animals.

### Cellular Organisation and Structure

- Protistans are small microscopic, unicellular animals.
- The body of protists remains covered by an envelope which protects them from harmful influences of external environment thereby permitting a controlled exchange of substances.
- The covering may be a thin plasma membrane or plasmalemma as in *Amoeba*, which allows change in shape and adhesion to substratum owing to its flexibility and presence of longitudinal ridges of mucopolysaccharides respectively.
- In some protists, the covering is in the form of differentiated, thicker and firm pellicle. Its rigidity provides definite shape to the body, e.g., *Euglena*, while it is variously ridged and sculptured in *Paramecium*.

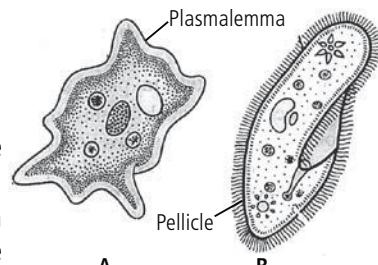


Fig.: A. Plasmalemma in *Amoeba*  
B. Pellicle in *Paramecium*

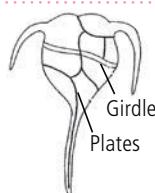
### Skeleton

Various kinds of permanent non-living external or internal layers are secreted which may be composed of organic substances as gelatin, cellulose or pseudochitin or inorganic substances such as silica, calcium carbonate, etc.

#### Types of external skeleton in protists

##### Theca

A coat of closely fitted cellulose layer is called theca, as in dinoflagellates. It may be differentiated into a number of plates laid out in a definite pattern, e.g., *Ceratium*.



##### Cyst

Formed as a temporary sheath in both free living and parasitic protists when they enter into dormant state.

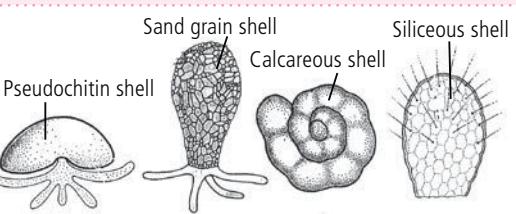
##### Lorica

It is a gelatinous or tectinous covering that fits less closely to the organism. It forms a cup or vase like structure with an opening through which the anterior part of body emerges out. In colonial forms, they may be attached directly to one another or by a stalk, e.g., *Poteriodendron*.



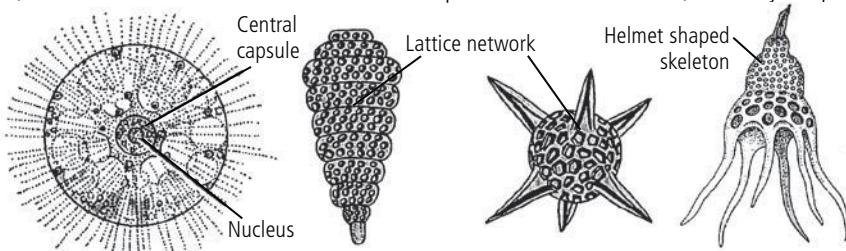
##### Shell or Test

These are widespread among protists and are provided with one or more openings. The shell may be thin and made up of chitinous substance pseudochitin, e.g., *Arcella*, sand grain shell in *Diffugia*, calcareous shell in *Discorbis* or siliceous shell in *Euglypha*.



### Internal Skeleton

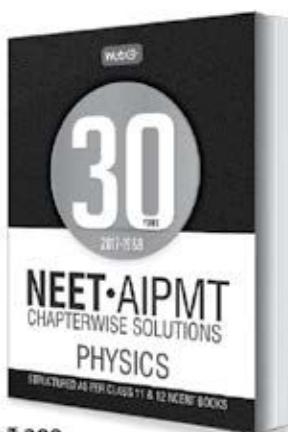
It is found between ectoplasm and endoplasm forming the central capsule. It is composed of gelatin, pseudochitin, silica or strontium sulphate. In radiolarians, the internal skeleton is continuous and comprise of a lattice network, variously sculptured and ornamented.



Cells are typically eukaryotic having membrane bound organelles like mitochondria, chloroplasts, Golgi bodies, endoplasmic reticulum, nucleus, etc.

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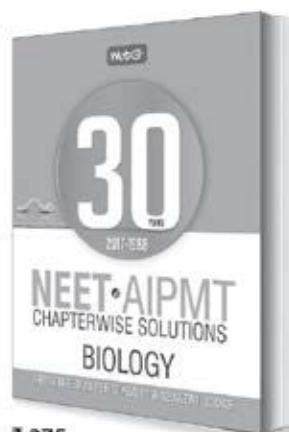
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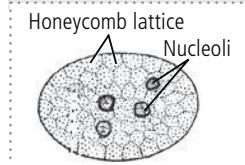
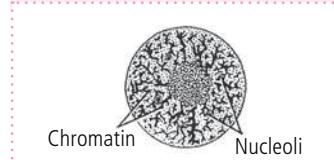
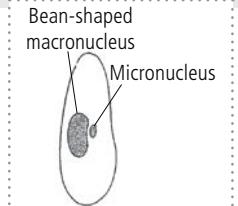
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## Nucleus in Protists

All protists possess nuclei. Many forms have more than one nuclei that may be similar or dissimilar in structure and function. E.g., in Ciliata, two types of nucleus are found, **macronucleus** or somatic nucleus (associated with metabolic activities) and **micronucleus** or generative nucleus (associated with sexual reproduction).

Due to differential coiling of chromosomes in a resting nucleus and different proportions of nuclear inclusions, nuclei show diverse appearances in protists.

### Types of Nucleus

Vesicular nucleus	Polyploid nucleus	Compact or massive nucleus
Most common type. Have distinct nuclear membrane, adequate nucleoplasm, prominent endosomes. Found in Sarcodina and Mastigophora.  	Contains chromosomes retained in interphase with chromatin distributed radially and nucleoli scattered in chromatin. It is found in many radiolarians, and nucleus of dinoflagellida.  	Contains an inconspicuous nuclear membrane and small amount of nuclear membrane as well as nucleoplasm. E.g., macronucleus of ciliates, nuclei of Dinoflagellida.  

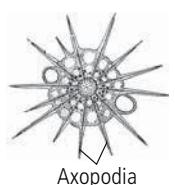
## LOCOMOTION IN PROTISTS

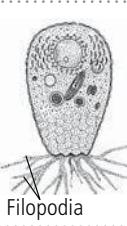
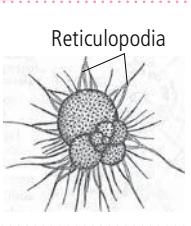
Locomotion in protists is carried out by various organelles and thus is described as mainly of 4-5 types.

Types of locomotion: (i) Pseudopodial locomotion, (ii) Flagellar locomotion, (iii) Ciliary locomotion, (iv) Wriggling, (v) Mucilage propulsion.

### Pseudopodial Locomotion

Slow creeping type of locomotion carried out by protoplasmic outgrowths called **pseudopodia**. Found in sarcodines and slime moulds. On the basis of form and structure, pseudopodia may be of four types:

 Lobopodia	<b>Lobopodia</b> <ul style="list-style-type: none"><li>Lobe like pseudopodia with broad and rounded ends, consisting of both ectoplasm and endoplasm.</li><li>Moves by pressure flow mechanism.</li><li>E.g., Amoeba</li></ul>	<b>Axopodia</b> <ul style="list-style-type: none"><li>Long and straight pseudopodia radiating from the surface of body.</li><li>Each axopodia comprises of a central axial rod covered by granular and adhesive cytoplasm.</li><li>Shows two way flow of cytoplasm.</li><li>Characteristic of heliozoans e.g., Actinophrys.</li></ul>  Axopodia
--	--	---

Types of Pseudopodia	
 Filopodia	<b>Filopodia</b> <ul style="list-style-type: none"><li>Filamentous pseudopodia, tapering from base to pointed tip, composed of ectoplasm only.</li><li>May be branched at times to form simple or complex networks.</li><li>E.g., Euglypha</li></ul>
	<b>Reticulopodia</b> <ul style="list-style-type: none"><li>Filamentous, branched and interconnected profusely to form a network.</li><li>Display two way flow of cytoplasm.</li><li>E.g., Globigerina</li></ul>  Reticulopodia

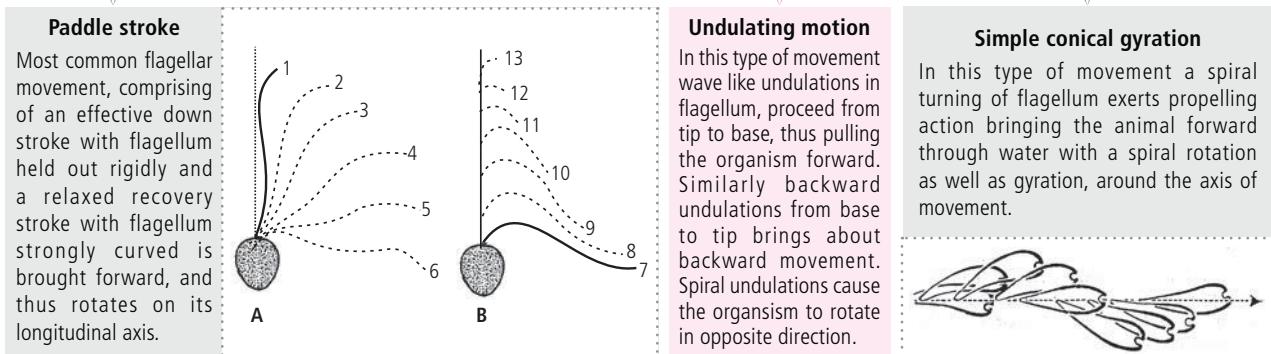
### Flagellar Locomotion

Carried out by thread like projections called flagella on the cell surface. A typical flagellum consists of an elongate, stiff axial filament, the **axoneme**, enclosed by an outer sheath. In axoneme, nine longitudinal peripheral paired fibres form a cylinder, which surrounds the two central longitudinal fibres, enclosed by a membranous inner sheath. Each of the peripheral pairs bears a double row of short arms. Axoneme arises from a basal granule, the **blepharoplast** or **kinetosome**.

Flagellar locomotion is characteristic of mastigophora, which may bear one to eight or more flagella.

The flagella needs a liquid medium for its movement and shows three types of movement.

## Types of flagellar movements



### Ciliary Movement

- Cilia are highly vibratile small ectoplasmic processes, resembling flagella in their basic structure. Cilium consists of external membranous sheath, continuous with plasma membrane of cell surface and enclosing the fluid matrix. Running along the entire length of body of cilium are nine paired peripheral fibres and two central fibres, all embedded in a structureless matrix.
- One sub-fibre or microfibre of each peripheral pair bears a double row of short projections, called arms, all pointing in the same direction.
- Each cilium arises from a thickened structure, the basal granule, basal body or blepharoplast.
- Ciliary movement is based on contraction of peripheral fibres and needs liquid medium for its movement. During movement, a cilium oscillates like a pendulum, comprising a fast effective stroke which propels body forward in opposite direction of stroke and a slow recovery stroke which bring cilium again into position for next effective stroke.
- All the cilia of body do not move simultaneously and independently but progressively in a characteristic wave like manner called **metachronic rhythm** e.g., *Paramecium*.
- In synchronal rhythm, all the cilia of a body beat simultaneously.

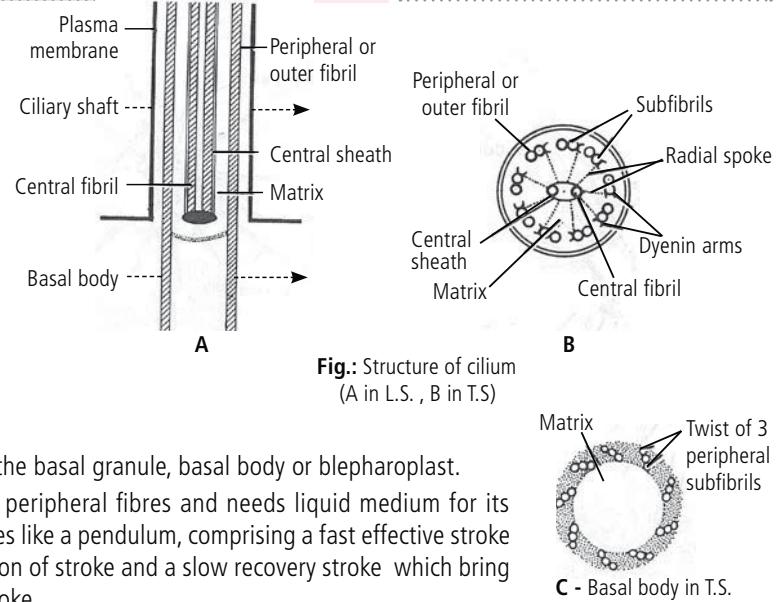


Fig.: Structure of cilium  
(A in L.S., B in T.S.)

### Wriggling Locomotion

- It is a slow worm like movement brought about by a wave of contraction and expansion in body i.e., peristaltic activity. As the peristaltic waves pass, the body becomes shorter and wider first at the anterior end, then in the middle and later at the posterior end. This movement is characteristic of euglenoids and therefore, also called **Euglenoid or metabolic movements**.

### Mucilage Propulsions

In some protists, locomotion occurs through secretion of mucilage. The movement occurs in the direction opposite to that of mucilage secretion. This specifically occurs in protists that do not have any organelles of locomotion, e.g., diatoms.

## NUTRITION IN PROTISTS

Protists obtain their nourishment through several ways as:

### Holophytic or photosynthetic

In this mode, the organisms prepare their food from  $\text{CO}_2$  and water by utilising sunlight with the help of photosynthetic pigments like chlorophyll. The process is called photosynthesis. E.g., dinoflagellates, diatoms and euglenoids.

## Holozoic nutrition

Majority of free-living protozoa derive nourishment by ingesting other organisms, both animals and plants. Such protozoans are called holozoic, and mode of nutrition is said to be holozoic nutrition. All sarcodina are strictly holozoic with the exception of some parasitic species. This mode of nutrition involves development of organelles for food capture, ingestion, digestion and egestion of indigestible residues.

## Pinocytosis

This involves ingestion of liquid food by invagination through surface of body. Pinocytosis channels are formed at some parts of body surface to enclose the fluid food from the surrounding medium. Lower ends of channels are pinched off as food vacuoles which circulate into the endoplasm. Pinocytosis is induced only by certain active substances in the medium surrounding the cell, such as some proteins and many salts.

## Saprozoic nutrition

Saprozoic nutrition involves absorption of food by osmosis, i.e., through general surface of body. This method of food-getting is referred to as *osmotrophy*. Food consists in the form of solution of dead organic matter, rendered so by the decomposing bacteria. This mode of nutrition is found in *Mastigamoeba*, and some colourless flagellates, e.g., *Chilomonas*, *Astasia*, *Polytoma*. Dissolved food materials, upon which the saprozoic protozoans subsist, are proteins and carbohydrates.

## Mixotrophic nutrition

This is a combination of more than one mode of nutrition. Many protozoa using photosynthesis as a means of food-synthesis also take in some part of their diet in dissolved form by osmotrophy or solid form by phagotrophy, e.g., *Euglena* and *Peranema*.

## Parasitic

Some protists get their food from the body of other organisms. The individual which obtains its food is called parasite and the organism from which parasite gets food is called host. E.g., *Trypanosoma*, *Giardia*, *Entamoeba*, *Plasmodium*.

## RESPIRATION AND EXCRETION IN PROTISTS

- Most of the protists respire aerobically. However the parasitic forms and those dwelling at bottom of aquatic habitats respire anaerobically.
- In freshwater protists, respiration occurs by diffusion through semi-permeable pellicle. The oxygen dissolved in water diffuses inside and the catabolic waste products such as  $\text{CO}_2$  and  $\text{NH}_3$  diffuse out into the external water, since their concentration is higher inside them (cell).

## Contractile Vacuoles and Osmoregulation

Contractile vacuoles are pulsating organelles found in freshwater Sarcodina, Mastigophora and Ciliata. They also occur in marine ciliates. They are altogether absent in parasitic forms of the protozoan classes, except Ciliata, where they occur frequently.

- The contractile vacuoles vary in structure and complexity in different protozoans.
- In *Amoeba*, the contractile vacuole is simplest, i.e., a spherical vesicle bounded by limiting membrane and surrounded by a circlet of mitochondria.
- In *Euglena*, contractile vacuole has fixed position and the formation of main vacuole is contributed by few accessory vacuoles.
- Ciliates being both freshwater and marine shows contractile vacuoles of advanced type, e.g., *Paramecium* has two vacuoles, one at anterior end and other at posterior end.

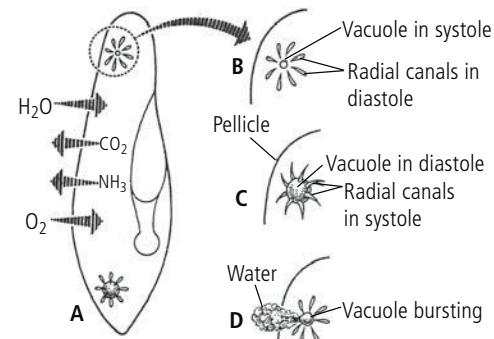


Fig.: Representation of respiration, excretion and osmoregulation

## Mechanism of Osmoregulation

The function of contractile vacuole is hydrostatic or osmoregulatory. Water in freshwater protozoa enters the organism by endosmosis and during feeding. The reason is that cytoplasm of a freshwater protozoan represents a medium denser than surrounding water and outermost plasmalemma or pellicle acts as a semi-permeable membrane. Thus water continuously flows inside to dilute the cytoplasm. If the organism does not possess a mechanism to get rid of this excess water, it will swell to the point of rupture and dissolution. The mechanism which is assumed to effect water regulation is the contractile vacuole. The vacuole periodically increases in volume (diastole) to get filled with water and contracts (systole) to discharge its water content to the surrounding environment.

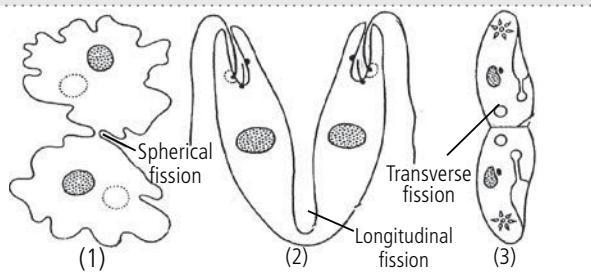
## REPRODUCTION IN PROTISTS

Protists show reproduction by both asexual and sexual methods.

### Asexual Reproduction

#### Binary fission

This involves the division of one individual into two approximately equal parts. The division is not a mere fragmentation but a complicated process of mitosis, during which nuclear division or karyokinesis is always followed by the division of cytoplasm or cytokinesis.



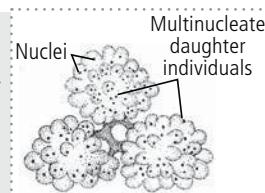
Irregular fission in any plane in *Amoeba*.

Division in longitudinal plane in *Euglena*.

Division in transverse plane in *Paramecium*.

#### Plasmotomy

It is a special type of binary fission concerned with the division of multinucleate protozoa into two or more smaller multinucleate daughter individuals, e.g., *Pelomyxa*, opalinids.

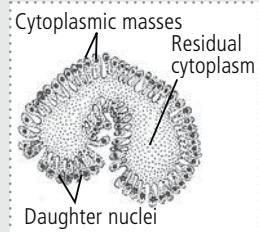


#### Plasmogamy

In certain Rhizopoda and Mycetozoa, two or more individuals may fuse by their cytoplasm to form a plasmodium, in which the nuclei remain distinct and they separate again unchanged afterwards. The process, which is thus non-sexual and not syngamy, is called plasmogamy.

#### Multiple fission

In this type, nuclear division is not followed immediately by division of cytoplasm. First, nucleus undergoes a series of divisions either by repeated binary fissions as in *Plasmodium*, or by simultaneous multiple divisions, as in Aggregata. The body thus becomes multinucleate. Later, the body cytoplasm divides into as many parts as there are daughter nuclei which usually arrange themselves at the periphery, each getting surrounded by a fragment of cytoplasm. Thus, the parent body simultaneously divides into as many daughter individuals as there are nuclei.



### Sexual Reproduction

#### Syngamy

It is complete fusion of two sex cells or gametes resulting in formation of zygote. The fusion nucleus of zygote is called **synkaryon**. It is of following types:

##### Hologamy

The two mature individuals instead of forming gametes themselves behave as gametes and fuse to form zygote. It is found in Sarcodina and Mastigophora, e.g., *Copromonas*.

##### Anisogamy

The two fusing gametes differ morphologically as well as in behaviour, they are called anisogametes. Usually small and motile gametes are the male or microgametes and large non-motile ones are the female or macrogametes. Fusion of such dissimilar gametes is anisogamy. This mode of sexual reproduction is widely seen in *Plasmodium* and *Volvox*.

##### Isogamy

The two fusing gametes are similar in size and shape but differ in behaviour, they are called isogametes and their union, isogamy. Isogametes are generally produced by multiple fission, e.g., *Elphidium*, *Monocystis*, *Chlamydomonas*.

##### Autogamy

It is the fusion of gametes derived from the same parent cell, as in *Actinophrys* and *Actinosaerium*. In *Actinophrys*, during sexual reproduction, pseudopodia are withdrawn and a cyst is formed. Now meiotic division takes place and two daughter nuclei with half number of chromosomes are formed. No cell division takes place. After sometime, gametic nuclei fuse to form a zygote nucleus.

#### Conjugation

This involves temporary union of two individuals, called **conjugants**, usually at oral or buccal regions of their body.

Fusion of protoplasm occurs at the place of contact. Macronuclei break up and disappear. Micronuclei undergo meiotic division forming four daughter nuclei, of which three micronuclei degenerate. The remaining micronucleus again divides forming two gametic micronuclei. Out of these two, one is considered male pronucleus and other female pronucleus. Male pronucleus of one conjugant moves through fused protoplasm into the other conjugant. In each conjugant, these male and female pronuclei fuse together forming a zygote nucleus. Now two individuals separate and are called **exconjugants**. Each exconjugant undergoes further nuclear and cytoplasmic divisions forming four daughter individuals.

## MAJOR GROUPS OF PROTISTS

The kingdom protista has been broadly divided into three main groups:

**Photosynthetic Protists**

**Consumer Decomposer Protists**

**Protozoan Protists**

### Photosynthetic Protists

- This group includes mainly the phytoplanktons, the green photosynthetic organisms, inhabiting aquatic habitats, e.g., dinoflagellates, chrysophytes and euglenoids.

#### 1. Dinoflagellates

**Division** - Pyrophyta, **Class** - Dinophyceae

##### Important characteristics

- Mostly marine but some occur in freshwater.
- Unicellular, motile and biflagellate predominantly golden brown but other forms as yellow, green, blue, etc., also occur due to change in proportion of various pigments.
- Cells are covered by rigid **theca** or **lorica** of articulated and sculptured plates of **cellulose**. Hence, known as **armoured dinoflagellates**.
- Possess two different flagella (**heterokont**) i.e., one transverse and other longitudinal. Both of them beat in different directions causing spinning of dinoflagellates while swimming in water.
- Nucleus being large in size is called **mesokaryon**.
- Non contractile vacuoles called **pusule** are present near flagellar base. They take part in floatation and osmoregulation. Contractile vacuoles are absent.
- Trichocysts and nematocysts are found in few dinoflagellates.
- Reserve food is in the form of starch and oil.
- Asexual reproduction is mainly through cell division.
- Sexual reproduction is isogamous and anisogamous type.
- Examples include - *Ceratium*, *Noctiluca*, *Glenodinium*, *Peridinium*, *Gonyaulax*.

- Red tide** is caused by growth of *Gymnodinium* and *Gonyaulax* in sea in large number, this makes the water look red.
- Bioluminescence** i.e., ability to emit light, is exhibited by some marine dinoflagellates, e.g., *Noctiluca*, *Pyrodinum*, *Pyrocystis*.
- Dinoflagellates like *Gonyaulax catenella* secretes toxin called **saxitoxin** which kills fishes and other aquatic animals.

#### 2. Chrysophytes

**Division** - Chrysophyta/Bacillariophyta

- These include both diatoms and desmids.

##### Diatoms

##### Important characteristics

- Occur in all aquatic and moist terrestrial habitats, as free floating or bottom dwellers.
- Body is covered by transparent **siliceous shell** known as **frustule**. It is made up of two valves that fit like a soap box.
- These are microscopic, variously coloured and do not possess flagella except in reproductive state.
- Possess a single large nucleus, suspended in the large central vacuole of cell.
- Contain chl *a* and chl *c* and fucoxanthin that imparts a brownish tinge.
- Reserve food is oil and leucosin (polysaccharide). Volutin globules (proteinaceous in nature) are also present.
- These commonly reproduce by binary fission.
- Sexual reproduction may vary from isogamy to oogamy. Fertilisation produces a zygotes that forms auxospore.

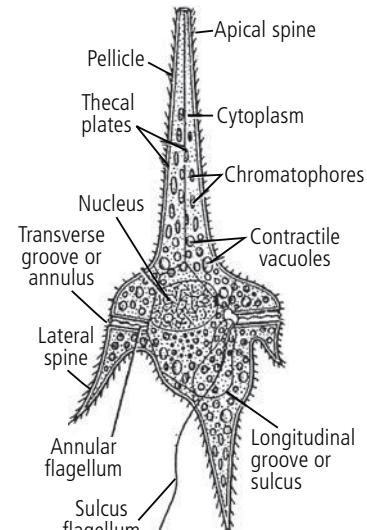


Fig.: Ceratium

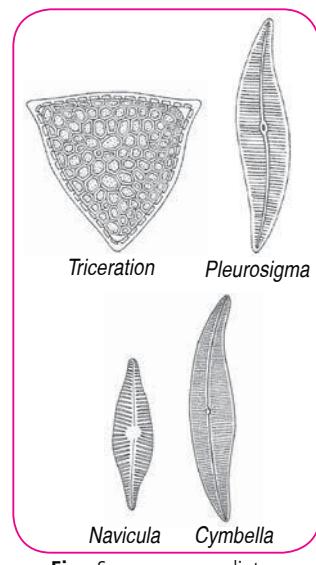


Fig.: Some common diatoms

- Their vegetative cells are diploid. Meiosis is gametic.
- About half of the organic matter synthesised on earth is believed to be produced by these photosynthetic diatoms.
- The siliceous frustules do not decay and get deposited at the bottom of reservoirs forming big heaps called **diatomite** or **diatomaceous** earth.
- Diatomite being chemically inert is used in filtration of sugar, alcohols, etc., as insulating material in refrigerators, boilers, source of water glass. They also act as **good pollution indicators**.

### Desmids

- Mainly found in freshwater.
- The cells have two distinct halves. The outer wall of cell show various protuberances covered with mucilagenous sheath.
- Possess large chloroplast.
- Sexual reproduction occurs by conjugation.
- Acts as **indicators of clean water**.

### 3. Euglenoids

**Division** - Euglenophyta, **Class** - Euglenophyceae

#### Important characteristics

- Free living, unicellular, flagellate protists found in freshwater habitats and damp soils.
- Show characteristics of plant and animals.
- The cell is devoid of cellulosic cell wall and instead is covered by thin and flexible pellicle.
- Bear two flagella, one long and other short. They are tinsel type (bear hairs). A flagellum bears a swelling called **paraflagellar body**. An **eye spot** or **stigma** is attached to the reservoir that serves as a screen to paraflagellar body while swimming.
- The cytoplasm is distinguished into dense, peripheral ectoplasm and fluid like granular endoplasm that contains cell organelles and inclusions.
- Contains large number of chloroplasts having photosynthetic pigments chl *a* and chl *b*. Each chloroplast has a single pyrenoid.
- Possess large contractile vacuole along with many small accessory vacuoles, that help in osmoregulation.
- Reserve food is stored in form of paramylum bodies (a form of carbohydrate) scattered in cytoplasm.
- Multiply by longitudinal binary fission under favourable conditions and by **palmella stage** under unfavourable conditions. Sexual reproduction is not observed.
- Examples : *Euglena*, *Phacus*, *Euteptia*, *Trachelomonas*, *Peranema*.

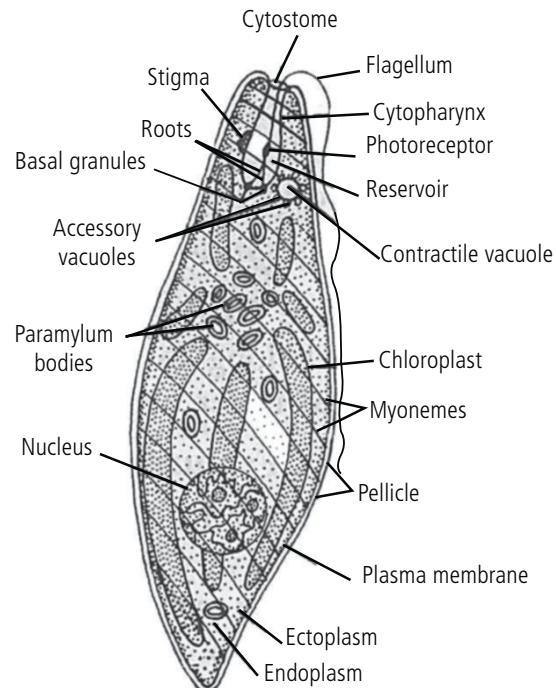


Fig.: *Euglena*

### Consumer Decomposer Protists - Slime Moulds

**Division**- Myxomycota

#### Important characteristics

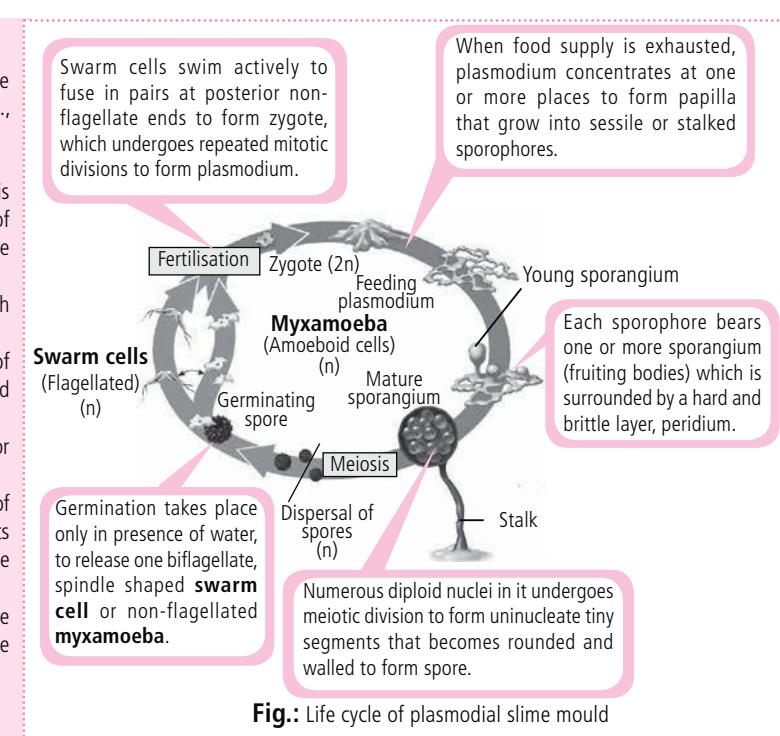
- Lack cell wall and are bounded by plasma membrane only. However, their spores have cellulosic cell wall.
- Mostly **saprotrophic** or **phagotrophic** in nutrition.
- Both asexual and sexual modes of reproduction are found.
- Resemble protozoa in their amoeboid plasmodial stage and resembles to fungi in spore formation.
- Slime moulds are of two types: acellular and cellular.

## Acellular or Plasmodial Slime Moulds

### Habitat

Found commonly on dead and decaying vegetable (organic) matter such as leaves, twigs, logs of wood, etc., in damp places.

- Somatic phase is diploid, multinucleate plasmodium.
- The free living thalloid body of acellular moulds is called **plasmodium**. These are wall less mass of multinucleate protoplasm covered by slime. All these nuclei divide simultaneously.
- Plasmodium possess a number of branched veins, which show reversible streaming movement.
- Plasmodium feeds on bacteria, protozoa, spores of fungi and other microbes through ingestion and engulfing.
- Plasmodium shows plamotomy (divide to form two or more plasmodia) during injury.
- Plasmodium perennates by forming two types of structures (i) Cyst i.e., small multinucleate fragments that secrete thick covering (ii) Sclerotium, i.e., entire plasmodium secretes thick covering around itself.
- These structures may remain dormant for variable periods and germinates to release multinucleate plasmodium upon onset of favourable conditions.
- Examples : *Tubifera, Physarum*



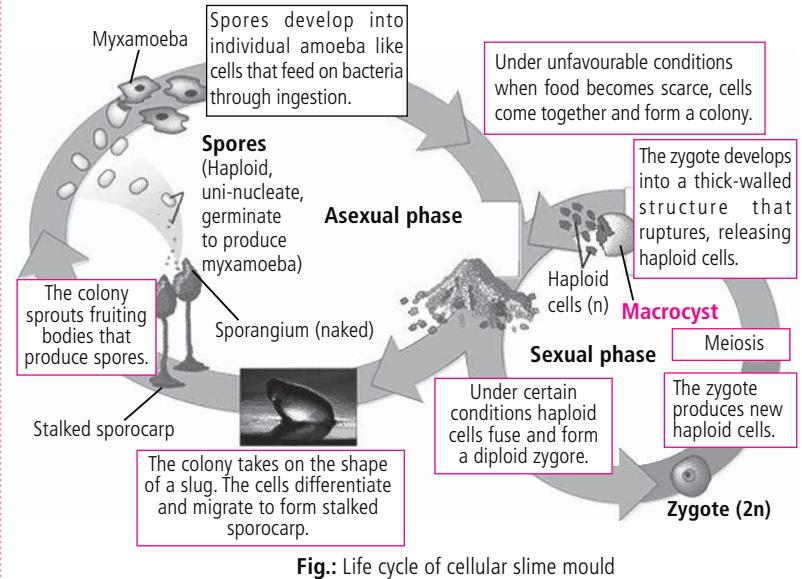
**Fig.:** Life cycle of plasmodial slime mould

## Cellular Slime Moulds

### Habitat

Occur in all humus containing upper layers of damp soil.

- Exhibit characters of both plants and animals.
- Represented by haploid and uninucleate cells called **myxamoebae**, i.e., lack cell wall and move by amoeboid movement.
- Secrete a rigid cellulose cell wall to form **microcyst**, under unfavourable conditions. Its cell wall ruptures to release myxamoeba which later forms amoeboid cells.
- Exhibit a community association by forming **pseudoplasmodium**, a primitive form of multicellularity, where cells maintain their identity but can live together. It also shows division of labour as some cells form fruiting body (sporangium) while others form spores. For this reason the cellular slime moulds are regarded as advanced protists or primitive fungi.
- Examples : *Dictyostelium, Polysphondylium*.



**Fig.:** Life cycle of cellular slime mould

## Significance of slime moulds

- They cause decay and decomposition of organic matter in soil.
- Their attractive colours are of artistic value.
- Their plasmodia provide excellent material for study of structure and physiology of protoplasm.

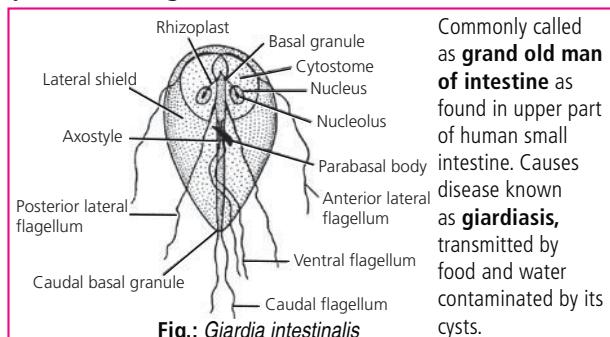
## Protozoans Protists

- Protozoans were first studied by **Leeuwenhoek**. Protozoans are divided into four groups on the basis of their locomotory organelles: flagellated, amoeboid, ciliated and sporozoans.

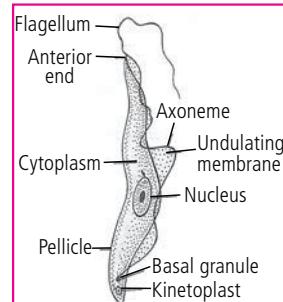
## 1. Flagellated protozoans

- They possess flagella for locomotion. They may be free living aquatics, parasites, commensals or symbionts. Zooflagellates are generally uninucleate, occasionally multinucleate. The body is covered by a firm pellicle. Nutrition is holozoic, saprobic and parasitic. Asexual reproduction is by binary fission. Sexual reproduction is recorded in some forms only.

### Examples of zooflagellates

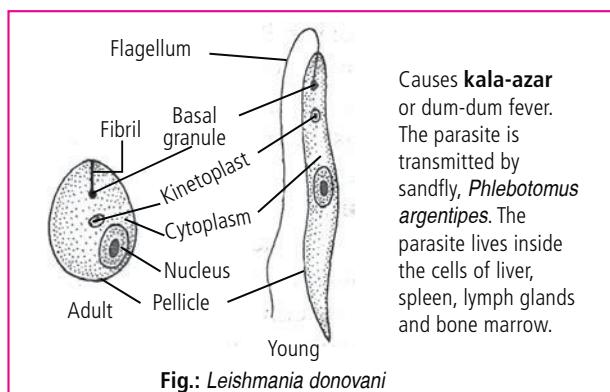


Commonly called as **grand old man of intestine** as found in upper part of human small intestine. Causes disease known as **giardiasis**, transmitted by food and water contaminated by its cysts.

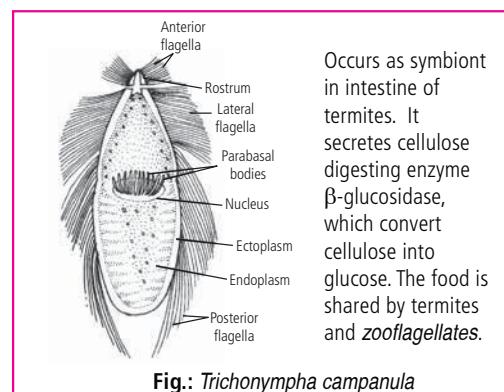


**Fig.: Trypanosoma gambiense**

Parasite of **sleeping sickness**, is transmitted by blood sucking **tse-tse fly, Glossina palpalis**. In humans it lives in blood plasma. Later, it enters cerebrospinal fluid and damages the brain, making patient lethargic and unconscious.



Causes **kala-azar** or dum-dum fever. The parasite is transmitted by sandfly, *Phlebotomus argentipes*. The parasite lives inside the cells of liver, spleen, lymph glands and bone marrow.



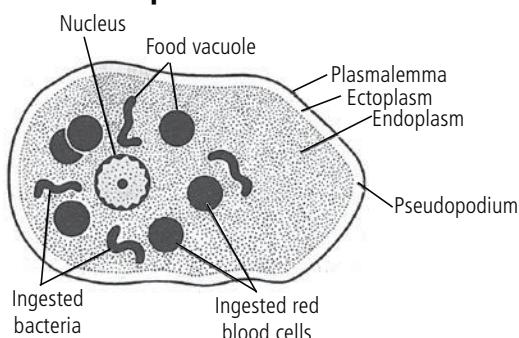
**Fig.: Trichonympha campanula**

Occurs as symbiont in intestine of termites. It secretes cellulose digesting enzyme  $\beta$ -glucosidase, which convert cellulose into glucose. The food is shared by termites and zooflagellates.

## 2. Amoeboid protozoans

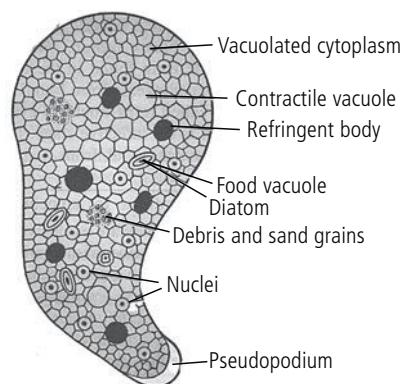
- They develop pseudopodia which are temporary protoplasmic outgrowths. These pseudopodia are used for locomotion and engulfing food particles. Mostly free living, found in freshwater, sea water and on damp soil. Only a few are parasitic. The body may be covered with plasmalemma or a shell. Nutrition is commonly holozoic. Generally uninucleate. Binucleate (e.g., *Arcella*) and multinucleate (e.g., *Pelomyxa*) types also occur but the nuclei are monomorphic. Asexual reproduction takes place by binary fission, multiple fission, budding and spores. Sexual reproduction occurs through syngamy.

### Examples of amoeboid protozoans



**Fig.: Entamoeba histolytica**

(Pathogen resides in upper part of human large intestine and causes amoebiasis or amoebic dysentery.)



**Fig.: Pelomyxa**

(Giant amoeba, about 2.5 mm long.)

## Radiolarians

- Radiolarians are exclusively marine, free floating sarcodines having a central perforated capsule and a fine framework or skeleton of silica. The protoplasm is differentiated into intracapsular and extracapsular parts. The extracapsular part develops pseudopodia (axopodia or filopodia) for locomotion and ingestion. The intracapsular part contains nuclei, small vacuoles and reserve food that represents the reproductive part. Examples, *Acanthometra* and *Collozoum*.

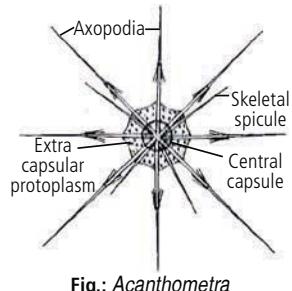


Fig.: *Acanthometra*

## Heliozoans

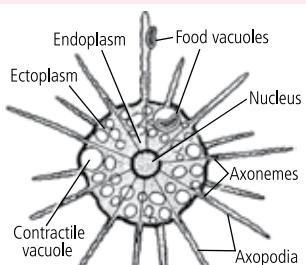


Fig.: *Actinophrys*

- Spherical structure which were previously called **sun-animalcules**. The fine pseudopodia are called axopodia which radiate. Heliozoans may be naked or with skeleton with siliceous scales or spines. *Actinophrys*, the sun organism is a common shellless heliozoan.

## Foraminiferans

- Bottom dwellers, marine or freshwater sarcodines which possess a calcareous shell having one or more chambers with one or more perforations. Protoplasm flows out of the pores to form a thin covering around the shell. The latter develop pseudopodia for creeping and ingestion which form a network (reticulopodia). E.g., *Globigerina* and *Elphidium* (= *Polystomella*).
- Calcareous foraminiferan shells collect at the bottom and form a foraminiferan ooze. With time, the **foraminiferan ooze** changes to limestone rocks. The same are used as building material, e.g., Egyptian pyramids. Fossilised foraminiferan shells often occur in petroleum bearing formations.

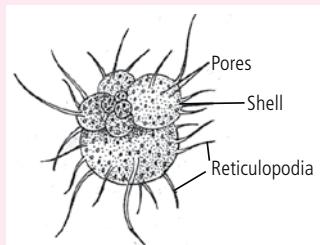


Fig. : *Globigerina*

## 3. Sporozoans

- All sporozoans are endoparasites, some such as *Eimeria* cause severe diseases like coccidiosis in the birds.
- Locomotory organelles (cilia, flagella, pseudopodia, etc.) are absent.
- Nutrition is parasitic and phagotrophy is rare.
- The body is covered with an elastic pellicle or cuticle.
- Contractile vacuoles are absent.
- Asexual reproduction occurs through multiple fission.
- Sexual reproduction takes place through syngamy.
- Life cycle consists of two distinct asexual and sexual phases. They may be passed in one (monogenetic) or two different hosts (digenic).
- Examples : *Plasmodium*, *Monocystis*, *Eimeria*.

## 4. Ciliated protozoans

- Ciliates are protozoan protists which develop a number of cilia during a part or whole of the life cycle. These are used for locomotion and driving food.
- A high degree of morphological and physiological specialisation is observed.
- Most ciliates are free living individuals in fresh and marine waters. A few are parasites.
- The body is covered by a pellicle.
- Nutrition is holozoic except in the parasitic forms. There are definite regions for ingestion and egestion.

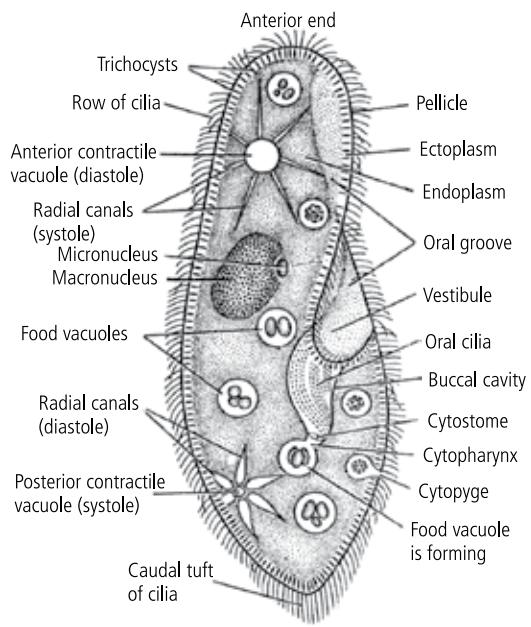
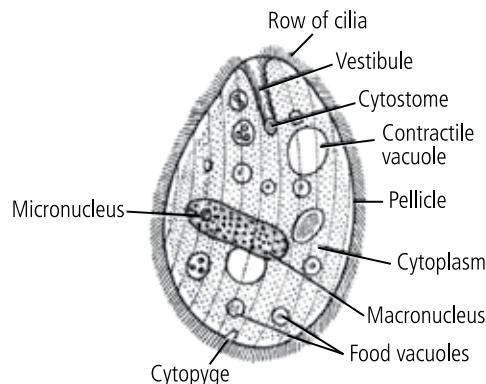


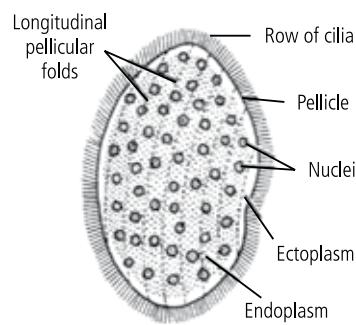
Fig.: *Paramecium caudatum*

- The region of ingestion consists of an oral groove, cytostome (mouth) and gullet.
- Ciliates show **nuclear dimorphism** or two types of nuclei, larger macronucleus (meganucleus) and smaller micronucleus.
- Ciliates often possess minute ejectable **trichocysts** for defence.
- Asexual reproduction takes place by transverse binary fission or budding. Cyst formation occurs under unfavourable conditions.
- Sexual reproduction is by means of conjugation.
- Examples : *Paramecium*, *Vorticella*, *Opalina*, *Balantidium*.



**Fig.: Balantidium**

(Lives as endoparasite in large intestine of human beings. Causes **ciliary dysentery** and is transmitted through food or water contaminated with cyst.)



**Fig.: Opalina**

# POWER EXERCISE

## New MCQs

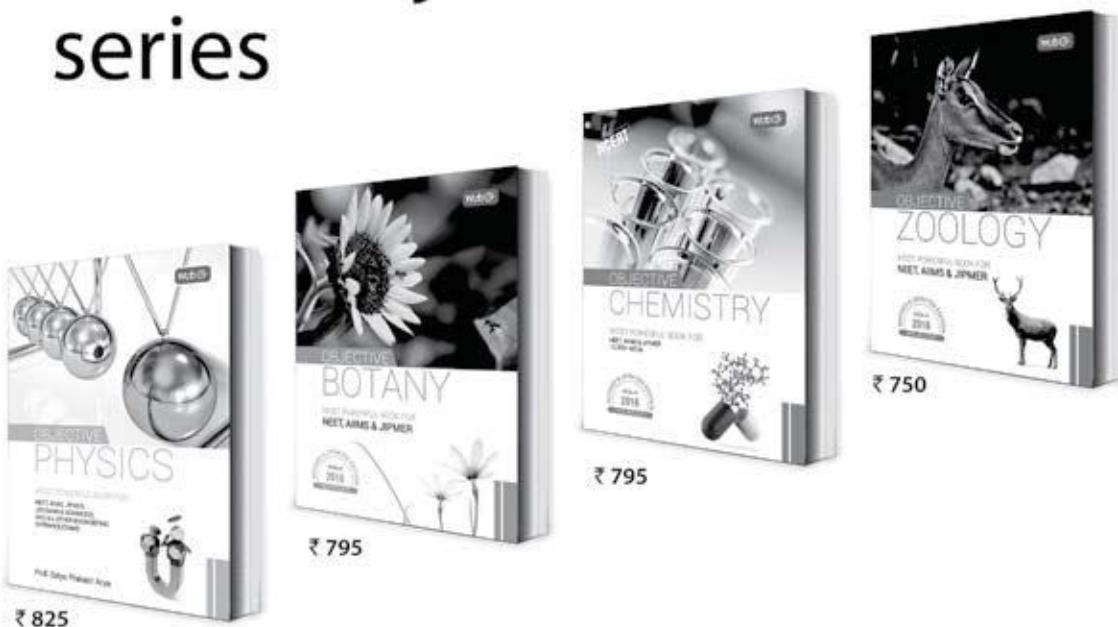
- Select the option which correctly fills the given blanks.
    - In euglenoids, the reserve food is stored in the form of \_\_\_\_\_.
    - \_\_\_\_\_ are considered to be advanced protists as they show division of labour.
    - \_\_\_\_\_ is a common shell-less heliozoan.
 

(i)	(ii)	(iii)
(a) volutin globules	Chrysophytes	<i>Globigerina</i>
(b) paramylum	Cellular slime moulds	<i>Actinophrys</i>
(c) glycogen	Acellular slime moulds	<i>Vorticella</i>
(d) oil	Acellular slime moulds	<i>Globigerina</i>
  - Posterior end of *Amoeba* is characterised by
    - plasmid
    - amphid
    - uripygium
    - lack of food vacuoles.
  - Trichonympha* belongs to
    - scyphozoa
    - sporozoa
    - dinoflagellates
    - zooflagellates.
  - An organism obtained from a water body showed given characteristics.
    - Both holophytic and holozoic nutrition.
    - Presence of contractile vacuole fed by number of canals.

The organism can be identified as
- (a) *Euglena*      (b) *Paramecium*  
 (c) *Peridinium*      (d) *Mycoplasma*.
5. Nuclear dimorphism is found in
  - Amoeba proteus*
  - Trypanosoma gambiense*
  - Plasmodium vivax*
  - Paramecium caudatum*.
6. Common characteristic of *Trypanosoma*, *Noctiluca*, *Monocystis* and *Giardia* is
  - all are ciliated
  - all are unicellular protists
  - all have flagella
  - all produce spores.
7. Which of the following groups of protozoa is totally parasitic?
  - Sporozoans
  - Slime moulds
  - Ciliates
  - Amoeboid protozoans
8. Which form of asexual reproduction is correctly matched with their respective organisms?
  - Euglena* → Transverse binary fission
  - Paramecium* → Longitudinal binary fission
  - Amoeba* → Multiple fission
  - Plasmodium* → Binary fission
9. *Entamoeba histolytica* differs from *Amoeba* in absence of
  - pseudopodia
  - contractile vacuole
  - nucleus
  - ectoplasm.
10. In *Amoeba*, the conversion of plasma gel into plasma sol at the trailing end and the conversion of plasma sol into plasma gel at the advancing end explains

- (a) attachment to substratum  
 (b) contraction theory  
 (c) continuous viscosity changes  
 (d) theory of rolling movement.
- 11.** Which of the Protists are known to show bioluminescence?  
 I. *Noctiluca*      II. *Gonyaulax*  
 III. *Navicula*      IV. *Pleurosigma*  
 V. *Pyrodinum*  
 (a) I, II and V      (b) II, III and IV  
 (c) I, III and V      (d) All of these
- 12.** Phylum Protozoa is classified on the basis of  
 (a) mode of reproduction (b) locomotory organelles  
 (c) mode of nutrition (d) mode of feeding.
- 13.** Select the correct statement.  
 (a) Slime moulds are haploid.  
 (b) Protozoans lack cell wall.  
 (c) Dinoflagellates are immotile.  
 (d) Pellicle is absent in *Euglena*.
- 14.** Match column I with column II and select the correct option.
- | <b>Column I</b>                    | <b>Column II</b>             |
|------------------------------------|------------------------------|
| A. Dinoflagellates                 | (i) <i>Physarum</i>          |
| B. Chrysophytes                    | (ii) <i>Amphipleura</i>      |
| C. Acellular slime moulds          | (iii) <i>Polysphondylium</i> |
| D. Cellular slime moulds           | (iv) <i>Ceratium</i>         |
| (a) A-(iii), B-(i), C-(ii), D-(iv) |                              |
| (b) A-(ii), B-(iii), C-(i), D-(iv) |                              |
| (c) A-(iv), B-(ii), C-(i), D-(iii) |                              |
| (d) A-(iv), B-(i), C-(iii), D-(ii) |                              |
- 15.** Locomotory organs are absent in  
 (a) sporozoans      (b) ciliates  
 (c) zooflagellates      (d) rhizopods.
- Exam Section**
- Select the wrong statement.  
 (a) The walls of diatoms are easily destructible.  
 (b) 'Diatomaceous earth' is formed by the cell walls of diatoms.  
 (c) Diatoms are chief producers in the oceans.  
 (d) Diatoms are microscopic and float passively in water.  
*(NEET Phase-II, 2016)*
  - Chrysophytes, euglenoids, dinoflagellates and slime moulds are included in the kingdom  
 (a) Fungi      (b) Animalia  
 (c) Monera      (d) Protista.  
*(NEET Phase-I, 2016)*
  - Which of these is wrong about diatoms?  
 (a) Microscopic      (b) Planktonic  
 (c) Overlapping shells      (d) Spores with 2 flagella  
 (e) Silica cell wall  
*(Kerala PMT, 2016)*
  - I. Unicellular Protists found in freshwater.  
 II. Possess a protein-rich outer layer called pellicle.  
 III. Have two flagella.  
 IV. Possess pigments identical to those in higher plants.  
 These characters apply to the genus  
 (a) *Alternaria*      (b) *Nostoc*  
 (c) *Chlorella*      (d) *Euglena*  
 (e) *Gonyaulax*.  
*(Kerala PMT, 2016)*
  - Match column I with column II and choose the right option.
- | <b>Column I</b>            | <b>Column II</b>                          |
|----------------------------|---|
| A. <i>Amoeba</i>           | (i) Has flagella for locomotion           |
| B. <i>Paramecium</i>       | (ii) Moves with the help of cilia         |
| C. <i>Trypanosoma</i>      | (iii) Puts out pseudopodia for locomotion |
| (a) A-(iii), B-(i), C-(ii) | (b) A-(iii), B-(ii), C-(i)                |
| (c) A-(ii), B-(i), C-(iii) | (d) A-(ii), B-(iii), C-(i)                |
| (e) A-(i), B-(ii), C-(iii) |   |
- (Kerala PMT, 2016)*
- In which group of organisms the cell walls form two thin overlapping shells which fit together?  
 (a) Dinoflagellates      (b) Slime moulds  
 (c) Chrysophytes      (d) Euglenoids      *(AIPMT, 2015)*
  - Which of the following groups of organisms have a protein rich layer called pellicle?  
 (a) Chrysophytes      (b) Euglenoids  
 (c) Dinoflagellates      (d) Slime moulds  
 (e) Protozoans      *(Kerala PMT, 2014)*
  - During conjugation in *Paramecium*  
 (a) out of the four micronuclei formed, three nuclei degenerate  
 (b) out of the twelve macronuclei formed, four nuclei degenerate  
 (c) zygote nucleus undergoes ten successive divisions in each conjugant  
 (d) out of the sixteen nuclei formed from zygote, 12 become macronuclei and 4 micronuclei.      *(AFMC, 2012)*
  - Paramecium* exhibits cytoplasmic inheritance through  
 (a) chromosome      (b) nuclear gene  
 (c) kappa particles      (d) DNA.      *(BHU, 2012)*
  - Which one of the following is a saprophytic protist?  
 (a) Desmid      (b) Slime mould  
 (c) *Euglena*      (d) *Gonyaulax*  
 (e) *Nostoc*      *(Kerala PMT, 2012)*
  - Which of the following are the characters of dinoflagellates?  
 A. Planktonic golden yellow algae with soap box like structure.  
 B. Marine red biflagellated protista.  
 C. Appear yellow, green, brown, blue and red in colour.  
 D. Biflagellated organisms with pellicle.  
 E. Saprophytic (or) parasitic unicellular forms.

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- (a) A, B and C only      (b) B, D and E only  
(c) B and C only      (d) B and E only  
(e) C, D and E only

(Kerala PMT, 2012)

12. When a freshwater protozoan is placed in marine water  
(a) the contractile vacuole disappears  
(b) the contractile vacuole increases in size  
(c) a number of contractile vacuoles appear  
(d) the contractile vacuole remains unchanged.

(Karnataka CET, 2011)

13. Which of the following does not belong to the Kingdom Protista?  
(a) Chrysophytes      (b) Euglenoids  
(c) Ascomycetes      (d) Dinoflagellates  
(e) Protozoans

(Kerala PMT, 2011)

14. *Amoeba proteus* contains a nucleus which is  
(a) flattened, cup shaped and slightly biconcave  
(b) rounded, cup shaped and slightly biconcave  
(c) flattened, discoidal shaped and slightly biconcave  
(d) rounded, cup shaped and slightly biconvex.

(BHU, 2010)

15. Which of the following is not a character of Protista?  
(a) Protists are prokaryotic.  
(b) Some protists have cell walls.  
(c) Mode of nutrition is both autotrophic and heterotrophic.  
(d) Body organisation is cellular.  
(e) Membrane bound organelles are present in cells.

(Kerala PMT, 2010)

### Assertion & Reason

The following questions consist of two statements each : assertion (A) and reason (R). To answer these questions, mark the correct alternative as directed below :

- (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.

1. **Assertion :** Slime moulds are excellent and pure source for study of protoplasm.

**Reason :** Slime moulds lack cell organelles.

2. **Assertion :** Sporozoans may have silica shells on their surface.  
**Reason :** Shells of sporozoans help in protection from acidic environment of the host.

3. **Assertion :** Termites feeding on wood live in symbiotic association with *Trichonympha*.  
**Reason :** *Trichonympha* contains  $\beta$ -glucosidase enzyme which digests cellulose.

4. **Assertion :** *Paramecium* undergoes sexual reproduction by the process of conjugation.

**Reason :** Conjugation is temporary union of two individuals to exchange their haploid pronuclei.

5. **Assertion :** Euglenoids can change their shape.

**Reason :** Euglenoids have cellulosic cell wall called pellicle.

### Short Answer Type Questions

1. Fill in the blanks.

- (i) In dinoflagellates, \_\_\_\_\_ is supposed to help in floatation and osmoregulation.  
(ii) \_\_\_\_\_ is a system of threads developed in the sporangia of acellular slime moulds.  
(iii) Sleeping sickness is caused by parasite \_\_\_\_\_ .

2. Differentiate between cilia and flagella.

3. What is diatomaceous earth? State its significance.

4. Name the types of locomotion found in protists and the structures or organelles involved in each of them.

### ANSWER KEY

### New MCQ

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

### Exam Section

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

### Assertion & Reason

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

### Short Answer Type Questions

1. (i) pusule                                 (ii) Capillitium

(iii) *Trypanosoma gambiense*

2. The differences between cilia and flagella can be summarised as:

	Cilia	Flagella
(i)	They are smaller in size.	They are larger in size.
(ii)	They usually occur throughout on major part of the surface of a cell.	They are commonly found at one end of the cell.
(iii)	They beat oar like and in a co-ordinated rhythm.	They beat whip-like and independently.



(iv)	Cilia help in locomotion, feeding, circulation, etc. Example : <i>Paramecium</i>	Flagella help in locomotion only. Example : <i>Euglena</i>
------	---	---

3. The siliceous frustules of diatoms do not decay easily, rather they keep on piling up at the bottom of ocean or sea, forming big heaps called diatomite or diatomaceous earth. Diatomite is porous and chemically inert and therefore used for various commercial and industrial purposes as in filtration of sugar, alcohol, oil, syrup, etc., as cleaning agent in toothpaste and metal polishes, insulating material in refrigerators and furnaces, as industry catalyst, etc. It is also a good pollution indicator.

4. The locomotion found in protists is mainly of four types:
- Pseudopodial locomotion - It occurs by the movement of pseudopodia, the protoplasmic outgrowths. It is observed in sarcodines and slime moulds.
  - Flagellar locomotion - It is whip like movement occurring by beating of flagella. It occurs in dinoflagellates.
  - Ciliary locomotion - It occurs by beating of cilia in synchronous or metachronic rhythm. It occurs in ciliates, e.g., *Paramecium*.
  - Wriggling locomotion - It is slow worm like movement brought about by a wave of contraction and expansion in body, i.e., peristaltic activity.



## ROBERT GEOFFREY EDWARDS

### (Father of Assisted Reproductive Technology)



Professor R.G.Edwards is known as one of the originators of *in-vitro* fertilisation. He was an English physiologist and pioneer in reproductive medicine. Edwards was born on 27<sup>th</sup> of September 1925 in the small Yorkshire mill town of Batley, to a working class family, the second of three brothers.

Edwards attended Manchester Central Boy's High School, Central Manchester in 1937, where Sir James Chadwick, (Nobel Laureate in Physics in 1935 for discovery of the neutron) also studied. He developed curiosity about natural history and especially the reproductive patterns that he observed among the farm's sheep, pigs and cattle in the Yorkshire Dales. His education was interrupted due to war and he left school in 1943. He was forced to serve British Army for almost four years. Edwards got place and grant to read agricultural sciences at the University College of North Wales at Bangor, but due to his disinterest in the course, he joined the Zoology Department. In 1951, aged 26 he gained a simple pass from here. Despite his ordinary degree he was accepted at the Institute of Animal Genetics and Embryology at Edinburgh University under Conrad Waddington, where he was awarded a PhD in 1955. In Edinburgh, Prof. Edwards not only started to map out his scientific career, but also met Ruth Fowler, who became his life-long scientific collaborator and wife in 1954. They have five daughters.

After a year as a postdoctoral research fellow at the California Institute of Technology, he joined the Medical Research Council (MRC) of the National Institute for Medical Research at Mill Hill, North London in 1958 to work on the science of immuno-contraception. His interests in eggs, fertilisation and in particular, the genetics of development posed

him to experiment with mice and trying to mimic *in-vitro* the *in-vitro* maturation of eggs.

Prof. Edwards left Mill Hill in 1962 and was invited to Glasgow University's Biochemistry Department. Around 1960, Edwards started to study not only human egg but also dog, monkey and baboon eggs. He continued his work when he arrived at University of Cambridge from Glasgow in 1963 laying the groundwork for his later success. In 1968, in collaboration with Patrick Steptoe, a gynaecologic surgeon from Oldham, General Hospital, Greater Manchester, Edwards developed human culture media to allow the fertilisation and early embryo culture. Steptoe used laparoscopy to recover oocytes from patients with tubal infertility. Their attempts were opposed, including refusal of the Medical Research Council to fund their research as well as by number of lawsuits. After a controversial era in the development of IVF, the world's first 'test-tube baby', Louise Brown, was born at 11:47 pm on 25 July 1978 at the Oldham General Hospital. With this breakthrough work, Prof. Edwards provided a solution to the couples that cannot have child in a natural way.

Sir Edwards was one of the founders of the European Society of Human Reproduction and Embryology (ESHRE), serving as its first Chairman and then being made an Honorary Member in 1993.

He was elected as a Fellow of the Royal Society (FRS) in 1984 and received the Albert Lasker Clinical Medical Research Award. In 2007, he was ranked 26<sup>th</sup> in The Daily Telegraph's list of 100 greatest living geniuses. He was awarded an honorary doctorate from the University of Huddersfield and Doctor Honoris Causa, University of Valencia (Spain). Edwards had been awarded the 2010 Nobel Prize in Physiology or Medicine for the development of *in-vitro* fertilisation. Prof. Edwards died at home near Cambridge, England on 10 April 2013 after a long lung illness.



# BIOLOGY

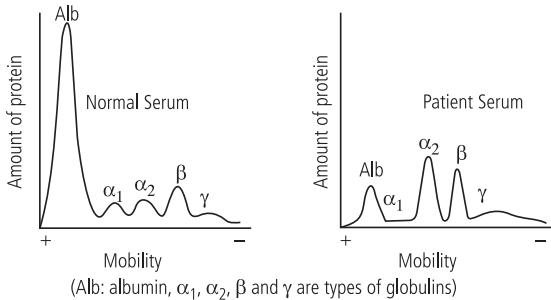
## OLYMPIAD PROBLEMS

- 1.** The rate of evolution varies in different lineages. For example: It is higher in rat lineage than in human lineage. Which of the following statements is correct?
- Rate of evolution would be the same for the coding and non-coding regions for a given species.
  - Errors during DNA replication of somatic cells are the major source of mutations that leads to evolution.
  - Rats have shorter generation time as compared to humans. Thus, more rounds of germ cell divisions would lead to more DNA replication errors. This can hasten rate of evolution.
  - Humans show lower rate of metabolism than rats. This would lead to fewer errors during DNA replication thereby reducing the rate of evolution. *(INBO 2016)*

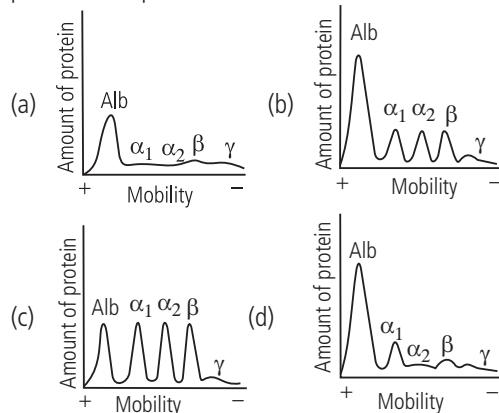
- 2.** No virus can evolve to target mammalian red blood cell because of the
- small size with a biconcave shape
  - high concentration of oxygen
  - lack of aerobic pathway to generate ATP
  - lack of nuclear material. *(NSEB 2015-16)*

- 3.** What is true about the deuterostomes?
- Mesoderm develops from out-pockets of archenteron.
  - Mouth develops from blastopore.
  - Cleavage is radial.
  - Cleavage is indeterminate.
- only (i) and (ii)
  - (i), (iii) and (iv)
  - only (i) and (iv)
  - only (iii) and (iv)
- (NSEB 2015-16)*

- 4.** The electrophoretic patterns of serum proteins from a healthy individual and a patient with advanced nephrosis are shown below.



Choose the graph that corresponds to the urinary protein profile of the patient.



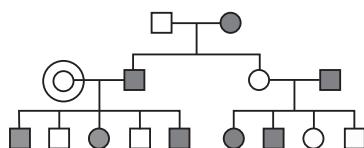
*(INBO 2015)*

- 5.** Three genes 'a', 'b' and 'c' are located on the same chromosome. The distance between 'a' and 'b' was 20 mu, 'b' and 'c' was 10 mu while 'a' and 'c' was 30 mu.

In one member of a population, it was noticed that the expression of gene 'b' was missing. When the map distance between 'a' and 'c' was calculated, it still showed 30 mu. Choose the probable explanations.

- The gene 'b' had a point mutation.
  - The gene 'b' was silenced epigenetically.
  - Segmental inversion occurred in the gene 'b'.
  - The gene 'b' was replaced by another DNA segment of the same size.
- I and III only
  - II and IV only
  - I, III and IV only
  - I, II, III and IV *(INBO 2015)*

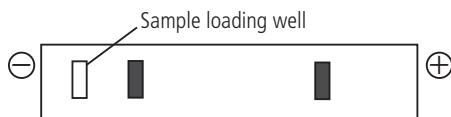
- 6.** The pedigree given below is for a dominant trait, caused by a gene A.



The possible genotype/s for the circled individual in the pedigree would be

- AA only
- Aa only
- AA or Aa only
- aa only. *(NSEB 2014-15)*

7. A nucleic acid extracted from animal liver is loaded and run on agarose gel. After staining it shows following pattern.



If the remaining sample is treated with RNase and loaded in gel, what result would you get?

- (a) 
- (b) 
- (c) 
- (d) 

(NSEB 2013-14)

8. The standard free energy change and standard activation energy for four biochemical reactions are listed in the table below:

Reaction	Standard free energy change (kcal/mol)	Standard activation energy (kcal/mol)
P	-40	18
Q	-71	18
R	-40	11
S	-71	11

A few interpretations are given below. Among these, the most appropriate interpretation is:

- (a) P, Q, R and S represent the same reaction carried out in the presence of enzyme, high temperature, absence of enzyme and low temperature, respectively.
- (b) Q and S represent the same reaction carried out at high and low temperatures, respectively.
- (c) R and S represent the same reaction carried out in the presence and absence of catalyst, respectively.
- (d) P and R represent the same reaction carried out in the absence and presence of enzyme, respectively.

(INBO 2013)

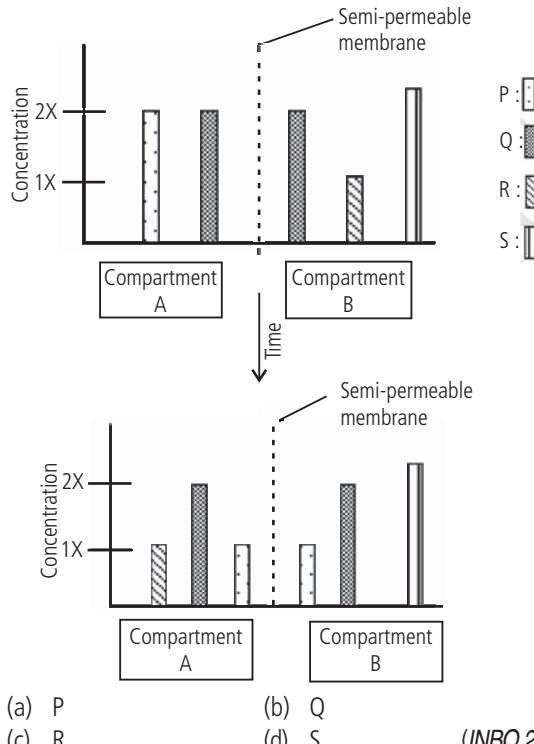
9. Read the following description.

"In these autotrophs, sporophyte is the dominant generation. Gametophyte is also photosynthetic and not dependent on sporophyte for nutrition."

These autotrophs are:

- (a) Bryophytes (b) Pteridophytes
- (c) Gymnosperms (d) Angiosperms. (INBO 2013)

10. The following figure represents the concentrations of solutes P, Q, R and S in the two compartments A and B which are separated by a semi-permeable membrane. The molecule that is actively transported across the membrane is:



(INBO 2013)

## SOLUTIONS

1. (c)

2. (d) : Virus requires host's machinery for replication of their genetic material, synthesis of new protein and multiplication. Red blood cells do not have nucleus and nuclear material therefore, virus cannot target them as host.

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3. (b) : In deuterostomes, blastopore forms the anus. Mouth is always formed away from the site of blastopore.
4. (d) : Nephrosis is a kidney disorder characterised by oedema and the loss of protein from the plasma into the urine due to increased glomerular permeability. Since the graph shows a significant reduction in amount of albumin and  $\alpha_1$  globulin in patient's serum, it indicates that these proteins are excreted in greater quantities in urine. On the other hand,  $\alpha_2$  and  $\beta$  globulins are retained in serum beyond the required amount (as in normal person), thus showing reduced amounts in urine.
5. (d) : Point mutation is the type of mutation in which any one nucleotide changes with another nucleotide. Therefore, only substitution of nucleotide will not effect the map distance but can change gene expression. Epigenetically silencing is the masking of gene expression without changing the DNA sequence. Hence, it also may be the reason for loss of gene expression but keeping same map distance. Similarly, segmental inversion (inversion of a gene segment) and replacement of DNA segment with another same sized segment will only affects/change the gene expression and not the distance between gene 'a' and 'c'.
6. (d) : In the given pedigree, the genotype of circled individual is 'aa'. Other genotypes (Aa and AA) are not possible because A is not expressed in circled individual which is a dominant trait.
7. (a) : The extracted nucleic acid get separated into two bands; one of DNA and another of RNA. RNA having lower molecular

weight travels greater distance than DNA. When nucleic acid is treated with RNase, the RNA gets degraded. Hence on further separation of this treated nucleic acid sample on agarose gel it shows only a single band i.e., of DNA.

8. (d) : P and R represent the same reactions as the change in standard free energy is same. However, different activation energy explains absence of enzyme in reaction P and presence of enzyme during reaction R. Enzyme lowers the activation energy of reaction R.
9. (b) : Sporophyte is the dominant generation in pteridophytes, gymnosperms as well as in angiosperms but gametophyte is non-photosynthetic and dependent for the nutrition on sporophyte in gymnosperms and angiosperms. In pteridophytes, gametophyte is green, free living and independent, called prothallus.
10. (c) : On comparing the concentrations of solutes after some time, it is found that solute P is transported passively along the concentration gradient as it moves from compartment A to B till concentration becomes equal in both compartments (isotonic). There is no transport of solute Q because its concentration is same in both compartments. Solute S also shows no movement but solute R is transported completely from one compartment to another without maintaining the equilibrium. This is possible only when solute moves against a concentration gradient i.e., active transport.



## UNSCRAMBLE ME

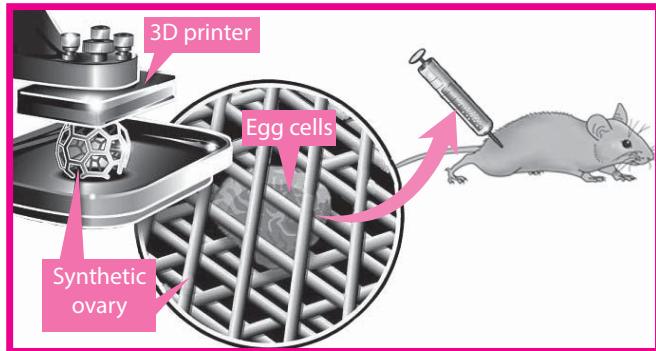
Unscramble the words given in column I and match them with their explanations in column II.

Column I	Column II
1. TRDIMYRCICHPOS	(a) A congenital cardiac abnormality in which heart is situated on the right side of the body.
2. AOCEVTECARS	(b) An instrument used for measuring transpiration.
3. SAOGOHL	(c) A plant with reduced aerial stem or without a stem.
4. SNEKHEAPILN	(d) A non-living structure that led to formation of first living cell.
5. IPZOCEORHYO	(e) Retention of testis in abdominal cavity.
6. DTREOCAXDIRA	(f) A mixture of alcohol and petrol used to run cars in U.S.A and Brazil.
7. CULAECEASTN	(g) Endogenous opioid peptide produced by neurons.
8. YSMCRPOHERTE	(h) Positively geotropic structures peculiar to <i>Selaginella</i> .
9. EHTPHOYELYRL	(i) Dispersal of seeds via surface of vertebrate animals.
10. POOZIHRHSER	(j) The occurrence of different types of leaves on the same plant under different environmental conditions.

Readers can send their responses at [editor@mtg.in](mailto:editor@mtg.in) or post us with complete address by 25<sup>th</sup> of every month to win exciting prizes.  
Winners' names will be published in next issue.

## 3-D PRINTED OVARIES - HOLY GRAIL OF BIOENGINEERING

A 3-D printed ovary allowed an infertile mice to naturally mate and give birth to pups of their own, according to a new research conducted by Ramille Shah, an assistant professor at McCormick School of Engineering and Teresa K. Woodruff, a scientist at Northwestern University in US. Ovaries are essential part of the female reproductive system. These glandular organs, when healthy, produce hormones and release at least one egg each month from a mature follicle for possible fertilisation. An artificial ovary needs to facilitate ovulation in order to be functional. Faced with this task, Shah and her colleagues created a 3-D printed structure made out of hydrogels, a material that is 99% water with a little polymer in it to give strength. Gelatin is a hydrogel made from collagen, which is found in human bones and skin and is safe to use inside the body. The scaffolding material was also endowed with pores in which follicles could be placed. The space was provided for follicles to grow and blood vessels to infiltrate the ovary without damaging it. Once seeded with follicles, the structure was transplanted into mice whose ovaries had been removed. The ovaries became fully functional as a soft-organ transplant. The follicles matured and the mice ovulated. After mating, their eggs were fertilised and they gave birth to atleast two pups each. The mice with the prosthetic ovaries were even able to produce milk in the normal way. The pups developed normally and were further able to reproduce. This breakthrough discovery may lead to a new era of regenerative medicine. Artificial ovaries could help restore fertility to young cancer survivors who underwent life-preserving treatments that rendered them sterile. The prosthetic ovaries in mice have shown to have a long term, durable function but further work is crucial to determine whether the synthetic ovaries would function in a similar manner in humans without a risk of cancerous cells. Professor Woodruff, suggested that it could also help in designing a range of artificial organs. It could be used instead of transplants from dead people that require the patient to take immune-suppressing drugs for the rest of their lives.



## THE BIZARRE SPIDER-GRYFFINDOR'S HAT COMES ALIVE!

A team of arachnologists from Mumbai discovered a species of spider in the Central Western Ghats of Karnataka. The spider resembles the magical hat worn by the character Gryffindor in Harry Potter series. The researchers, also fans of this series based on the book by author, J.K. Rowling, paid a tribute by naming the spider after the magical character. The scientific name of this spider is *Eriovixia gryffindori*. This spider is hardly 7mm in length and has an oddly-shaped brown patterned body that arises from a wide base with a tapered, bent peak above the spider's back. The spider takes the shape of a magical hat and camouflages itself by resembling a dried leaf during daytime for protection from predators. The *Eriovixia* genus contains 20 species of orb-weaving spider and is widely distributed across Asia and Africa. They are known for having a hairy carapace and a tapering abdomen that is sometimes tipped with a tail-like appendage. Though it resembled other types of *Eriovixia* spiders, parts of its exoskeleton and the shape of its genitalia told the scientists that it is different enough to be considered as a new species. In the study, the scientists described their whimsical name choice as "an effort to draw attention to the fascinating, but often overlooked world of invertebrates and their secret lives," proclaiming *E. gryffindori* to be an ode from the authors, for magic lost and found.



# Laser Eye Surgery

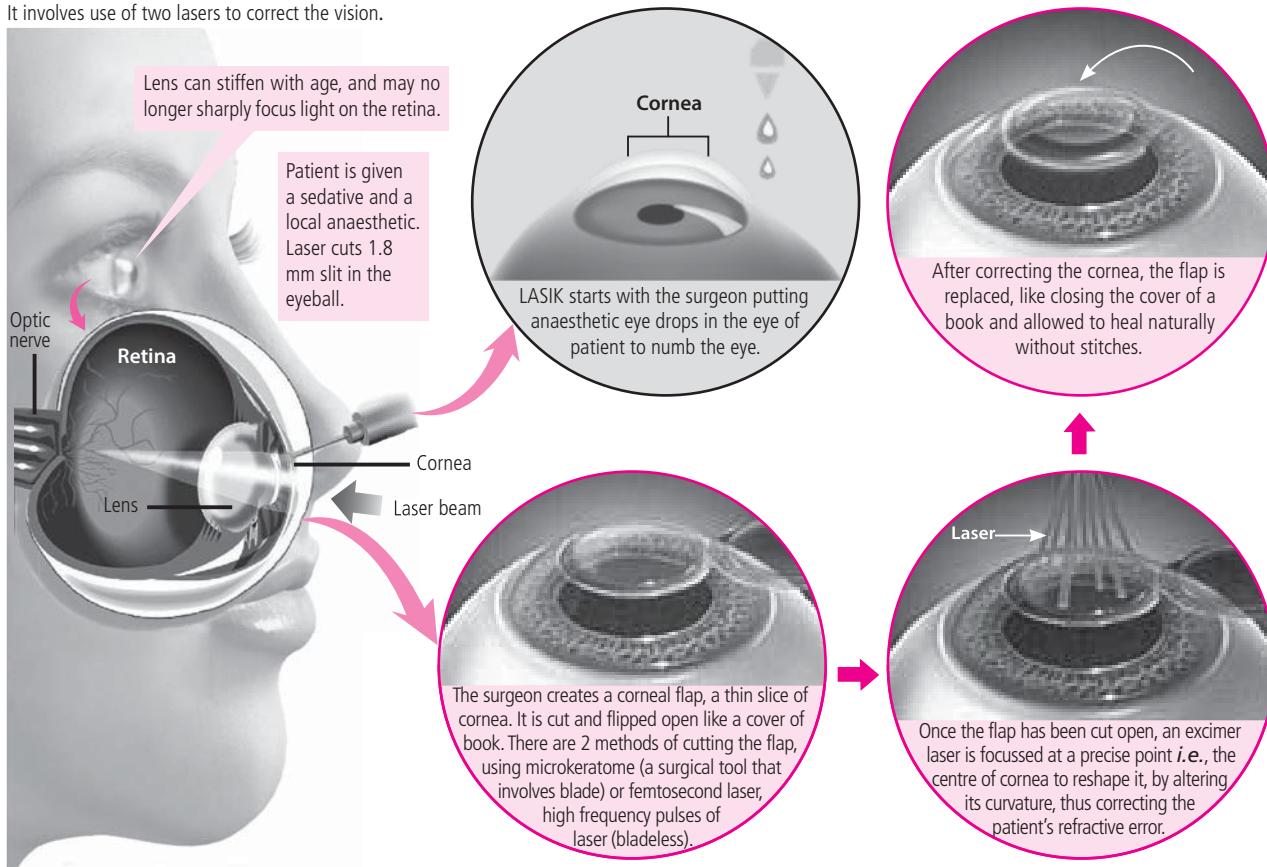
Laser eye surgery is an umbrella term for various eye surgeries used to correct refractive errors *i.e.*, myopia (near-sightedness), hyperopia (far-sightedness) and astigmatism. The most common types of laser eye surgery include LASIK, PRK, LASEK and EpiLASIK. Each of these four surgeries use the same special laser, called an “excimer” laser to reshape cornea (clear cover that rests over the coloured iris and lens). They differ in specificity, recovery time, surgical instruments and patient candidacy.



LASIK (Laser Assisted *in situ* Keratomileusis) is commonly performed laser eye surgery. Before laser eye surgery, doctor evaluates health, shape and thickness of cornea, tear layer, pupil size and existing conditions and their severity. The type of surgery to be performed is determined by surgeon after the consultation which is influenced by patient's eye prescription and lifestyle.

## LASIK

It involves use of two lasers to correct the vision.



Laser eye surgery is pain free, and completed within 15 minutes for both eyes. The patient is able to go home the same day with improved vision without eyeglasses or contact lenses, and can have normal vision within 24 hours.

In LASEK (Laser Assisted Sub-Epithelial Keratomileusis) surgery, only one laser is used to correct the vision, rather than two lasers used in LASIK. An ultra-thin sheet of alcohol solution is applied to the surface of an eye. The alcohol solution loosens the thin layer of cells on eye's surface called the epithelium. The cells stick to the sheet of alcohol are then gently moved to the side of the eye, giving the surgeon access to the layer of cornea which will be treated by the laser.

After the laser has reshaped the cornea, a protective contact lens is put on eye to increase comfort whilst it heals. Later, this lens is normally removed after about four days.

# HIGH

# YIELD

# FACTS



Class XI

## Breathing and Exchange of Gases

- Breathing** refers to the muscular movements that send fresh air to the respiratory organs (**inspiration**) and remove foul air from them (**expiration**).
- During normal breathing, inspiration is an active process, and expiration is a passive process.
- The process of respiration involves:
  - inflow of air between atmosphere and the alveoli of the lungs, *i.e.*, breathing
  - diffusion of gases ( $O_2$  and  $CO_2$ ) across alveolar membrane
  - transport of gases by the blood
  - diffusion of  $O_2$  and  $CO_2$  between the blood and the tissues
  - utilisation of  $O_2$  by the cells for catabolic reactions and resultant release of  $CO_2$  (**cellular respiration**).
- Respiration** is a biochemical process by which organic compounds present in the food are oxidised to liberate chemical energy in a step-wise manner. The terms 'breathing' and 'respiration' are not synonymous.

**Table:** Differences between breathing and respiration

	Breathing	Respiration
(i)	It is simply an intake of fresh air and removal of foul air.	It is an oxidation of food to form carbon dioxide, water and energy.
(ii)	It occurs outside the cells, hence it is an <b>extracellular process</b> .	It occurs inside the cells, hence it is an <b>intracellular process</b> .
(iii)	<b>It is a physical process.</b>	<b>It is a biochemical process.</b>
(iv)	No energy is released, rather used.	Energy is released in the form of ATP.
(v)	No enzymes are involved in the process.	A large number of enzymes are involved in this process.

	Analysis of various PMTs from 2013-2017					
	2013	2014	2015	2016	2017	
AIIMT/NEET	1	1	1	3	1	
AIMS	1	-	1	-	-	
AMU	2	-	3	-	-	
Kerala	4	4	2	1	-	
K-CET	2	1	-	-	-	
J & K	-	1	1	1	2	

## Types of Respiration

### Aerobic respiration

- Oxygen is used for oxidation of food.
- It provides much more energy.
- It occurs both in cytoplasm (glycolysis) and in the mitochondria (Krebs' cycle and electron transport chain).
- Examples: Most of plants and animals.

#### External respiration

The exchange of O<sub>2</sub> and CO<sub>2</sub> with surrounding medium.

#### Internal respiration

Uptake of oxygen by tissue cells, oxidation of food inside cells by oxidising enzymes and elimination of carbon dioxide from tissues.

### Cellulose fermentation

It occurs in anaerobic bacteria and protozoa found in rumen and reticulum chambers of ruminant stomach, where cellulose is converted into volatile fatty acids, lactic acid, CO<sub>2</sub> and methane.

### Anaerobic respiration

- Food is oxidised without using molecular oxygen.
- It takes place in cytoplasm and provides less energy.
- Examples: Muscles, anaerobic bacteria, yeast, and parasitic worms like *Ascaris*, *Fasciola*, *Taenia*.
- In microorganisms, term **fermentation** is used in place of anaerobic respiration.

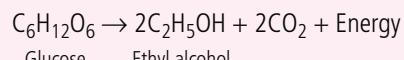
#### Lactic acid fermentation

It occurs in some bacteria and muscle cells, where glucose is metabolised to lactic acid.



#### Alcoholic fermentation

It occurs in yeasts, where they oxidise glucose to ethyl alcohol and carbon dioxide.



## Respiratory surface and medium

- The surface at which exchange of gases (CO<sub>2</sub> and O<sub>2</sub>) occurs is termed as **respiratory surface**.
- For the efficient exchange, respiratory surface should have the following features:
  - It should be thin, large and moist.
  - It should be permeable to respiratory gases.
  - It should be highly vascular.
  - It must be directly or indirectly in contact with the source of oxygen (that is either air or water).
- Air or water may serve as the source of oxygen for animals. The source of oxygen is called **respiratory medium**. The respiratory medium supplies oxygen to the body at the body's respiratory surface.

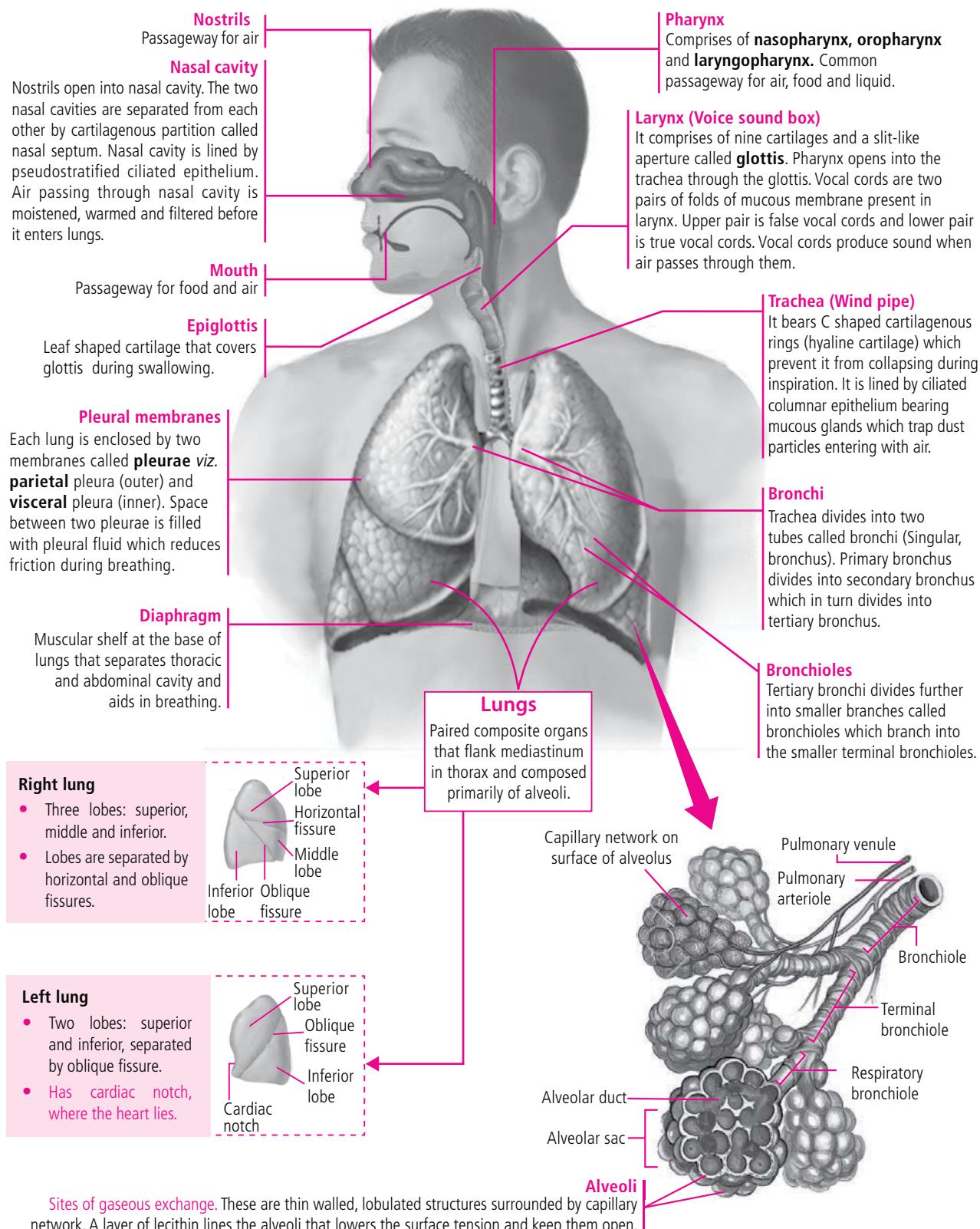
## Hiccups, Sneezing and Coughing

A **hiccup** is an **involuntary contraction of diaphragm** that may repeat several times in a minute. It involves a reflex arc, once triggered, causes strong contractions of diaphragm followed by closure of vocal cords. At the same time normal peristalsis of oesophagus is suppressed.

A **sneeze** is a semi autonomous expulsion of air from lungs through nose and mouth, usually caused by foreign particles irritating the nasal mucosa. It is linked to sudden exposure to bright light, sudden change in temperature, breeze of cold air or viral infection. The brain, in response to signal, activates the pharyngeal and tracheal muscles and creates a large opening of nasal and oral cavities, resulting in a powerful release of air and particles.

**Coughing** is preceded by a long-drawn and deep inspiration that is followed by a complete closure of the glottis, resulting a forcible expiration that suddenly pushes glottis open and sends a blast of air through the upper respiratory passages. Stimulus for this reflex act could be a foreign body lodged in the larynx, trachea, or epiglottis.

## HUMAN RESPIRATORY SYSTEM



- The airway beyond larynx can be divided into two zones:

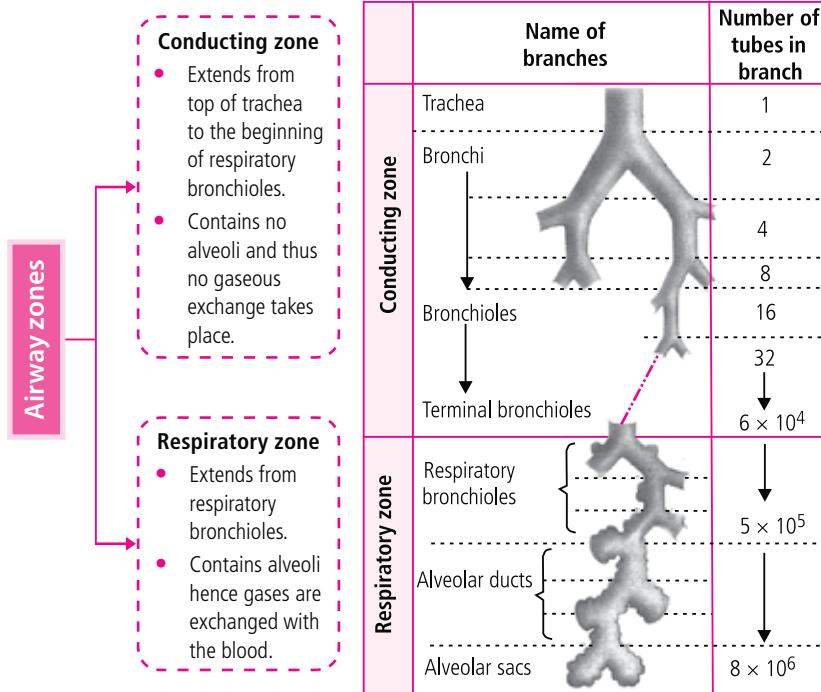


Fig.: Airway branching

## MECHANISM OF BREATHING

- Breathing in humans is brought about by alternate expansion and contraction of thoracic cavity. The two steps in breathing are:

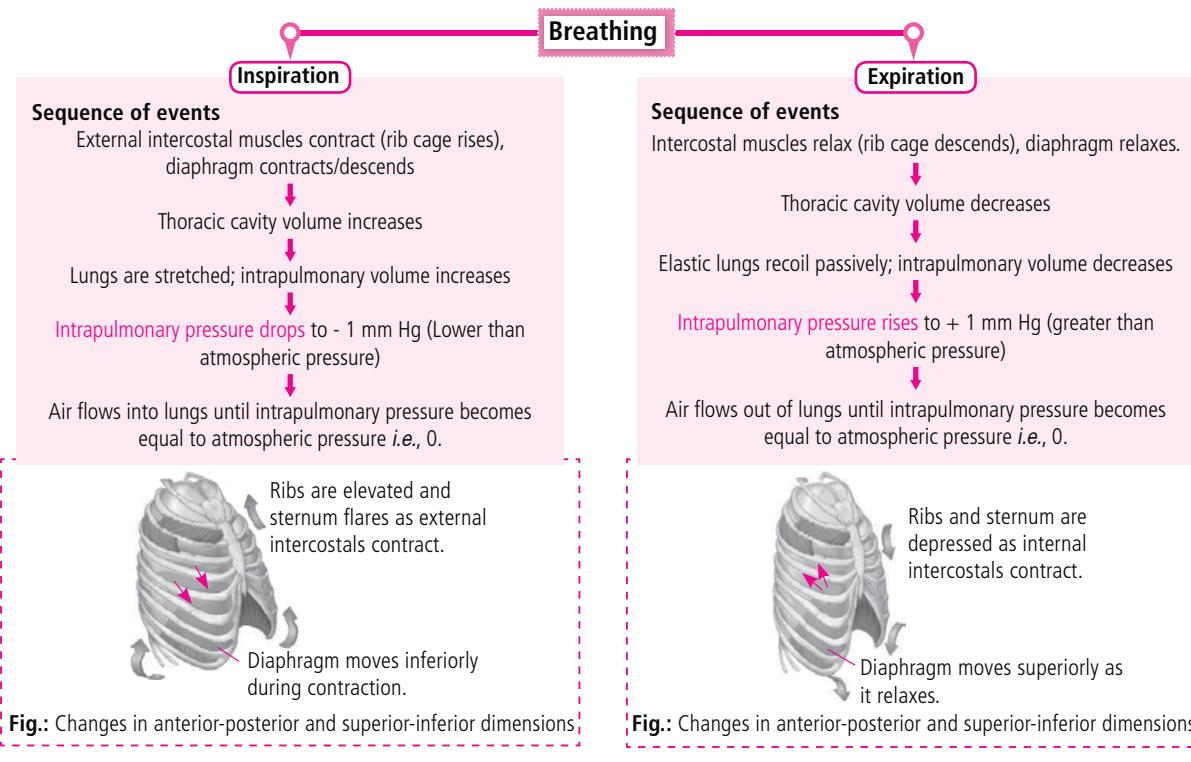


Fig.: Changes in anterior-posterior and superior-inferior dimensions

Fig.: Changes in anterior-posterior and superior-inferior dimensions

- The movement of air into and out of the lungs is carried out due to the pressure gradient between lungs and the atmosphere.

## Vocal sound production

- Sound is produced by the true vocal cords.
- For the production of sound, the vocal cords are brought parallel and closer to each other by the action of the pharyngeal muscles.
- When expired air is passed through the true vocal cords under pressure from the lungs, the vocal cords are set into vibration, which results in the production of sound.
- The quality of sound is altered by the tension on the vocal cords. The pharynx, buccal cavity, soft palate, tongue and lips assist the larynx in producing articulate human speech.

### Negative pressure breathing

Mammals have negative pressure breathing, i.e., the lungs draw air due to reduction in pressure within them. This allows them to eat and breathe at the same time. If air were to be forced into the lungs, it might carry food particles into the trachea and block it. Negative pressure breathing gently moves air which is less likely to carry food particles into the wind pipe.

## PULMONARY OR RESPIRATORY VOLUMES AND CAPACITIES

- The quantity of air that lungs receive, hold or expel under different conditions are called pulmonary volumes.
- Combinations of two or more pulmonary volumes are called pulmonary capacities.
- Spirometry** is the process of recording the changes in the volume movement of air into and out of lungs. The instrument used for this purpose is called **spirometer** or **respirometer**.
- The different types of pulmonary volumes and capacities are discussed below:

### Tidal Volume (TV)

- It is the volume of air inspired and expired during normal breathing.
- It is about 500 mL and has lowest value among all respiratory volumes.

### Inspiratory Reserve Volume (IRV)

- It is an extra amount of air that can be inspired forcibly after a normal inspiration.
- It is about 2500-3000 mL.

## Respiratory Volumes

### Residual Volume (RV)

- It is the volume of air that always remains in the lungs after forcible expiration. It enables the lungs to continue exchange of gases even after maximum exhalation or on holding the breath.
- It is about 1100-1200 mL.

### Expiratory Reserve Volume (ERV)

- It is an extra amount of air that can be expelled after a normal expiration.
- It is about 1000 -1100 mL.

## Pulmonary Capacities

### Inspiratory Capacity (IC)

- It is the maximum volume of air that can be inhaled after a normal expiration.
- It includes tidal volume and inspiratory reserve volume ( $IC = TV + IRV$ ).
- It is about 3000 - 3500 mL.

### Expiratory Capacity (EC)

- It is the total volume of air a person can expire after normal inspiration.
- It includes tidal volume and expiratory reserve volume ( $EC = TV + ERV$ ).
- It is about 1500-1600 mL.

### Functional Residual Capacity (FRC)

- It is the volume of air that remains in lungs after normal expiration.
- It includes residual volume and expiratory reserve volume ( $FRC = RV + ERV$ ).
- It is about 2400 mL.

### Vital Capacity (VC)

- It is the maximum volume of air a person can breathe in after a forced expiration or maximum volume of air a person can breathe out after a forced inspiration.
- It is the sum total of tidal volume, inspiratory reserve volume and expiratory reserve volume. ( $VC = TV + IRV + ERV$ )
- It is about 3500 - 4700 mL.

### Total Lung Capacity (TLC)

- It is the total amount of air present in the lungs and the respiratory passage after a maximum inspiration.
- It is the sum total of vital capacity and the residual volume ( $TLC = VC + RV$  or  $(TLC = TV + IRV + ERV + RV)$ ).
- It is about 4900 - 5900 mL.

## UNSCRAMBLED WORDS

JULY 2017

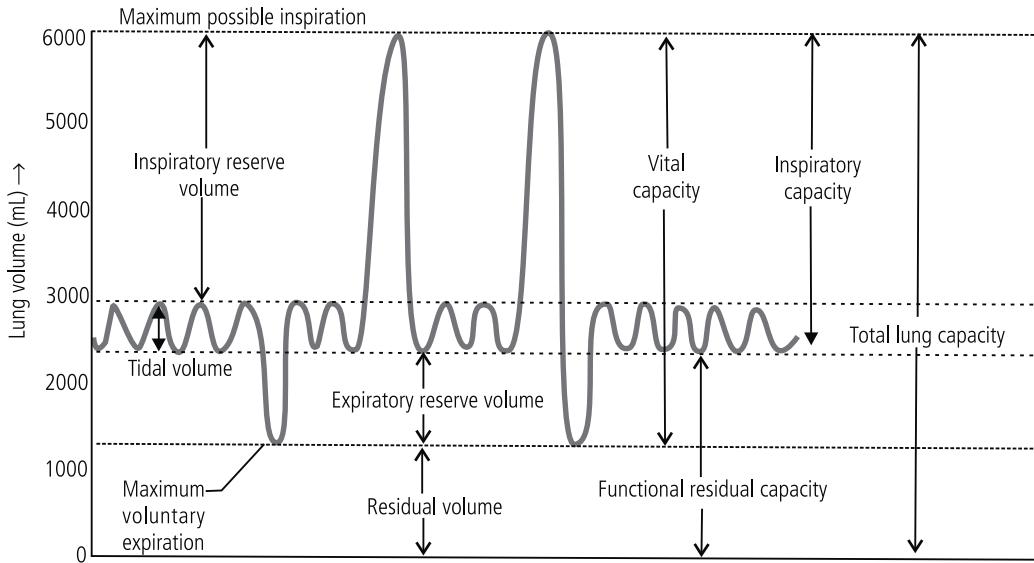
- |                      |                      |
|----------------------|----------------------|
| 1-j- CNIDOBLAST      | 2-e- METACHROSIS     |
| 3-a- CHIROPTEROPHILY | 4-f- UREOTELIC       |
| 5-b- PLEIOTROPY      | 6-i- THYROCALCITONIN |
| 7-c- ANTHOCYANIN     | 8-d- BIOTYPE         |
| 9-g- MARIJUANA       | 10-h- SANCTUARY      |

Winners : Arnav A. Joshi, Sumit Nageshwar Paliwal (Akola), Shobit Singh (Meerut), Adwayee Paul (Kolkata), Reshma Singh (New Delhi)

## Spellathon Winners

July-2017

- Jaedeepr Thotamalla (Telangana)
- Mohd. Saani



**Fig.: Lung volumes and capacities**

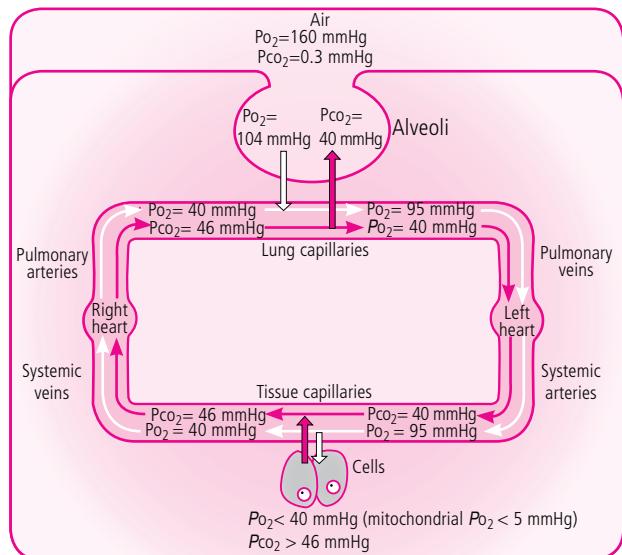
- All pulmonary volumes and capacities are about 20-25% less in women than in men and they are greater in tall persons and athletes as compared to small and slightly build people.

## EXCHANGE OF GASES

### (a) Exchange of Gases at Alveolar Surface

- Gaseous exchange between alveoli and blood capillaries takes place across respiratory membrane.
- Respiratory membrane consists of following layers :
  - Alveolar epithelium
  - Epithelial basement membrane
  - Thin interstitial space
  - Capillary basement membrane
  - Capillary endothelium
- The barrier between the alveolar wall and alveolar capillaries is extremely thin and hence **diffusion of gases takes place from higher partial pressure to lower partial pressure**.
- The blood that reaches the alveolus (venous blood) has lower  $Po_2$  (40 mm Hg) and higher  $Pco_2$  (46 mm Hg) than the alveolar air ( $Po_2$  is 104 mm Hg and  $Pco_2$  is 40 mm Hg).
- As a result oxygen diffuses into the blood and carbon dioxide out of the blood into the alveolus.
- By the time blood leaves the alveolus (arterial blood) it has almost the same  $Po_2$  (104 mm of Hg) and  $Pco_2$  (40 mm of Hg) as the alveolar air.
- When this blood present in alveolar capillaries combines with the shunt blood (blood that shunted past the gas exchange area) having  $Po_2 = 40$  mm Hg, the  $Po_2$  of the blood entering the left heart fall to about 95 mm Hg.

- The percentage saturation of blood also rises from 70% (venous blood) to 95% (arterial blood). The composition of alveolar air remain relatively unchanged.
- Partial pressure of  $N_2$  is same in alveoli and in the blood present in capillaries. This is maintained because  $N_2$  as gas is not used up by the body.

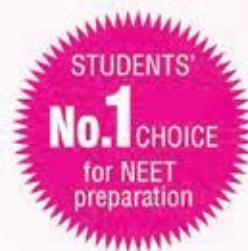
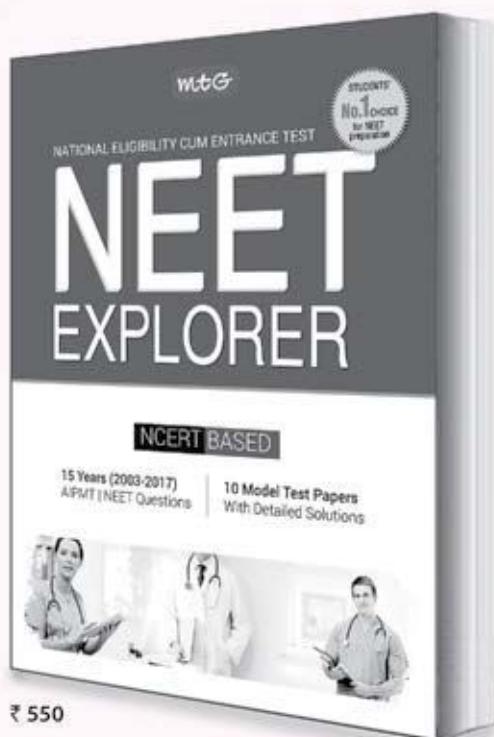


**Fig.: Gaseous exchange across alveolar and capillary wall and plasma membrane.**

### (b) Exchange of Gases between Blood and Tissue Cells

- Exchange of gases occurs between the blood and the tissue cells through tissue fluids that surround the tissue cells. Blood that reaches the tissues has more partial pressure of

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$O_2$  ( $P_{O_2} = 95$  mmHg), than that in the tissue cells (average  $P_{O_2} = 23$  mmHg). Similarly partial pressure of  $CO_2$  is more in tissue cells (= 46 mmHg) than in the blood (= 40 mmHg).

- Due to these differences in partial pressure of gases,  $O_2$  from blood diffuses in the tissues and  $CO_2$  from tissues diffuses into the blood. The blood becomes deoxygenated and then goes to the right side of the heart that sends it to lungs via pulmonary artery for reoxygenation.

## TRANSPORT OF OXYGEN

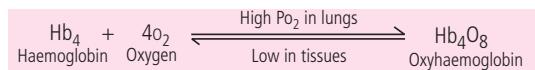
- Oxygen is carried by blood in two forms – as dissolved gas (in plasma) and as oxyhaemoglobin by RBCs.

### (i) As Dissolved Gas

- Oxygen is soluble in plasma to a small extent under normal conditions of temperature and pressure. Hence most of it is carried by red blood cells.
- About 3% of oxygen is transported by blood in dissolved form in plasma.

### (ii) As Oxyhaemoglobin

- RBCs contain a protein called **haemoglobin**. It has four polypeptide chains (hence may be written as  $Hb_4$ ) and four haem groups or 4 atoms of iron in ferrous form ( $Fe^{2+}$ ) attached to it, thus it can combine with 4 molecules of oxygen to form  $Hb_4O_8$ . This is called **oxyhaemoglobin**.



- Haemoglobin has high affinity for oxygen** and this affinity is increased by fall in  $Pco_2$  of blood.
- At the alveolus in lungs, venous blood has low oxygen and is exposed to low  $Pco_2$  of alveolus, thus oxygen diffuses into red blood cells and form oxyhaemoglobin.
- As  $CO_2$  diffuses from blood to alveolus, blood  $Pco_2$  falls increasing the further uptake of oxygen.

## Oxygen-Haemoglobin Dissociation Curve

- The relationship between the partial pressure of oxygen ( $P_{O_2}$ ) and percentage saturation of the haemoglobin with oxygen ( $O_2$ ) is graphically illustrated by a curve called **oxygen haemoglobin dissociation curve** (also called oxygen dissociation curve).
- The  $P_{O_2}$  of the air within alveoli is approximately 105 mmHg. The  $P_{O_2}$  of the blood leaving the alveoli is about 100 mmHg.
- This is because the blood plasma is not completely saturated with oxygen.
- The percentage of haemoglobin that is bound with  $O_2$  is called **percentage saturation of haemoglobin**.
- At blood  $P_{O_2}$  of 100 mmHg, 97% of hemoglobin in RBCs is in oxyhaemoglobin form.
- As blood moves through capillaries, oxygen leaves blood and diffuses into the tissues.
- The blood that leaves the tissue in veins has  $P_{O_2}$  to about 40 mmHg.
- At this lower  $P_{O_2}$ , the percentage saturation of haemoglobin accounts for only 75%.
- A person at rest, therefore, has only 22% (97% minus 75%) of the oxyhaemoglobin that has released its oxygen to the tissues, i.e., **1/5<sup>th</sup> of oxygen is unloaded to tissue and rest 4/5<sup>th</sup> is reserved**.
- During heavy exercise, the muscles use more oxygen from capillary blood, decreasing  $P_{O_2}$  in the venous blood.
- Now suppose,  $P_{O_2}$  in veins drops to 20 mmHg. This makes percent saturation of haemoglobin to only 35%.
- Because arterial blood still has 97% oxyhaemoglobin, the amount of oxygen unloaded is now 62% (97% – 35%) instead of 22% at rest.
- In addition to serve during exercise, oxygen reserve ensures blood has enough oxygen to maintain life for 4 – 5 minutes even after heart stops pumping.

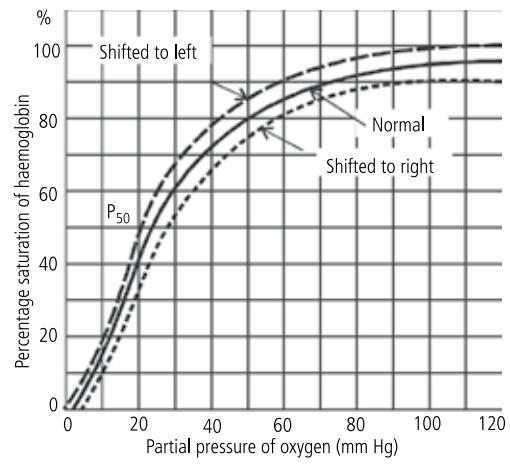
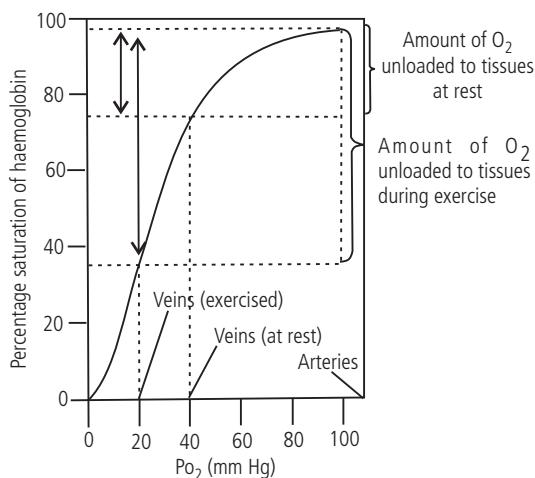
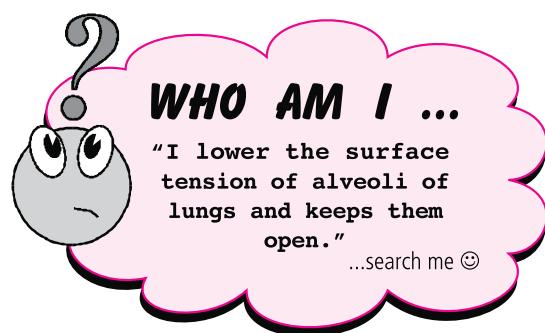


Fig.: Oxygen-haemoglobin dissociation curve



**Fig.:** The oxyhaemoglobin dissociation curve representing saturation of haemoglobin during rest and heavy exercise

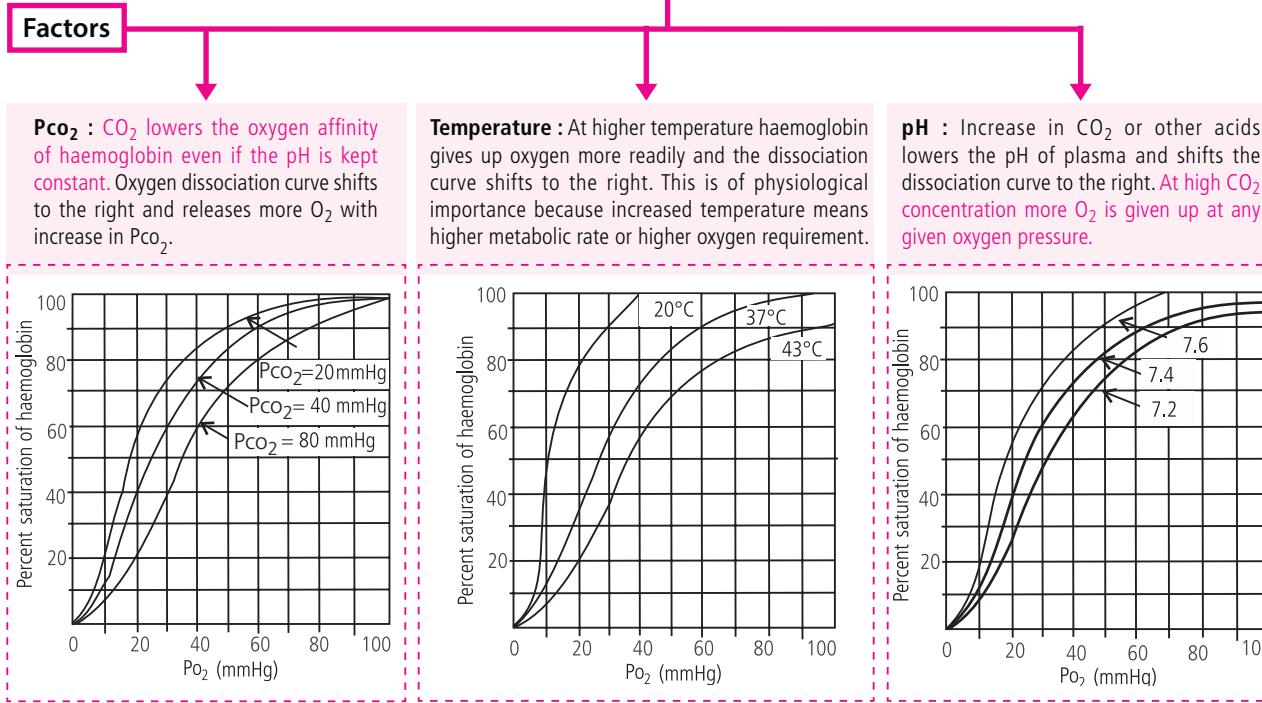
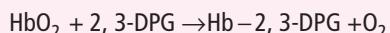


### Co-operativity

- Haemoglobin does not take up oxygen at low Po<sub>2</sub>, but as the oxygenation of pigment occurs, its affinity for more O<sub>2</sub> increases. In haemoglobin where 4 sub-units are present, acquisition of one molecule of oxygen increases the affinity of neighbouring haems for oxygen. This is known as co-operativity between active sites.

### Factors Affecting Oxygen Dissociation Curve

**2, 3-diphosphoglyceric acid (2,3-DPG)** is present in the red blood cells, formed from 3-phosphoglyceric acid (a product of glycolysis). It competes for oxygen binding sites in the haemoglobin molecule. As it binds to the β-chain of HbA (especially deoxy HbA), it causes the right shift of dissociation curve i.e., more unloading of O<sub>2</sub> in tissues.



### The Bohr Effect

It is named after the Danish physiologist **Christian Bohr** (1855-1911). An increase in carbon dioxide in the blood decreases the affinity of haemoglobin for oxygen that causes oxygen to be displaced from the haemoglobin and hence increases release of oxygen to the tissue. This is called Bohr effect. This is an important to deliver increased amount of oxygen to the tissues.

This can be explained as : When the blood passes through the tissue,  $\text{CO}_2$  diffuses from the tissue into the blood. This increases the blood  $\text{PCO}_2$  and the pH of the blood falls. These effects shift the oxygen dissociation curve to the right.

### Oxygen dissociation curve for myoglobin in muscle

Myoglobin is an iron-containing pigment found in greater quantities in muscles specialised for sustained contraction, e.g., muscles of leg and heart muscles. It contains only one heme group with one polypeptide chain.

The shape of oxygen dissociation curve for myoglobin is hyperbolic because it has great affinity for oxygen and binding of oxygen to the single polypeptide chain is non-cooperative. It takes up  $\text{O}_2$  at low pressure much more readily than does blood. Even at  $\text{PO}_2$  of 40 mmHg it is 95% saturated with  $\text{O}_2$ ; and when  $\text{PO}_2$  falls below 5 mmHg, it becomes < 60% saturated. Since myoglobin cannot deliver a large fraction of its bound oxygen even at 20 mm Hg, it cannot serve as an effective vehicle for delivery of oxygen from lungs to peripheral tissues.

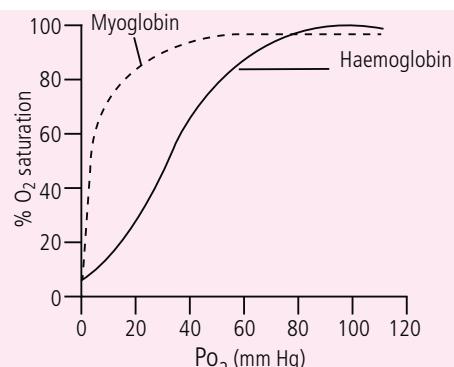


Fig.: Dissociation curve for haemoglobin and myoglobin at 37°C;  $\text{PCO}_2$  40 mmHg and pH 7.4.

### Fetal haemoglobin

The haemoglobin of a fetus has a higher affinity for oxygen than the mother's haemoglobin. This enables the fetal haemoglobin to pick up oxygen at oxygen pressures low enough to cause the mother's haemoglobin to release oxygen. If fetal and maternal haemoglobins had the same affinity for oxygen, then fetus would not pick up much of the oxygen released by the mother's blood. After birth, the fetal haemoglobin gets gradually replaced by adult haemoglobin.

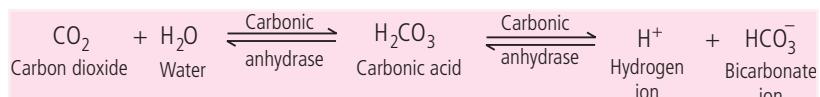
## TRANSPORT OF CARBON DIOXIDE

- Carbon dioxide in gaseous form diffuses out of the cells into the capillaries, where it is transported in three ways.
- (i) In Dissolved Form

- Because of its high solubility, about **7 percent carbon dioxide gets dissolved in the blood plasma** and is carried in solution to the lungs.

### (ii) In Form of Bicarbonate

- The largest fraction of **carbon dioxide (about 70%) is converted to bicarbonate ions ( $\text{HCO}_3^-$ )** and transported in plasma.
- When carbon dioxide diffuses into the RBCs, it combines with water, forming carbonic acid ( $\text{H}_2\text{CO}_3$ ).  $\text{H}_2\text{CO}_3$  is unstable and quickly dissociates into hydrogen ions and bicarbonate ions.



- This reaction is very slow in blood plasma, but occurs very rapidly inside RBCs because of a zinc containing enzyme, the **carbonic anhydrase**.

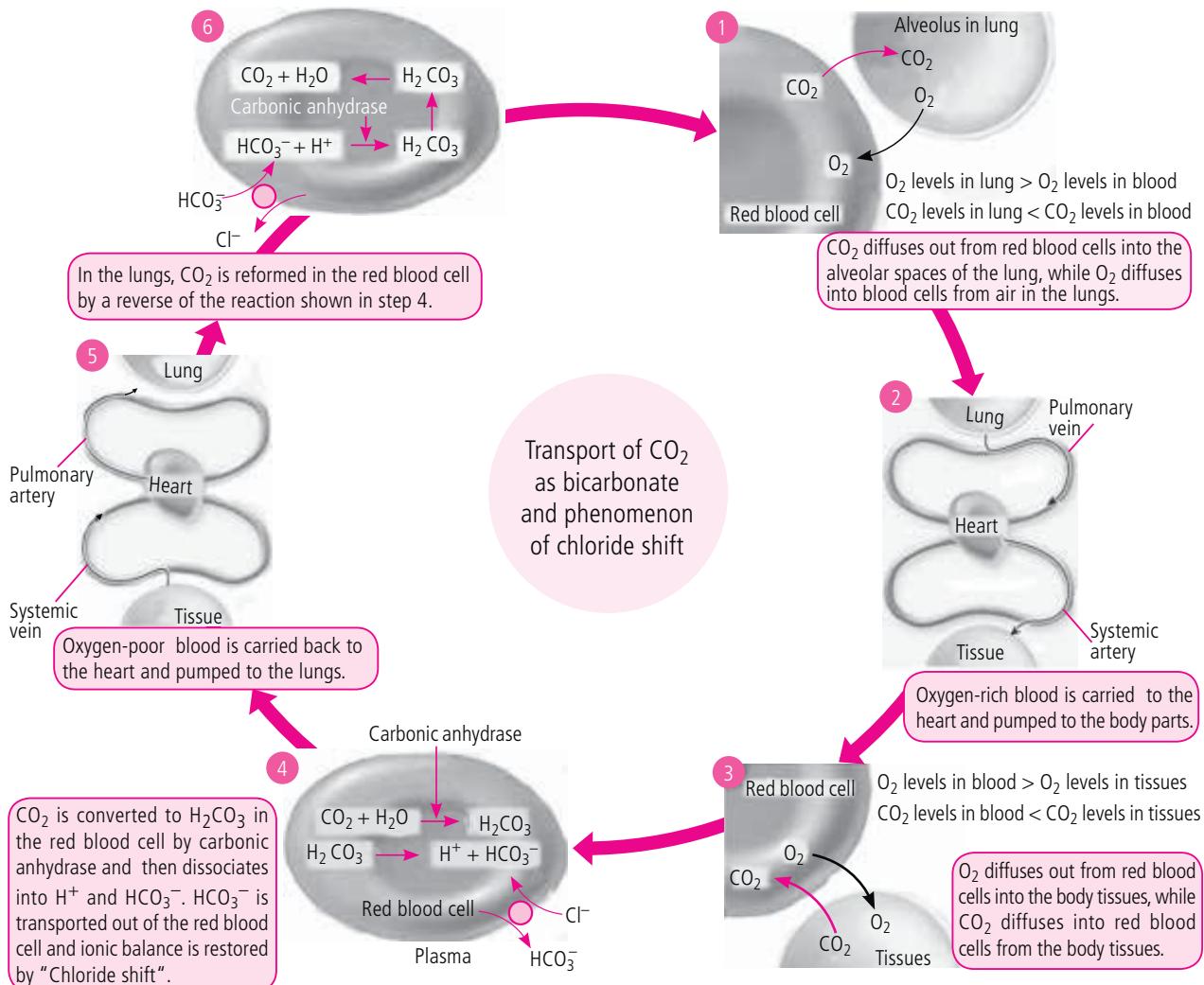
### (iii) In Form of Carbaminohaemoglobin

- $\text{CO}_2$  also combines with the amine radicals of haemoglobin to form carbaminohaemoglobin.
- About 23%  $\text{CO}_2$  is carried by haemoglobin in this form.



## Chloride shift

- The most of bicarbonate ions ( $\text{HCO}_3^-$ ) formed within RBCs diffuse out into the blood plasma along the concentration gradient. Exit of bicarbonate ions, considerably changes ionic balance between the plasma and the erythrocytes (RBCs). To restore this ionic balance, the chloride ions diffuse from the plasma into the erythrocytes. This movement of chloride ions is called **chloride shift** or **Hamburger's phenomenon**.



## HALDANE EFFECT

- It was proposed by **J.B.S. Haldane**. It is based on the fact that **combination of oxygen with haemoglobin causes the haemoglobin to become a strong acid**.
- Binding of oxygen with haemoglobin tends to displace carbon dioxide from the blood.** This is called **Haldane effect**. It is far more important in promoting carbon dioxide transport than is the Bohr effect which promotes oxygen transport.
- As carbon dioxide enters the systemic bloodstream, it causes more oxygen to dissociate from haemoglobin (Bohr effect), which in turn allows more carbon dioxide to combine with haemoglobin and more bicarbonate ions to be formed (Haldane effect).
- In the pulmonary circulation, the situation is reversed.
- Uptake of oxygen facilitates the release of carbon dioxide. As haemoglobin becomes saturated with oxygen, the hydrogen ions released combine with  $\text{HCO}_3^-$ , helping to unload  $\text{CO}_2$  from the pulmonary blood.
- The Haldane effect encourages  $\text{CO}_2$  exchange in both the tissues and lungs.

## Haemoglobin as buffer

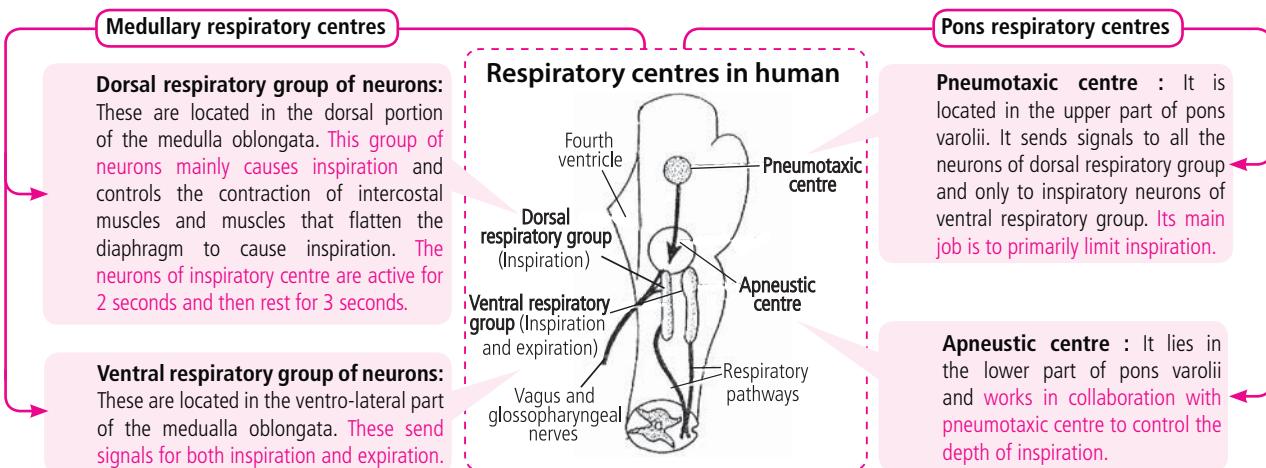
- Addition of hydrogen ions due to release of  $\text{CO}_2$  from the tissues, would make the blood acidic. However, most of the hydrogen ions are neutralised by combination with haemoglobin, which is negatively charged, forming acid haemoglobin. This reduces the acidity of the blood, and also releases additional oxygen. If the blood becomes too basic, acid haemoglobin dissociates, releasing hydrogen ions.  
 $\text{HHb} \rightarrow \text{H}^+ + \text{Hb}$ .
- Thus, the haemoglobin also acts as a buffer, a substance that keeps the pH from fluctuating.

## REGULATION OF RESPIRATION

- Respiration is under neural, chemical as well as mechanical regulation.

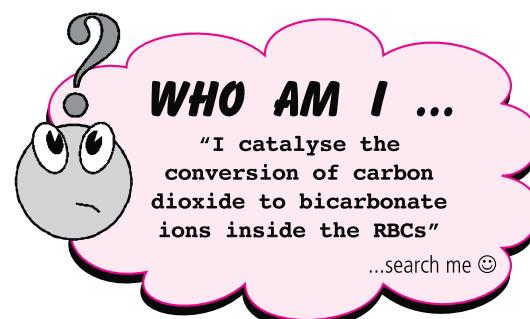
### Nervous Regulation

- The respiratory centre is composed of several widely dispersed groups of neurons located in the **medulla oblongata** and **pons varolii**.
- The voluntary control / system is located in the cerebral cortex and send impulses to the respiratory motor neurons via the corticospinal tracts.
- The autonomic system is located in the pons and medulla and the efferent output from this system to the respiratory motor neurons is located in the lateral and ventral portion of spinal cord.



### Chemical Control

- The peripheral chemoreceptors located in the neck at the bifurcation of the common carotid arteries and in the thorax on the arch of aorta are called **carotid bodies** and **aortic bodies** respectively. They respond to changes in arterial blood. Peripheral chemoreceptors are stimulated by:
  - Significantly decreased  $\text{Po}_2$  (hypoxia)
  - Increased  $\text{H}^+$  concentration (metabolic acidosis)
  - Increased  $\text{Pco}_2$  (respiratory acidosis)They send appropriate nerve impulses in respiratory muscles, which quicken or slow down breathing as required till normal  $\text{CO}_2$  and  $\text{O}_2$  levels are regained.
- **Central chemoreceptors** located in the medulla oblongata, respond to changes in the brain extracellular fluid. They are stimulated by increased  $\text{Pco}_2$  via associated changes in  $\text{H}^+$  concentration.



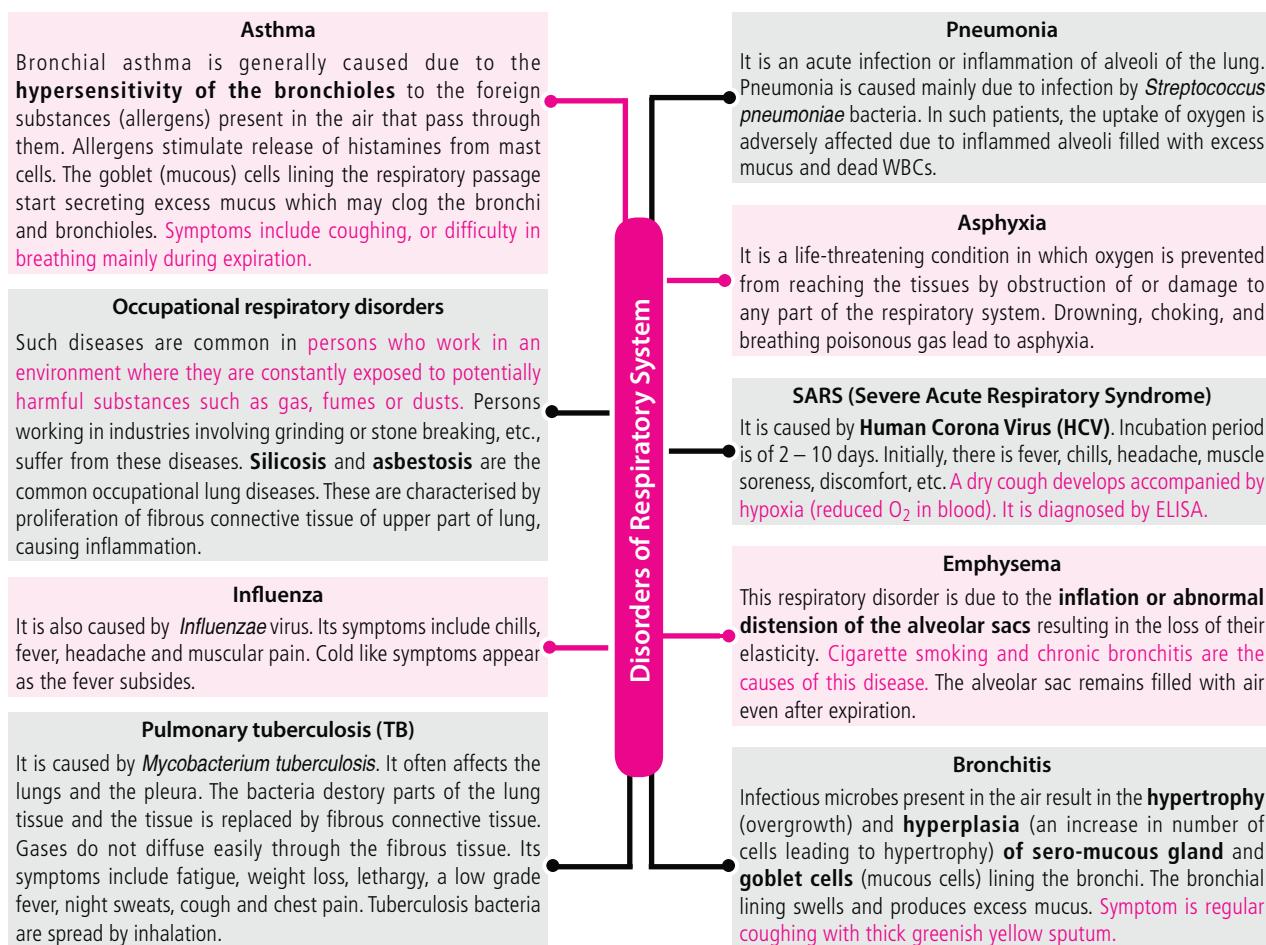
### $\text{CO}_2$ level has more effect on breathing

The level of  $\text{CO}_2$  has more effect on breathing than does the level of oxygen. If the  $\text{CO}_2$  content of the blood drops below a certain critical level, breathing stops. If we hold our breath by closing the nostrils,  $\text{CO}_2$  level in the blood rises, and breathing is accelerated on reopening the nostrils. If we resort to repeated deep inhalations and exhalations in rapid successions, the  $\text{CO}_2$  level of the blood falls so much that we can hold breath longer. Oxygen does not seem to have a significant effect on the respiratory centres.

## Mechanical Control

- **Pulmonary stretch receptors**, lie in the airway smooth muscle layer and are activated by a large lung inflation.
- Action potentials in the **afferent nerve fibers** from the stretch receptors travel to the brain and inhibit the activity of the **medullatory inspiratory neurons**. This is called the **Hering-Breuer reflex**.
- Thus, feedback from the lungs helps to terminate inspiration by **inhibiting inspiratory nerves** in the dorsal respiratory group. However, this reflex plays a role in setting respiratory rhythm only under conditions of very large tidal volumes, as in strenuous exercise.

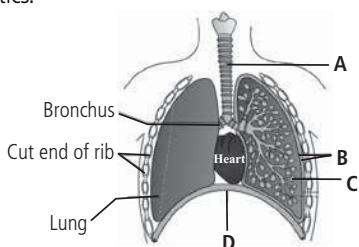
## RESPIRATORY DISORDERS



# SPEED PRACTICE

1. In tissues, high concentration of carbon dioxide  
(a) increases the affinity of haemoglobin to both oxygen and hydrogen  
(b) increases the affinity of haemoglobin to oxygen but decreases its affinity to hydrogen  
(c) decreases the affinity of haemoglobin to oxygen but increases its affinity to hydrogen  
(d) decreases the affinity of haemoglobin to both oxygen and hydrogen.
2. Deep inspiratory capacity after maximum expiration is called  
(a) total lung capacity (b) functional residual capacity  
(c) vital capacity (d) expiratory capacity.

- 3.** Inspiration occurs when there is a negative pressure in the lungs with respect to atmospheric pressure. This negative pressure is achieved when
- intrapulmonary pressure is less than the atmospheric pressure
  - intrapulmonary pressure is greater than the atmospheric pressure
  - intrapulmonary pressure is equal to the atmospheric pressure
  - intrapleural pressure becomes more than the intra-alveolar pressure.
- 4.** The oxygen haemoglobin dissociation curve shifts either to right or left according to various factors. Shift to right indicates dissociation of oxygen from haemoglobin. Which of the following factors will shift the curve to the right?
- Decrease in partial pressure of oxygen
  - Increase in partial pressure of carbon dioxide
  - Decrease in hydrogen ion concentration
  - Increase in pH      (v) Increase in body temperature
- (i) and (iv)
  - (ii), (iv) and (v)
  - (i), (ii) and (v)
  - (iii) and (iv)
- 5.** People living at sea level have around 5 million RBC per cubic millimeter of their blood whereas those living at an altitude to 5400 metres have around 8 million. This is because at high altitude
- people eat more nutritive food, therefore more RBCs are formed
  - people get pollution-free air to breathe and more oxygen is available
  - atmospheric O<sub>2</sub> level is less and hence more RBCs are needed to absorb the required amount of O<sub>2</sub> to survive
  - there is more UV radiation which enhances RBC production.
- 6.** The factor which does not affect the rate of alveolar diffusion is
- solubility of gases
  - thickness of the membranes
  - pressure gradient
  - reactivity of the gases.
- 7.** During winter, a person sleeping in a closed room having a container with burnt charcoals, was found dead next morning. What could be the possible reason of his death?
- Non-availability of oxygen
  - Hb has more affinity to combine with carbon monoxide
  - Hb has more affinity to combine with nitrogen
  - Combined effect of (a) and (b)
- 8.** A large proportion of oxygen remains unused in the human blood even after its uptake by the body tissues. This O<sub>2</sub>
- acts as a reserve during muscular exercise
  - raises the Pco<sub>2</sub> of blood to 75 mm of Hg
  - is enough to keep oxyhaemoglobin saturation at 96%
  - helps in releasing more O<sub>2</sub> to the epithelial tissues.
- 9.** A person suffers punctures in his chest in an accident, without any damage to the lungs. It would result in
- decrease in breathing rate
  - rapid increase in breathing rate
  - no change in respiration
  - cessation of breathing.
- 10.** The partial pressure of oxygen is maximum in
- alveolar air
  - arterial blood
  - venous blood
  - expired air.
- 11.** The carbon dioxide is transported *via* blood to lungs mostly
- in combination with haemoglobin only
  - dissolved in blood plasma
  - in the form of bicarbonates
  - as carboxyhaemoglobin.
- 12.** Which one of the following statements is incorrect?
- The principle of countercurrent flow facilitates efficient respiration in gills of fishes.
  - The residual air in lungs slightly decreases the efficiency of respiration in mammals.
  - The presence of non-respiratory air sacs increases the efficiency of respiration in birds.
  - In insects, circulating body fluids serve to distribute oxygen to tissues.
- 13.** Match the columns and select the correct option from the codes given below.
- | <b>Column I</b>            | <b>Column II</b>                   |
|----------------------------|------------------------------------|
| (A) TV + ERV               | (i) Expiratory capacity            |
| (B) RV + ERV + TV + IRV    | (ii) Total lung capacity           |
| (C) ERV + RV               | (iii) Functional residual capacity |
| (a) A-(i), B-(ii), C-(iii) | (b) A-(iii), B-(i), C-(ii)         |
| (c) A-(iii), B-(ii), C-(i) | (d) A-(ii), B-(iii), C-(i)         |
- 14.** About 1000 mL of air is always known to remain inside the human lungs. It is described as \_\_\_\_\_.
- inspiratory reserve volume
  - expiratory reserve volume
  - residual volume
  - tidal volume
- 15.** Tachypnea is
- normal breathing
  - slow breathing
  - rapid shallow breathing
  - no breathing.
- 16.** The figure shows a diagrammatic view of human respiratory system with labels A, B, C and D. Select the option which gives correct identification and main function and/or characteristics.



- (a) C - Alveoli - Thin walled vascular bag like structures for exchange of gases.  
 (b) D - Lower end of lungs - Diaphragm pulls it down during inspiration.  
 (c) A - Trachea - Long tube supported by complete cartilaginous rings for conducting inspired air.  
 (d) B - Pleural membrane - Surrounds ribs on both sides to provide cushion against rubbing.
- 17.** Chemosensitive area of respiratory centre in medulla is affected by  
 (a) less CO<sub>2</sub> and H<sup>+</sup> ions      (b) less O<sub>2</sub> and H<sup>+</sup> ions  
 (c) excess CO<sub>2</sub> and H<sup>+</sup> ions    (d) excess O<sub>2</sub> and H<sup>+</sup> ions.
- 18.** When diaphragm of man is completely dome shaped it shows  
 (a) end of expiration and beginning of inspiration  
 (b) beginning of expiration and end of inspiration  
 (c) increased rate of breathing  
 (d) decreased rate of breathing.
- 19.** Surfactant  
 (a) is a polysaccharide produced by type I alveolar cells  
 (b) is excessive in many premature infants resulting in difficulties in breathing  
 (c) decreases the surface tension of the fluid lining the alveoli  
 (d) secretion is decreased when a deep breath is taken.
- 20.** If the respiratory rate of 'A' is 35 breaths/min and tidal volume 185cc/ breath and of 'B' is 25 breaths/min and tidal volume 259cc/ breath, then  
 (a) pulmonary ventilation of 'A' and 'B' is same  
 (b) alveolar ventilation of 'A' and 'B' is same  
 (c) pulmonary ventilation of 'A' is greater than 'B'  
 (d) alveolar ventilation of 'A' is greater than 'B'
- 21.** How much amount of oxygen is present in one gram of haemoglobin?  
 (a) 20 mL                                  (b) 1.34 mL  
 (c) 40 mL                                  (d) 13.4 mL
- 22.** Which of the following match is correct?  
 (a) Emphysema : reduction of surface area of alveoli and bronchi  
 (b) Pneumonia : occupational disease with asbestos  
 (c) Silicosis : inflammation of alveoli  
 (d) Asthma : excessive secretion of bronchial mucus
- 23.** The respiratory centre in the brain is stimulated by  
 (a) CO<sub>2</sub> concentration in venous blood  
 (b) O<sub>2</sub> concentration in arterial blood  
 (c) CO<sub>2</sub> concentration in arterial blood  
 (d) O<sub>2</sub> concentration in venous blood.
- 24.** Hiccups can be best described as  
 (a) forceful sudden expiration  
 (b) forceful contraction of intercostal muscles during deep breathing
- (c) vibration of the soft palate during breathing while sleeping  
 (d) jerky incomplete inhalation of air.
- 25.** **Statement A :** Extra oxygen consumption in human body is known as oxygen debt.  
**Statement B :** The extra oxygen is required by the body to oxidise the accumulated lactic acid produced during strenuous exercise.  
 (a) Both statements A and B are correct and B is the correct explanation of A.  
 (b) Both statements A and B are correct but B is not the correct explanation of A.  
 (c) Statement A is correct but statement B is incorrect.  
 (d) Both statements A and B are incorrect.
- 26.** In man and mammals, air passes from outside into the lungs through  
 (a) nasal cavity, larynx, pharynx, trachea, bronchi, alveoli  
 (b) nasal cavity, pharynx, larynx, trachea, bronchioles, bronchi, alveoli  
 (c) nasal cavity, larynx, pharynx, trachea, bronchioles, alveoli  
 (d) nasal cavity, pharynx, larynx, trachea, bronchi, bronchioles, alveoli
- 27.** Mammalian lungs have an enormous number of minute alveoli (air sacs). This is to allow  
 (a) more surface area for diffusion of gases  
 (b) more space for increasing the volume of inspired air  
 (c) more nerve supply to keep the lungs working  
 (d) more spongy texture for keeping lungs in proper shape.
- 28.** Which of the following statements is correct?  
 (a) The contraction of internal intercostal muscles lifts up the ribs and sternum.  
 (b) The RBCs transport oxygen only.  
 (c) The thoracic cavity is anatomically an air tight chamber.  
 (d) Healthy man can inspire approximately 500 mL of air per minute.
- 29.** Rate of breathing is controlled mainly by  
 (a) CO<sub>2</sub> level in blood      (b) pH in blood  
 (c) O<sub>2</sub> level in blood      (d) O<sub>2</sub> level and pH in blood.
- 30.** Increased dissociation of oxyhaemoglobin due to increase in CO<sub>2</sub> concentration is called  
 (a) Chloride shift                         (b) Hamburger's phenomenon  
 (c) Bohr effect                               (d) Haldane effect.

**ANSWER KEY**

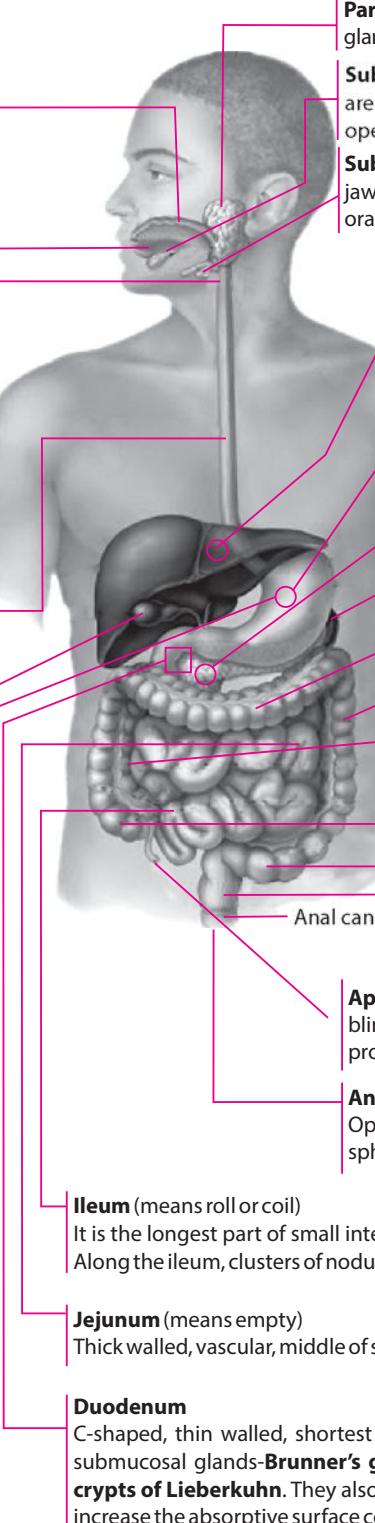
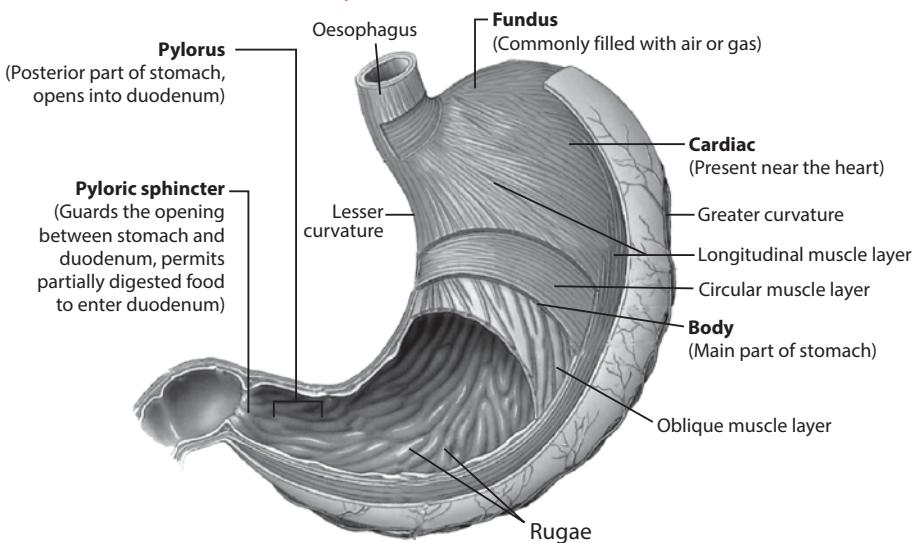
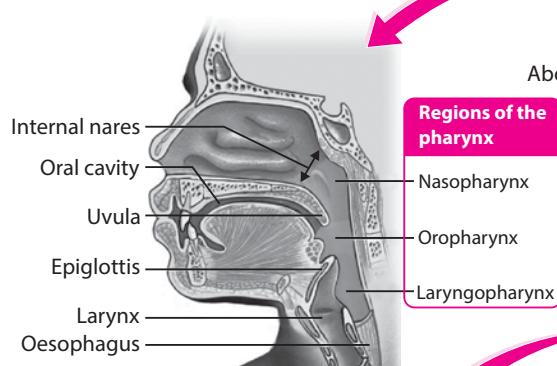
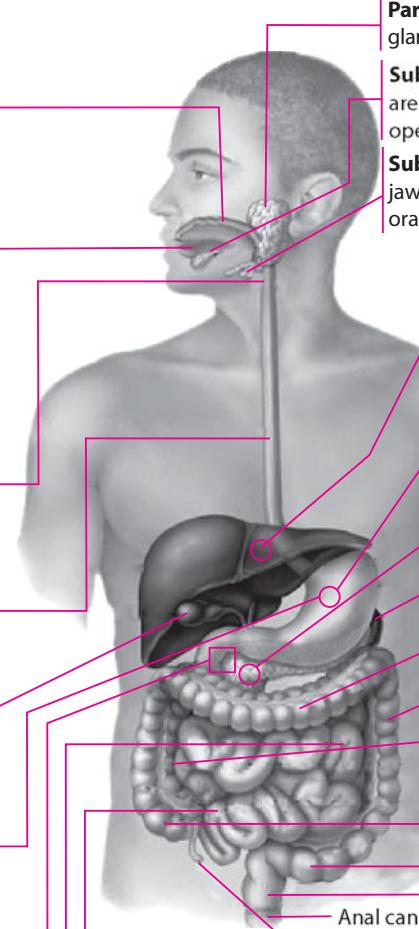
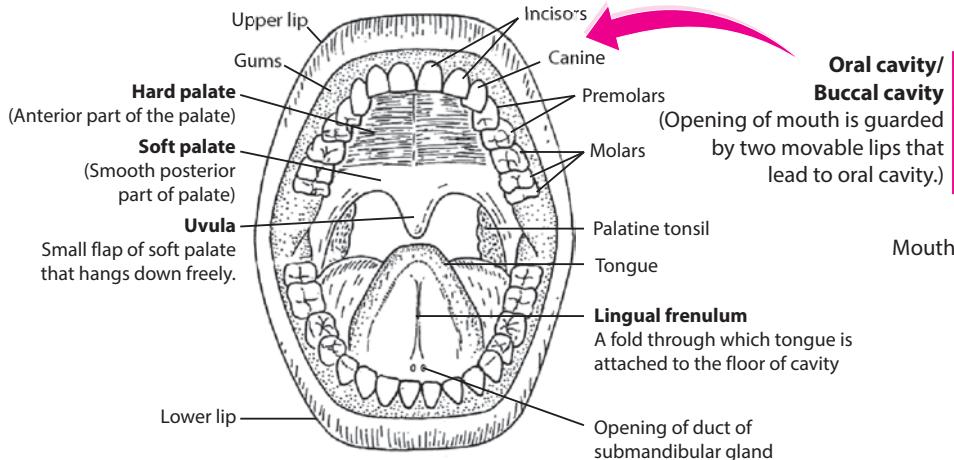
1. (c)	2. (c)	3. (a)	4. (c)	5. (c)
6. (d)	7. (d)	8. (a)	9. (d)	10. (a)
11. (c)	12. (d)	13. (a)	14. (c)	15. (c)
16. (a)	17. (c)	18. (a)	19. (c)	20. (a)
21. (b)	22. (a)	23. (c)	24. (d)	25. (a)
26. (d)	27. (a)	28. (c)	29. (a)	30. (c)



# CONCEPT MAP

# HUMAN DIGESTIVE SYSTEM

Humans show holozoic nutrition wherein they feed by ingesting complex organic matter. They have a digestive system. The organic matter is subsequently digested and absorbed in this system. The human digestive system is a tube like gastrointestinal (GI) tract or alimentary canal (approximately 9 m in adults) and digestive glands which secrete enzymes and hormones through the body from mouth to anus. Each region of this tract is specialised to carry out particular steps in the process of digestion. The movement of food through the tract is brought about by peristaltic movements of its contents.



# STEM

a specialised digestive system includes a long tract. The GI tract runs in digestion and allow

**Otic gland** - Located near the ears and are largest of the three glands. Duct opens into the oral cavity near upper second molars.

**Sublingual gland** - They are located beneath the tongue and are smallest of three glands. Their ducts (**ducts of Rivinus**) open into the floor of oral cavity.

**Submandibular glands** - They are located at angles of lower jaw, medium sized. Their ducts (**Wharton's duct**) open into oral cavity near lower central incisors.

## Liver

Largest gland of the body, lies in the upper right side of abdominal cavity just below the diaphragm. Divided into two main lobes which are further subdivided into **lobules**, the functional unit of liver.

## Pancreas

Soft, lobulated, greyish-pink gland, located posterior to the stomach in the abdominal cavity. It comprises of both exocrine and endocrine cells.

## Spleen

Transverse colon  
Descending colon  
Ascending colon

**Colon**  
Possess three longitudinal bands called **taeniae coli** and small pouches called **hastra**. It contains microbial flora.

**Caecum** - Pouch like structure, about 6 cm long and leads to colon.

Sigmoid colon

**Rectum** - Short muscular tube, comprising last 20 cm of gut and terminates in 2 cm long anal canal.

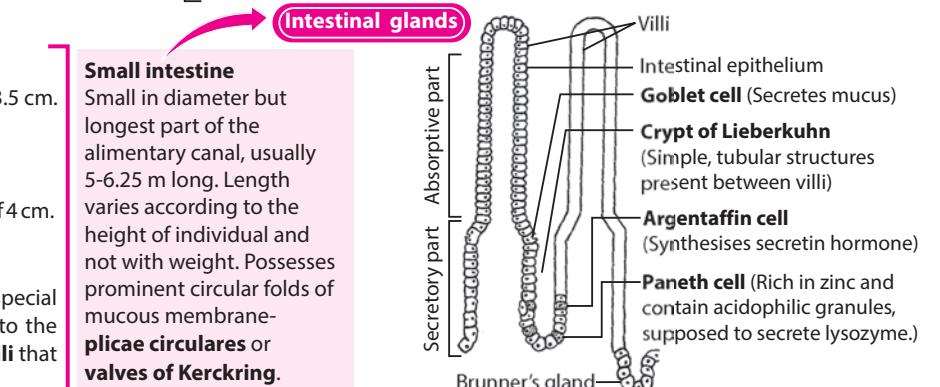
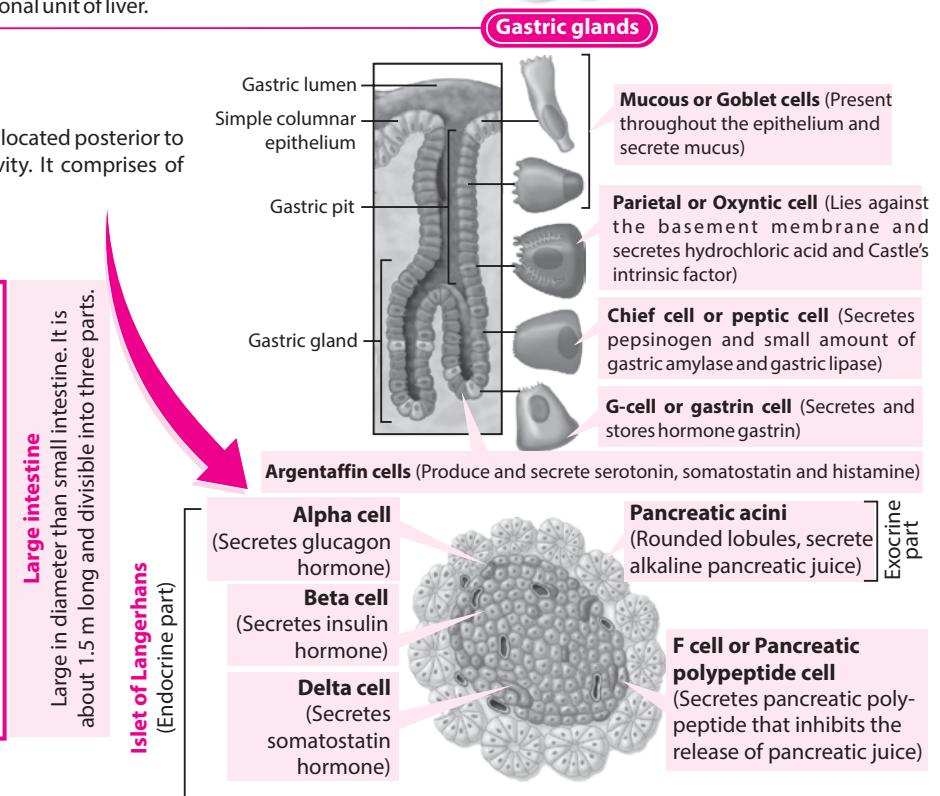
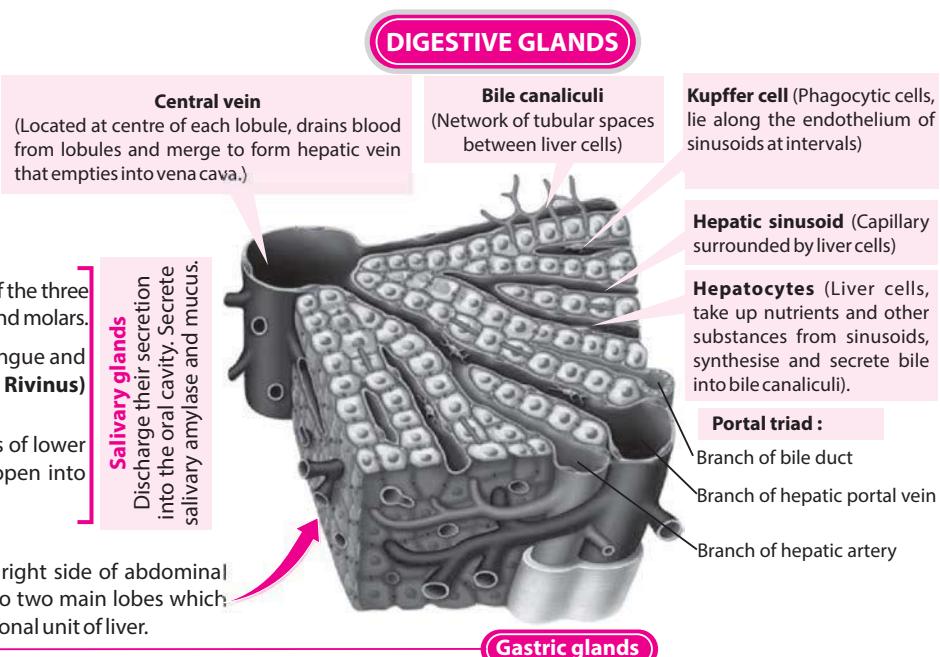
**Appendix** - Outgrowth of caecum, slightly coiled tube and vestigial in humans. Its wall contains prominent lymphoid tissue.

**Anus**  
Opening of anal canal, guarded by internal anal sphincter and external anal sphincter.

Intestine (approximately 3.5 m), with a diameter of 3.5 cm. Lesions called **Peyer's patches** are present.

Small intestine, about 2.5 m long with a diameter of 4 cm.

and widest part of small intestine. Numerous special **gland** are present in which empty thin ducts into the lumen to show numerous finger like projections called **villi** that considerably.



This specially designed column enables students to self analyse their extent of understanding of specified chapters. Give yourself four marks for correct answer and deduct one mark for wrong answer. Self check table given at the end will help you to check your readiness.

- **Biomolecules**
- **Cell Cycle and Cell Division**

**Total Marks : 160**

**Duration : 40 Min.**

1.  $\beta$ -alanine helps in the formation of
  - (a) nicotinamide
  - (b) coenzyme A and pantothenic acid
  - (c) pantothenic acid and  $\beta$ -keratin
  - (d) coenzyme A and  $\beta$ -keratin.
2. Meiosis in AaBb will result in gametes
  - (a) AB, ab
  - (b) Aa, Bb
  - (c) AB, aB, Ab, ab
  - (d) Aa, bb.
3. Which of the following is a heterocyclic amino acid?
  - (a) Proline
  - (b) Phenylalanine
  - (c) Tyrosine
  - (d) Isoleucine
4. Select the option having correct pairing of heteropolysaccharide.
  - (a) Chitin, arabinoxylans, peptidoglycan
  - (b) Fructan, chitin, agar
  - (c) Chitin, arabinoxylans, galactan
  - (d) Fructan, xylan, araban
5. The number of mitotic cell divisions required to produce 256 cells from single cell would be
  - (a) 10
  - (b) 12
  - (c) 6
  - (d) 8.
6. Colchicine is a cell poison which arrests cell division at \_\_\_\_\_ and can induce \_\_\_\_\_.
  - (a) metaphase, parthenocarpy
  - (b) anaphase, parthenocarpy
  - (c) metaphase, polyploidy
  - (d) anaphase, polyploidy
7. What is the position of nitrogen atoms in pyrimidine?
  - (a) 1, 3, 7 and 9
  - (b) 1, 3 and 7
  - (c) 1, 7 and 9
  - (d) 1 and 3
8. Sugar 'X' was added to a solution of copper sulphate. On gently heating the solution, its colour changes to reddish green. 'X' cannot be
  - (a) sucrose
  - (b) maltose
  - (c) glucose
  - (d) fructose.
9. Which of the following events are not characteristic features of telophase?
  - A. Chromosome material condenses to form compact mitotic chromosomes.
  - B. Nucleolus, Golgi complex and ER reform.
  - C. Nuclear envelope assembles around the chromosome clusters.
  - D. Centromeres split and chromatids separate.
  - E. Chromosomes cluster at opposite, spindle poles and their identity as discrete elements is lost.
  - (a) A, B and D
  - (b) A and D only
  - (c) B and C
  - (d) C, D and E
10. A competitive enzyme inhibitor
  - (a) increases  $K_m$  without affecting  $V_{max}$
  - (b) decreases  $K_m$  without affecting  $V_{max}$
  - (c) increases  $V_{max}$  without affecting  $K_m$
  - (d) decreases both  $V_{max}$  and  $K_m$ .
11. Congression refers to the phenomenon of
  - (a) tightening of chromatin material
  - (b) bringing of chromosomes on the equatorial plate
  - (c) movement of chromosomes towards poles
  - (d) disorganisation of nuclear envelope during karyokinesis.
12. Select the type of enzyme involved in the given reaction.

$$S - G + S' \rightarrow S + S' - G$$

  - (a) Oxidoreductase
  - (b) Transferase
  - (c) Hydrolase
  - (d) Lyase



- 13.** Match column I with column II and select the correct codes.  
(There can be more than one match for items in column I).

<b>Column I</b>		<b>Column II</b>	
<b>(i)</b>	<b>(ii)</b>	<b>(iii)</b>	<b>(iv)</b>
(i) Pigment	A. Curcumin		
(ii) Lectin	B. Carotenoid		
(iii) Drug	C. Codeine		
(iv) Alkaloid	D. Vinblastin		
	E. Concanavalin A		
<b>(i)</b>	<b>(ii)</b>	<b>(iii)</b>	<b>(iv)</b>
(a) B	E	A, D	C
(b) B	A, E	D	C
(c) E	A, D	D	B, C
(d) C	A, B	D	C

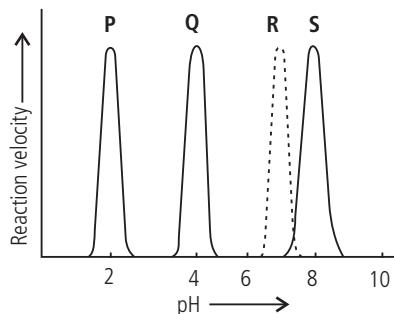
- 14.** Which of the following events are not characteristic features of diplotene?

- I. Separation of the homologous chromosomes in the region of crossing over.
  - II. In some oocytes, this stage is extended and metabolically active for months and years.
  - III. The pairing of homologous chromosomes takes place to produce a synaptonemal complex.
  - IV. Partial dissolution of nucleoprotein complex at the attachment points between the homologous chromosomes.
  - V. The chromosomes at this stage show a peculiar arrangement called bouquet stage.
- (a) I, III and V      (b) II, III and IV  
 (c) III, IV and V      (d) I, II and III

- 15.** Mitotic cyclin on being activated, causes a transition from

- (a) G<sub>1</sub> to S phase      (b) S to G<sub>2</sub> phase  
 (c) G<sub>2</sub> to M phase      (d) M to G<sub>0</sub> phase.

- 16.** Refer to the given graph showing relation between pH and activity of four enzymes. Identify P, Q, R and S and select incorrect statement regarding them.



- (a) P could be found in stomach and helps in digestion of proteins.  
 (b) Q could be found in intestinal juice and helps in digestion of carbohydrates.  
 (c) R could be found in oral cavity and is responsible for digestion of 60% of starch.

- (d) S could be found in pancreatic juice and helps in activation of a proenzyme.

- 17.** Enkephalins are produced by

- (a) cartilage cells      (b) bone cells  
 (c) adipose cells      (d) nerve cells.

- 18.** Amitosis is

- (a) division involving formation of chromosome bridges
- (b) division involving spindle formation
- (c) division in which chromosomes are unequally distributed
- (d) cleavage of nucleus without recognisable chromosome distribution.

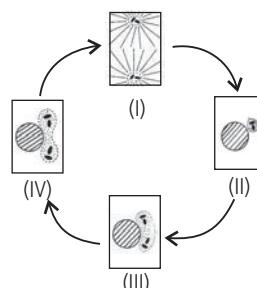
- 19.** Select the option which is not correct with respect to enzyme action.

- (a) Substrate binds with enzyme at its active site.
- (b) Addition of lot of succinate does not reverse the inhibition of succinic dehydrogenase by malonate.
- (c) A non-competitive inhibitor binds the enzyme at a site distinct from the site or substrate binding.
- (d) Inhibition of activity of hexokinase by glucose-6-phosphate is an allosteric modulation.

- 20.** Which of the following statements is correct?

- (a) Arachidonic acid has 20 carbons excluding the carboxyl carbon.
- (b) Glycerol is trihydroxy propane.
- (c) Lipids are generally water soluble.
- (d) Oils have higher melting point than fats.

- 21.** Refer to the given figure of centrosome cycle during cell division.



Identify the stages of cell cycle to which these corresponds.

- | <b>I</b> | <b>II</b>      | <b>III</b>     | <b>IV</b>      |
|----------|----------------|----------------|----------------|
| (a) M    | G <sub>1</sub> | G <sub>2</sub> | S              |
| (b) M    | S              | G <sub>2</sub> | G <sub>1</sub> |
| (c) S    | G <sub>1</sub> | M              | G <sub>2</sub> |
| (d) M    | G <sub>1</sub> | S              | G <sub>2</sub> |

- 22.** Enzyme that helps in union of separated chromatid segments during meiosis is

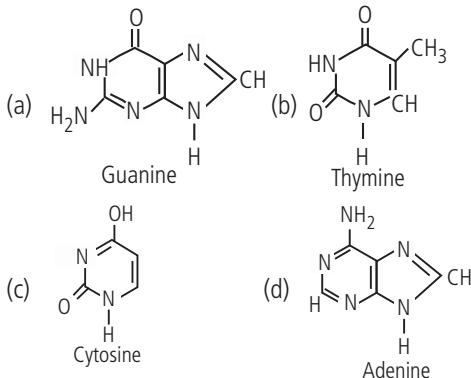
- (a) A-protein      (b) R-protein  
 (c) T-protein      (d) U-protein.

23. Read to the given pair of differences between primary and secondary metabolites and select the incorrect ones.

	Primary metabolites	Secondary metabolites
(i)	These are produced in generous quantities and can easily be extracted from the plant.	These are produced in small quantities and their extraction from the plant is difficult.
(ii)	They are found in one plant species or families and not all.	These are found throughout the plant kingdom.
(iii)	These are not part of the basic molecular structure of the cell.	These are part of the basic molecular structure of the cell.
(iv)	They have limited role in plant.	They are highly useful in plant.
(v)	They are found from the start of plant life.	They are found at particular stages of development.

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

24. Given below are four structures of nitrogenous bases. Identify the incorrect one.



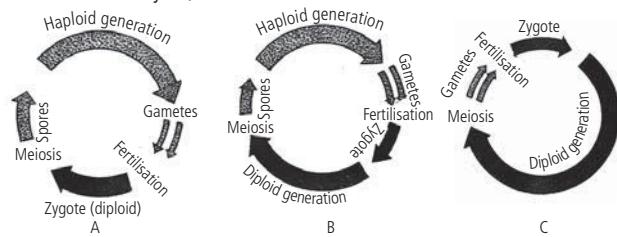
25. During cytokinesis, cell plate grows A in plants whereas in animal cell it grows B. Identify A and B.

- |                   |               |
|-------------------|---------------|
| <b>A</b>          | <b>B</b>      |
| (a) centrifugally | centripetally |
| (b) centripetally | centrifugally |
| (c) directly      | indirectly    |
| (d) indirectly    | directly      |

26. Which of the following protein exhibit antiparallel  $\beta$ -pleated structure of protein?

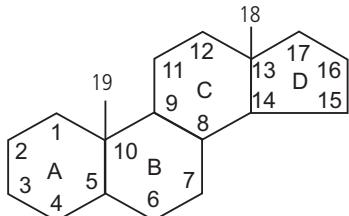
- (a)  $\beta$ -keratin    (b) Fibroin of silk  
 (c) Ribonuclease    (d) Both (b) and (c)

27. Study to the given figure regarding different types of meiosis and identify A, B and C.



- |             |          |          |
|-------------|----------|----------|
| <b>A</b>    | <b>B</b> | <b>C</b> |
| (a) Gametic | Zygotic  | Sporic   |
| (b) Gametic | Sporic   | Zygotic  |
| (c) Zygotic | Sporic   | Gametic  |
| (d) Zygotic | Gametic  | Sporic   |

28. Identify the given figure and select correct option regarding it.



It could be

- (a) lipoprotein and is found in blood, milk and egg yolk  
 (b) prostaglandin which is a derivative of arachidonic acid and helps in cell communication and vasodilation  
 (c) terpene which is formed of isoprene  
 (d) steroid and is found in hormones like estrogen and progesterone.

29. If you are provided with root-tips of onion in your class and are asked to count the chromosomes, which of the following stages can you most conveniently look into?

- (a) Metaphase    (b) Telophase  
 (c) Anaphase    (d) Prophase

30. Which one of the following biomolecules is correctly characterised?

- (a) Lecithin - a phosphorylated glyceride found in cell membrane  
 (b) Palmitic acid - an unsaturated fatty acid with 18 carbon atoms  
 (c) Raffinose - non-reducing sugar formed of glucose, fructose and lactose  
 (d) Alanine - sulphur containing amino acid

31. Energy barrier that inhibits a chemical reaction to start automatically may be due to

- (a) mutual repulsion occur due to presence of electrons on surface of reactants.  
 (b) salvation or holding of reactants in solution form by hydrogen bonds.

- (c) precise collision do not occur as reaction site of reactive molecules is small  
 (d) all of these.

**32.** Arrange the given sugars in the increasing order of their sweetening index.

- (a) Lactose < Maltose < Sucrose < Fructose < Saccharin  
 (b) Maltose < Lactose < Sucrose < Fructose < Saccharin  
 (c) Saccharin < Fructose < Sucrose < Maltose < Lactose  
 (d) Lactose < Maltose < Fructose < Sucrose < Saccharin

**33.** Synaptonemal complex has a role in

- (a) chromosome pairing  
 (b) chromosome movement  
 (c) chromosome segregation  
 (d) chromosome organisation.

**34.** How many double bonds are present in arachidonic acid?

- (a) One (b) Two (c) Three (d) Four

**35.** Select the correct match.

- |                |                                  |
|----------------|----------------------------------|
| A. S phase     | - DNA replication                |
| B. Zygote      | - Synapsis                       |
| C. Diplotene   | - Crossing over                  |
| D. Meiosis     | - Both haploid and diploid cells |
| E. Gap-2 phase | - Quiescent stage                |
| (a) A and B    | (b) C and D                      |
| (c) C and E    | (d) A, C and E                   |

**36.** When number of chromosomes is already reduced to half in the first reductional division of meiosis, what is the necessity of second meiotic division?

- (a) The division is required for the formation of four gametes.  
 (b) The division ensures equal distribution of haploid chromosomes.  
 (c) The division ensures equal distribution of genes on chromosomes.  
 (d) The division is required for segregation of replicated chromosomes.

**37.** Refer to the given pair of differences between G<sub>1</sub> phase and G<sub>2</sub> phase and select the incorrect ones.

	G <sub>1</sub> phase	G <sub>2</sub> phase
(i)	Available factors determine its fate, entry in G <sub>0</sub> , differentiation or continuity of cell cycle.	There is very little choice for the cell except to proceed further in cell cycle.

(ii)	Cell organelles increase in number.	Cell organelles do not increase in number.
(iii)	Both cell and nucleus grow in size.	Cell grows in size but growth of nucleus is little.
(iv)	It synthesises RNAs, proteins and other biochemicals for cell growth and subsequent replication of DNA.	It synthesises RNAs, proteins and other biochemicals for spindle formation and M-phase division.

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

**38.** Refer to the given statements regarding cell division and select the incorrect one.

- (a) Spindle formed during plants mitosis is amphimaster whereas in animal mitosis it is anastral.  
 (b) Meiosis II is an equational division as it maintains number of chromosomes.  
 (c) During meiosis a distinct G<sub>2</sub> phase is either short or absent.  
 (d) In mitosis anaphasic, chromosomes are single stranded.

**39.** Refer to the given statements and select the option that correctly fills the blanks in any two of them.

- A. During mitosis, microtubular astral rays connect to (i).  
 B. During telophase of mitosis, cytoplasmic viscosity (ii).  
 C. Gametic meiosis results in (iii) life cycle.  
 D. Number of bivalents is (iv) the number of total chromosomes.  
 (a) (i) pericentriolar satellites, (iii) haplontic  
 (b) (ii) increase, (iv) double  
 (c) (i) centriole, (iv) double  
 (d) (iii) diplontic, (iv) half

**40.** Which statement best explains the evolutionary advantage of meiosis?

- (a) Meiosis is necessary for sexual reproduction.  
 (b) Genetic recombinations are possible from generation to generation.  
 (c) Meiosis alternates with mitosis from generation to generation.  
 (d) The same genetic system is passed on from generation to generation.

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## SELF CHECK

### Check your score! If your score is

No. of questions attempted .....  
 No. of questions correct .....  
 Marks scored in percentage .....

> 90%	EXCELLENT WORK !	You are well prepared to take the challenge of final exam.
90-75%	GOOD WORK !	You can score good in the final exam.
74-60%	SATISFACTORY !	You need to score more next time.
< 60%	NOT SATISFACTORY!	Revise thoroughly and strengthen your concepts.

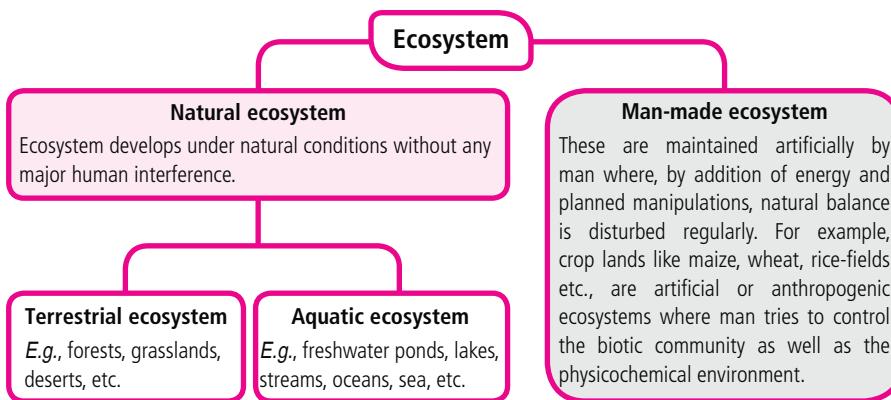
# HIGH YIELD FACTS



Class XII

## Ecosystem

- Ecosystem refers to a self regulated and self sustaining structural and functional unit of nature comprising of a community of living organisms as well as its physical environment. The term ecosystem was introduced by **A.G. Tansley**. For example- consider earth as giant ecosystem where abiotic and biotic components are constantly acting and reacting upon each other thereby bringing structural and functional changes. Since, this vast ecosystem, termed as biosphere is difficult to study, it is artificially divided into subdivisions or smaller units of ecosystem.



### Characteristics of Ecosystem

- Ecosystem is an open system which receives input in the form of solar energy and matter and results in synthesis of organic food. At the same time each component of ecosystem gives out energy as well as waste matter, referred to as output. Therefore, a regular input of energy is necessary for maintenance of life upon earth.
- Ecosystem maintains a relatively stable state of equilibrium amongst its various components by homeostasis. It fluctuates within certain limits and can be controlled via number of controls as carrying capacity, recycling of wastes, self regulation and feedback system.

	Analysis of various PMTs from 2013-2017					
	2013	2014	2015	2016	2017	
AIPMT/NEET	3	3	2	3	1	-
AIIMS	1	-	-	-	-	-
AMU	2	1	2	-	-	-
Kerala	-	3	4	-	-	-
K-CET	-	2	3	1	-	-
J & K	-	1	2	-	-	-

## Components of an Ecosystem

The ecosystem comprises of two main components.

### Biotic

(Living members of an ecosystem)

#### Producers (Autotrophs)

Fixation of light energy, use of simple inorganic substances and build up of complex substances predominate in this component. The component is constituted mainly by green plants, including photosynthetic bacteria. Members of the autotrophic component are known as **producers**. Major producers are algae, bryophytes and vascular plants. Phytoplankton are major producers of aquatic ecosystem.

#### Consumers (Heterotrophs)

Utilisation and rearrangement of complex materials predominate in this component. The organisms involved are known as **consumers**, as they consume the matter built up by the producers (autotrophs). Consumers are differentiated into **herbivores** and **carnivores**.

#### Decomposers (Reducers)

They are saprotrophs which feed on dead bodies of organisms and organic wastes of living organisms. The decomposer organisms secrete digestive enzymes to digest the organic matter externally. The digested form of organic matter is partly absorbed by microorganisms for their own assimilation. The remaining adds raw materials and minerals back into the substratum, the phenomenon is called **mineralisation**. Decomposers are also called **reducers** because they are able to remove or degrade the dead bodies of organisms. Because of their small size they are also known as **microconsumers**.

### Abiotic

(Non living substances)

#### Temperature

Temperature range varies in different parts of the earth. Organisms generally live within narrow range of temperature ( $5^{\circ} - 35^{\circ}\text{C}$ ). Few organisms can be found in hot springs ( $60^{\circ} - 90^{\circ}\text{C}$ ) or permafrost ( $-30^{\circ}$  to  $-50^{\circ}\text{C}$ ). High or low temperature causes inactivity and death of organisms.

#### Light

It provides solar energy to the ecosystem for heating and photosynthesis. Maximum solar or light energy is available at equator. It decreases towards poles. In a tree, more energy is available to upper leaves than the lower ones. Their rate of photosynthesis is accordingly higher.

#### Water

Land plants meet their water requirements from soil. Land animals obtain the same from pools, lakes, rivers, springs, etc. Plants and animals show modifications according to availability of water in the area and requirement of conserving the obtained water. Xerophytes develop modifications to increase water absorption, reduce transpiration and at times store absorbed water. Certain animals of dry areas do not drink water at all, e.g., kangaroo rat. They use water from food and its metabolism to run their body machinery. Animals of dry areas often reduce water loss by producing solid faeces and excreting concentrated urine.

#### Wind

It controls weather, transpiration, pollination and dissemination of propagules. High speed winds inhibit tree growth and flight animals. Unidirectional wind does not allow growth of branches on the windward side.

#### Soil

It determines vegetation growth and pattern, underground flora and fauna through its constitution, origin, temperature range, water retentivity, aeration, minerals, etc. Soil present on the slopes as well as the one which is uncovered are liable to be eroded by water and wind respectively.

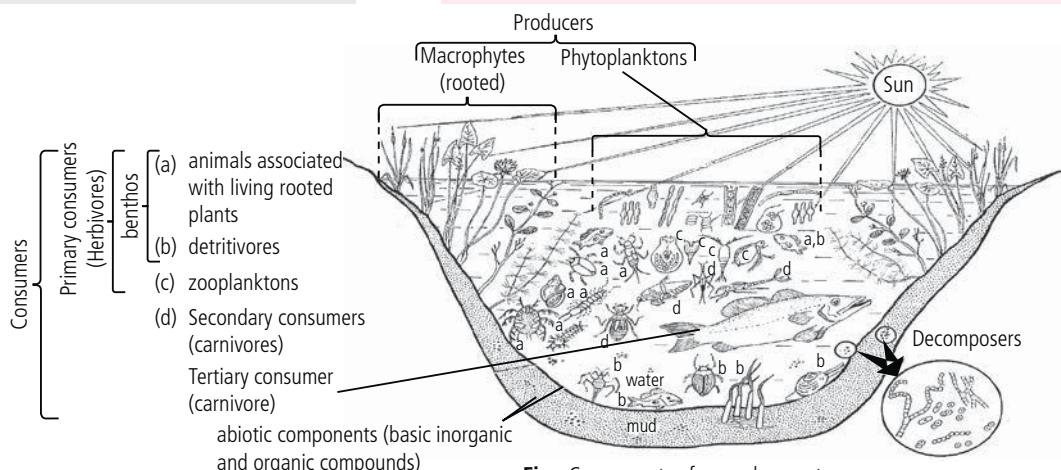


Fig.: Components of a pond ecosystem

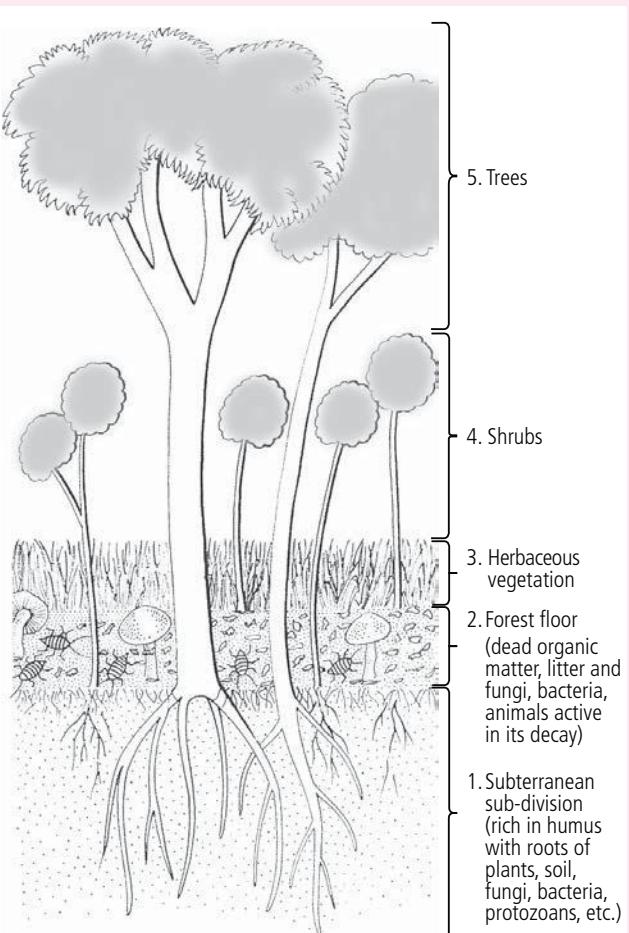
## Terms Related to Ecosystem:

- **Trophic Structure** - Each ecosystem has specific food chains and food webs e.g., grazing food chain in grassland. Food chain is divided into trophic levels, each characterised by the method of obtaining its food. The number of trophic levels is equal to number of steps in food chain. These together constitute the trophic structure.

First trophic level	Producers	Organisms
	They are autotrophic or photosynthetic organisms found in an ecosystem which synthesise organic nutrients from inorganic raw materials with the help of solar radiations not only for themselves but also for heterotrophic organisms or consumers.	Phytoplankton, grasses, trees
Second trophic level	Primary consumers	Organisms
	They are herbivores, which depend on plants for nourishment and are consumers of first order.	Zooplankton, cow, grasshopper
Third trophic level	Secondary consumers	Organisms
	They are carnivores and consumers of the second order and are dependent on herbivores.	Birds, fishes, wolf
Fourth trophic level	Tertiary consumers (Top carnivores)	Organisms
	Top carnivores are last order consumers which are not preyed upon by other animals.	Man, Lion

- **Standing Crop** - It refers to the amount of living biomass or number of living organisms present in an unit area of ecosystem.

- **Standing State** - It is defined as the amount of inorganic nutrients present at any time in the soil or water of ecosystem. It may vary in each ecosystem and from season to season.
- **Stratification** - It is formation of vertical layers where vegetation is dense, e.g., division of 5-7 strata in tropical rain forest, i.e., tall trees, canopy trees, understory trees at top, shrub layer below them, herbs at bottom and grass at ground level.



**Fig.:** Diagrammatic representation of a complex deciduous forest community showing stratification, where five vertical sub-divisions of different vegetational types (subterranean, forest floor, herbaceous vegetation, shrubs and trees) may be easily distinguished.

## Functions of Ecosystem

- Ecosystem representing the highest level of ecological integration is capable of energy transformation, accumulation and circulation. Ecologically, it emphasises on obligatory relationships, interdependence and causal relations. The four important functional aspects of ecosystem can be discussed as: (i) productivity, (ii) decomposition (iii) energy flow and (iv) nutrient cycling.

# PRODUCTIVITY

The productivity of an ecosystem refers to the rate of production, i.e., the amount of organic matter or biomass accumulated per unit area in any unit time. It is measured as weight ( $\text{g/m}^2/\text{yr}$ ) or energy ( $\text{kcal/m}^2/\text{yr}$ ). Productivity is of following types:

## Primary productivity

The amount of energy accumulated in green plants as biomass or organic matter per unit area over a time period through the process of photosynthesis is known as primary productivity. It is of two sub-types: GPP and NPP.

### Gross primary productivity (GPP)

It is the amount of organic matter synthesised by producers per unit time and per unit area.

It is equal to rate of increase in body weight of producers plus loss suffered through respiration, grazing and damages.

It depends upon photosynthetic efficiency of producers, availability of solar energy as well as inorganic nutrients.

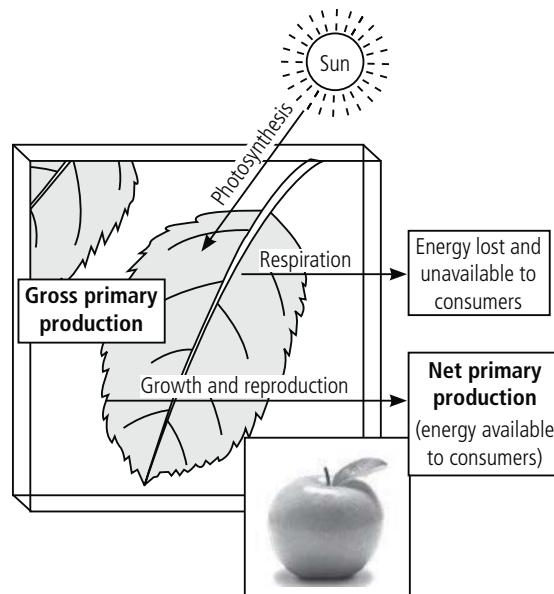
### Net primary productivity (NPP)

It is the amount of organic matter stored by producers per unit time and per unit area.

It is equal to organic matter synthesised by photosynthesis minus utilisation in respiration and other losses.

It depends upon gross primary productivity as well as amount of consumption of photosynthates.

NPP is equal to  $\text{GPP} - \text{R}$ , where R is energy used in respiration.



**Fig.:** Distinction between gross primary productivity (GPP) and net primary productivity (NPP). A plant uses some of its GPP to survive through respiration. The remaining energy is available to consumers.

## Secondary Productivity

The rate of resynthesis of organic matter by the consumers is known as secondary productivity.

- It depends upon the loss while transferring energy containing organic matter from the previous trophic level plus the consumption due to respiration and predation.
- It is small and decreases with rise of trophic level.
- It is due to synthesis of organic matter from organic matter.

## DECOMPOSITION

- It is physical and chemical breakdown of complex organic remains with the help of organisms called decomposers. In terrestrial ecosystem, upper layer of soil is the main site of decomposition. Organic remains (dead plant parts, animal remains and excretions) are also called **detritus**. It is of two types- **above-ground detritus** (leaf litter, dried plant parts, remains of animals, their droppings and excretions) and **below-ground detritus** (mainly dead roots, also underground dead animals).
- Decomposition completely disposes off the whole detritus. It helps in recycling of biogeochemicals and creating space for newer generations of organisms.

### Processes Involved in Decomposition

#### Fragmentation of detritus

Detrivores (e.g., termites, carrion beetles, earthworms) feed on larger pieces. The smaller fragments are left. Pulverisation occurs in the digestive tract of detrivores as a part of detritus comes out undigested. The part digested by detrivores is immobilised. Due to fragmentation, left-over detritus comes to have large surface area. Earthworms are called farmer's friends because they help in fragmentation of detritus and loosening of soil.

#### Catabolism

The decomposers (e.g., bacteria, fungi) excrete digestive enzymes over the detritus. It changes insoluble complex organic substances into simple and soluble organic compounds and inorganic substances. A part of the broken down food is taken up by decomposers and immobilised.

#### Leaching

Soluble substances formed during decomposition are subjected to leaching or passage to deeper layers of soil or ground water by percolating water.

## Decomposition gives rise to two products

### Humus

- It is formed by the process of humification.
- Humus is dark coloured amorphous organic matter rich in lignin and cellulose.
- Colloidal in nature. Resistant to microbial action.
- Reservoir of nutrients and helpful in maintenance of soil moisture and aeration.
- Gets decomposed slowly and thus, releases nutrients slowly.

### Minerals/Inorganic nutrients

- It is formed by the process of mineralisation.
- Involves release of both non-minerals and minerals from organic matter.
- It is a slow process because of trapping in humus and immobilisation in decomposers.
- Prevents their washing out or leaching.

## Factors Affecting Decomposition

- **Temperature:** A soil temperature of 25°C and more hastens decomposition. Low temperature of less than 10°C reduces rate of decomposition.
- **Moisture:** It is essential for decomposition. Decomposition rate is very low in tropical deserts despite presence of favourable temperature. Excessive moisture impedes decomposition probably due to anaerobiosis.
- **pH:** Neutral and slightly alkaline soils are rich in detritivores, earthworms and decomposer microbes. Acidity decreases the number of detritivores and earthworms. **Decomposer microbes occur in slightly acidic soils but with the rise in acidity, their number begins to fall.** As a result decomposition of detritus is quite slow in acidic soils.
- **Aerobiosis:** Aerobic conditions are essential for activity of decomposer organisms because **decomposition is oxygen requiring process.** Anaerobiosis reduces decomposition and causes piling up of detritus.

## FOOD CHAIN

- The transfer of food energy from the producers, through a series of organisms (herbivores to carnivores to decomposers) with repeated eating and being eaten, is known as a **food chain**. Producers utilise the radiant energy of sun which is transformed to chemical form, ATP during photosynthesis.

### Characteristics of food chain

A food chain is generally straight.

The number of trophic levels is 3-6.

There is progressive reduction in available biomass, energy and number of individuals with the rise in trophic level.

A food chain consists of series of populations which are related by eating and being eaten.

A major part of energy made available at each trophic level is lost as heat.

In each trophic level a lot of biomass is consumed in liberating energy.

Food chains are sustained by producers and decomposers.

Some organisms like humans operate at more than one trophic level.

### Grazing food chain

This type of food chain starts from the living green plants, goes to grazing herbivores (that feed on living plant materials with their predators), and on to carnivores (animal eaters). Ecosystems with such type of food chain are directly dependent on an influx of solar radiation. This type of chain thus depends on autotrophic energy capture and the movement of this captured energy to herbivores. Most of the ecosystems in nature follow this type of food chain. From energy standpoint, these chains are very important. **Producers are also known as transducers because they are able to change radiant or light energy into chemical form.**

E.g., Vegetation → Squirrel → Wildcat → Tiger

### Types of food chains

### Detritus food chain

This type of food chain goes from dead organic matter to microorganisms and then to organisms feeding on detritus (detritivores) and their predators. Such ecosystems are thus less dependent on direct solar energy. These depend chiefly on the influx of organic matter produced in another system. For example, such type of food chain operates in the decomposing accumulated litter in a temperate forest.

E.g., Fungi/bacteria → Crabs/insect larvae → Small fish → Large fish/fish eating birds and

Detritus → Earthworm → Sparrow → Falcon

↓  
Frog → Snake → Peacock

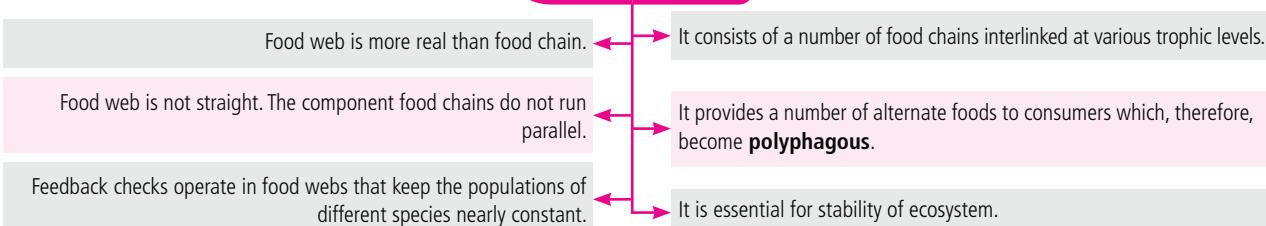
**Table: Differences between grazing and detritus food chain**

Grazing food chain	Detritus food chain
• The chain begins with producers as the first trophic level.	• The chain begins with detritivores and decomposers as the first trophic level.
• Energy for the food chain comes from sun.	• Energy for the food chain comes from organic remains or detritus.
• Food chain adds energy into the ecosystem.	• It retrieves food energy from detritus and prevents its wastage.
• The food chain binds up inorganic nutrients.	• The food chain helps in releasing inorganic nutrients to the cycling pool.
• It supports detritus food chain by providing organic matter.	• It supports grazing food chain by providing inorganic nutrients.

## FOOD WEB

It is a network of food chains which become interconnected at various trophic levels so as to form a number of feeding connections amongst the different organisms of a biotic community. For example, in grazing food chain of a grassland, in the absence of rabbit, grass may also be eaten by mouse. The mouse, in turn, may be eaten directly by hawk or by snake first and then eaten by hawk. Thus, in nature alternatives are found which all together constitute some sort of interlocking pattern-the **food web**.

### Characteristics



## Significance

- The food webs are very important in **maintaining the stability of an ecosystem in nature**. For example, decrease in the population of rabbit would naturally cause an increase in the population of alternative herbivore, the mouse. This may decrease the population of the consumer (carnivore) that prefers to eat rabbit. Thus, alternatives serve for maintenance of stability of the ecosystem. Moreover, a balanced ecosystem is essential for the survival of all living organisms of the system. For instance, if primary consumers (herbivores) had not been in nature, the producers would have perished due to overcrowding and competition. Similarly, the survival of primary consumers is linked with the secondary consumers (carnivores) and so on. Thus, each species of any ecosystem is indeed kept under some sort of a natural check so that the system may remain balanced.
- The complexity of any food web depends upon the diversity of organisms in the system. It would accordingly depend upon two main points:
  - Length of the food chain - Diversity in the organisms based upon their food habits would determine the length of food chain. More diverse the organisms in food habits, more longer would be the food chain.
  - Alternatives at different points of consumers in the chain - More the alternatives, more would be the interlocking pattern. In deep oceans, seas, etc., where we find a variety of organisms, the food webs are much complex.

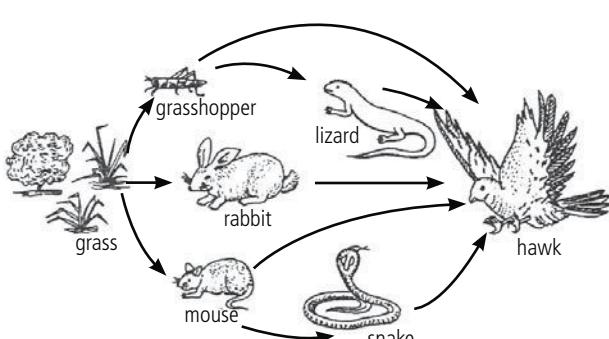


Fig.: Food web in a grassland ecosystem

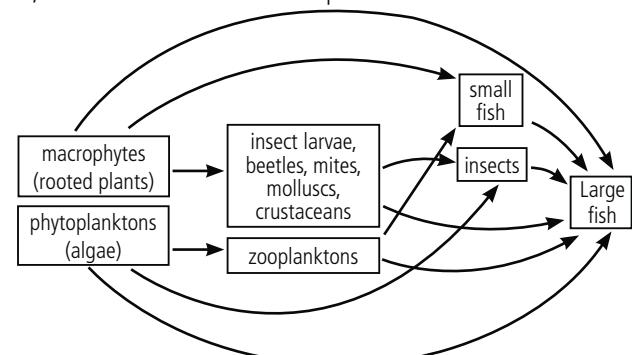
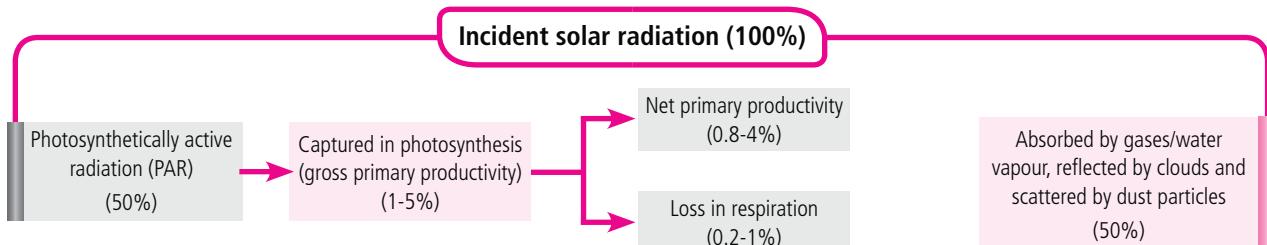


Fig.: Food web in a pond ecosystem

## ENERGY FLOW

- Ecosystems require a constant input of energy as every component of an ecosystem is regularly dissipating energy.
- Flow of energy is governed by two laws of thermodynamics.
  - First law, energy can be transferred as well as transformed but is neither created nor destroyed.
  - Second law, every activity involving energy transformation is accompanied by dissipation of energy.
- The source of energy in all ecosystems, except deep hydrothermal ecosystem is solar energy.



**Flow chart:** Fate of solar energy incident on vegetation

- Energy does not remain trapped permanently in any organism. It is either passed on to the higher trophic level or becomes available to detritivores and decomposers after the organism dies. Normally, herbivores feed on producers. Part of the food energy is wasted in digestion and assimilation. Some of the assimilated food is broken down to release energy for performing body activities. A very small portion becomes part of the body of herbivore. Herbivores are eaten by primary carnivores, the latter by secondary carnivores and so on. At every step a lot of energy is wasted.

### Flow of Energy in Ecosystem

- Energy flow in an ecosystem is always unidirectional** or one way, i.e., solar radiations → producers → herbivores → carnivores. It cannot pass in the reverse direction.
- There is decrease in the content and flow of energy with the rise in trophic level. A part of energy captured by producers (gross primary productivity) is used for maintenance (through liberation in respiration) and as food to herbivores. The remaining net productivity is either used by humans or passes into detritus chain.
- A lot of wastage of food occurs during ingestion by herbivores. Energy is used for digestion of food. A part is lost as faecal matter to decomposers.
- Part of assimilated food is also broken down to release energy in the process of respiration. This energy is lost as heat.

### 10% Law

Lindeman proposed 10% law, according to which only 10% of the energy available at one trophic level passes to the next trophic level and 90% of energy is lost. Thus, 1000 kcal of biomass energy makes available only 1 kcal of biomass energy at the level of carnivore II and 0.1 kcal of biomass energy at the level of carnivore III. Therefore, for supporting a higher trophic level organism a large amount of biomass is required at the producer level.

The residual energy decreases drastically within 2-3 trophic levels. Therefore, an ecosystem can support only a limited number of trophic levels.

$$\begin{array}{cccc} \text{Producers} & \rightarrow & \text{Herbivore} & \rightarrow \text{carnivore I} \rightarrow \text{carnivore II} \\ 1000 \text{ kcal} & & 100 \text{ kcal} & & 10 \text{ kcal} & & 1 \text{ kcal} \end{array}$$

## ELTONIAN PYRAMIDS (ECOLOGICAL PYRAMIDS)

- An ecological pyramid is a graphic representation of an ecological parameter, like biomass, energy or number of individuals present in various trophic levels of a food chain with producers forming the base and top carnivores the tip. Each trophic level represents a functional level. Therefore, it includes all the members of all the species operating at that level.



## Types of Pyramids

### Based on the shape of pyramid

#### Inverted

Narrow base, gradually becoming broader towards the tip.

#### Spindle-shaped

Narrow both at base and tip, with broader part in the middle.

#### Upright

With larger base and gradually tapering towards tip.

### Based on the ecological parameters

#### Pyramid of numbers

Shows number of individual organisms at each level.

#### Pyramid of biomass

Shows the total dry weight and other suitable measure of total amount of living matter.

#### Pyramid of energy

Shows rate of energy flow and productivity at successive trophic level.

## Pyramid of Numbers

### Grassland ecosystem

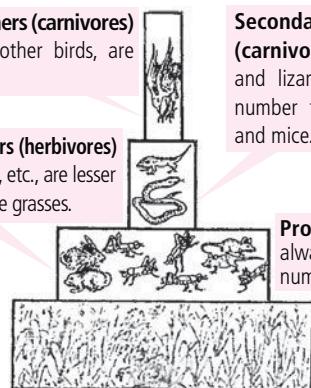
It is always upright.

**Tertiary consumers (carnivores)**  
e.g., hawks or other birds, are least in number.

**Secondary consumers (carnivores)** e.g., snakes and lizards are lesser in number than the rabbits and mice.

**Primary consumers (herbivores)**  
e.g., rabbits, mice, etc., are lesser in number than the grasses.

**Producers** e.g., grass always maximum in number.



### Pond ecosystem

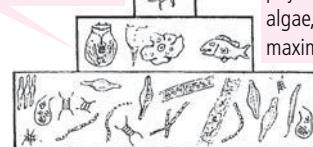
It is upright.

**Tertiary consumers (carnivores)**, the bigger fish are least in number.

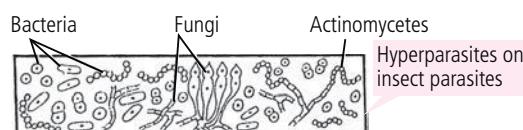
**Primary consumers (herbivores)** e.g., smaller fish, rotifers, etc., are lesser in number than the producers.

**Secondary consumers (carnivores)** such as small fish eating each other, water beetles, etc., are lesser in number than the herbivores.

**Producers** mainly the phytoplankton such as algae, bacteria, etc., are maximum in number.



### Pyramids of numbers in different kinds of ecosystem



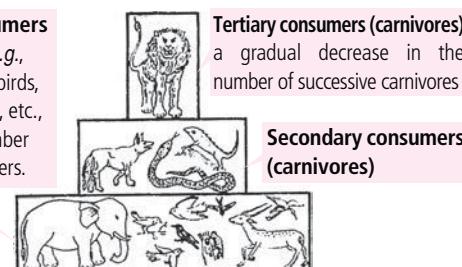
**Herbivores** e.g., fruit-eating birds which in turn may provide nutrition to several parasites.

**Producers** e.g., a single plant may support the growth of many herbivores

#### Parasitic food chain

In a parasitic food chain the pyramids are always **inverted**. This is due to the fact that the number of organisms gradually shows an increase, making the pyramid inverted in shape.

**Primary consumers (herbivores)** e.g., the fruit-eating birds, elephants, deers, etc., are more in number than the producers.



**Tertiary consumers (carnivores)** a gradual decrease in the number of successive carnivores

**Secondary consumers (carnivores)**

**Producers** are mainly large-sized trees, are lesser in number, and form the base of the pyramid.

### Forest ecosystem

In the forest ecosystem, the pyramid can be either inverted or spindle shaped.

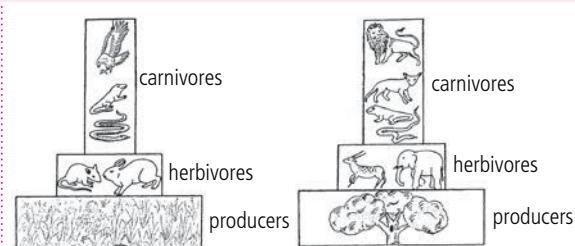
## Pyramid of Biomass

Maximum biomass occurs in producers. There is a progressive reduction of biomass found in herbivores, primary carnivores, secondary carnivores, etc. It is found that about 10-20% of the biomass is transferred from lower trophic level to higher trophic level. The rest is consumed in providing energy for giving heat, overcoming entropy and performing various body activities.

### Pyramid of Biomass

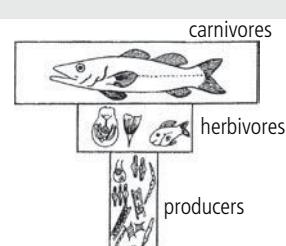
#### Grassland and forest ecosystem

In grassland and forest there is generally a gradual decrease in biomass of organisms at successive levels from the producers to the top carnivores. Thus, pyramids are **upright**.



#### Pond ecosystem

In a pond, as the producers are small organisms, their biomass is least, and this value gradually shows an increase towards the apex of the pyramid, thus, making the pyramid **inverted** in shape.



## Pyramid of Energy

The energy pyramids give the best picture of overall nature of the ecosystem. Here, number and weight of organisms at any level depends not on the amount of fixed energy present at any one time in the level just below but rather on the rate at which food is being produced. In contrast with the pyramids of numbers and biomass, which are pictures of the standing situations (organisms present at any moment), the pyramid of energy is a picture of the rates of passage of food mass through the food chain. It is always **upright**, as in most of the cases there is always a gradual decrease in the energy content at successive trophic levels from the producers to various consumers.

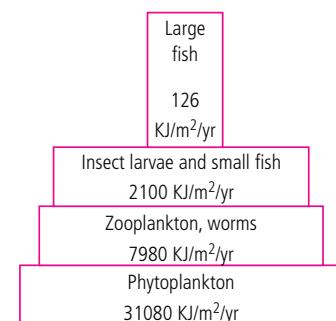


Fig.: Pyramid of energy in a pond ecosystem

### Limitations of Ecological Pyramids

Pyramids assume that food chains are simple but simple food chains do not occur in nature.

Ecological pyramids have no method of accomodating species that operate at two or more trophic levels.

Ecological pyramids do not provide any place for detrivores and decomposers, despite their vital role in ecosystem.

## ECOLOGICAL EFFICIENCY

- It is defined as the ratio between the energy assimilated over the energy available between two trophic levels. It was first studied by Lindeman (1942).
- It is useful in determining the degree to which organisms of a trophic level exploit food energy resource and convert the same into biomass.

**Photosynthetic efficiency**-It is referred to as the percentage of incident solar radiations trapped by producers to perform photosynthesis and produce gross primary productivity. It may be 1-5%.

$$\text{Photosynthetic efficiency} = \frac{\text{Energy in GPP}}{\text{Energy in incident solar radiations}} \times 100$$

**Net Production Efficiency** - It is the percentage of net primary productivity in relation to GPP. Net production efficiency is greater in small sized producers, i.e., herbs have greater net production efficiency than large sized trees with large biomass.

$$\text{Net production efficiency} = \frac{\text{NPP}}{\text{GPP}} \times 100$$

**Assimilation Efficiency** - It is the percentage of food energy assimilated for body building to total food ingested.



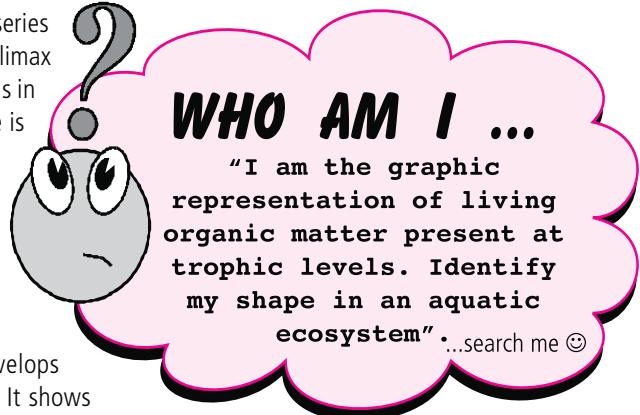
$$\text{Assimilation efficiency} = \frac{\text{Food energy assimilated}}{\text{Food energy ingested}} \times 100$$

**Ecological efficiency/Trophic level efficiency** - It refers to the percentage of energy converted into biomass by a higher trophic level over the energy of food resources available at the lower trophic level.

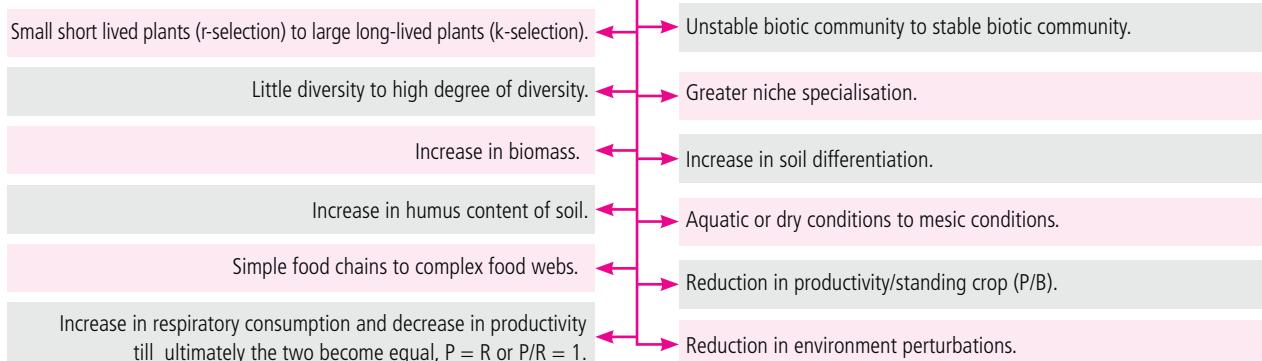
$$\text{Ecological efficiency} = \frac{\text{Energy converted into biomass at higher trophic level}}{\text{Energy present in biomass at lower trophic level}} \times 100$$

## ECOLOGICAL SUCCESSION

- Biotic or ecological succession is the natural development of a series of biotic communities at the same site, one after the other till a climax community develops which does not change further because it is in perfect harmony with the environment of the area. The change is orderly and sequential. There is a parallel change in the physical environment. Rather, succession occurs because each biotic community changes the environment of the area that suits another biotic community more than itself.
- The first biotic community which develops in a bare area is called **pioneer community**. It shows little diversity.
- The final, stable, self perpetuating biotic community that develops at the end of biotic succession is called **climax community**. It shows maximum diversity and niche specialisation.
- The various biotic communities that develop during biotic succession are called **seral** or **transitional communities**. It is replaced by another subsequent successional community.



### Changes during biotic succession



### Types of Succession

#### Primary succession

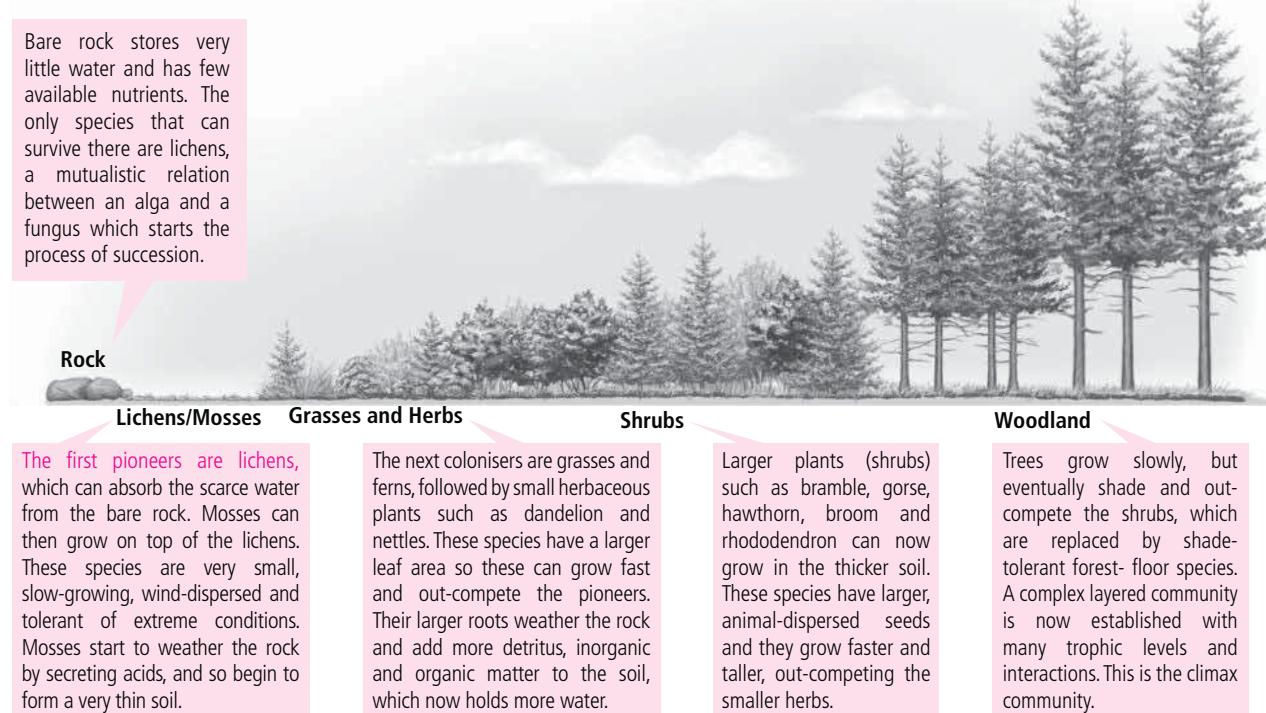
- It occurs in an area which has been bare from the beginning.
- Soil is absent at the time of beginning of primary succession.
- There is no humus in the beginning.
- Reproductive structures of any previous community are absent.
- Pioneer community comes from outside.
- In the beginning the environment is very hostile.
- Seral communities are many.
- Primary succession takes long time for completion (1000 years or more).

#### Secondary succession

- It occurs in an area which has been denuded recently.
- Soil is present in the area where secondary succession begins.
- Humus is present from the very beginning.
- Reproductive structures of the previous occupants are present in the area.
- Pioneer community develops partly from previous occupants and partly from migrants.
- The environment is favourable from the beginning.
- Few seral communities are found.
- Secondary succession takes less time for completion (50-200 years).

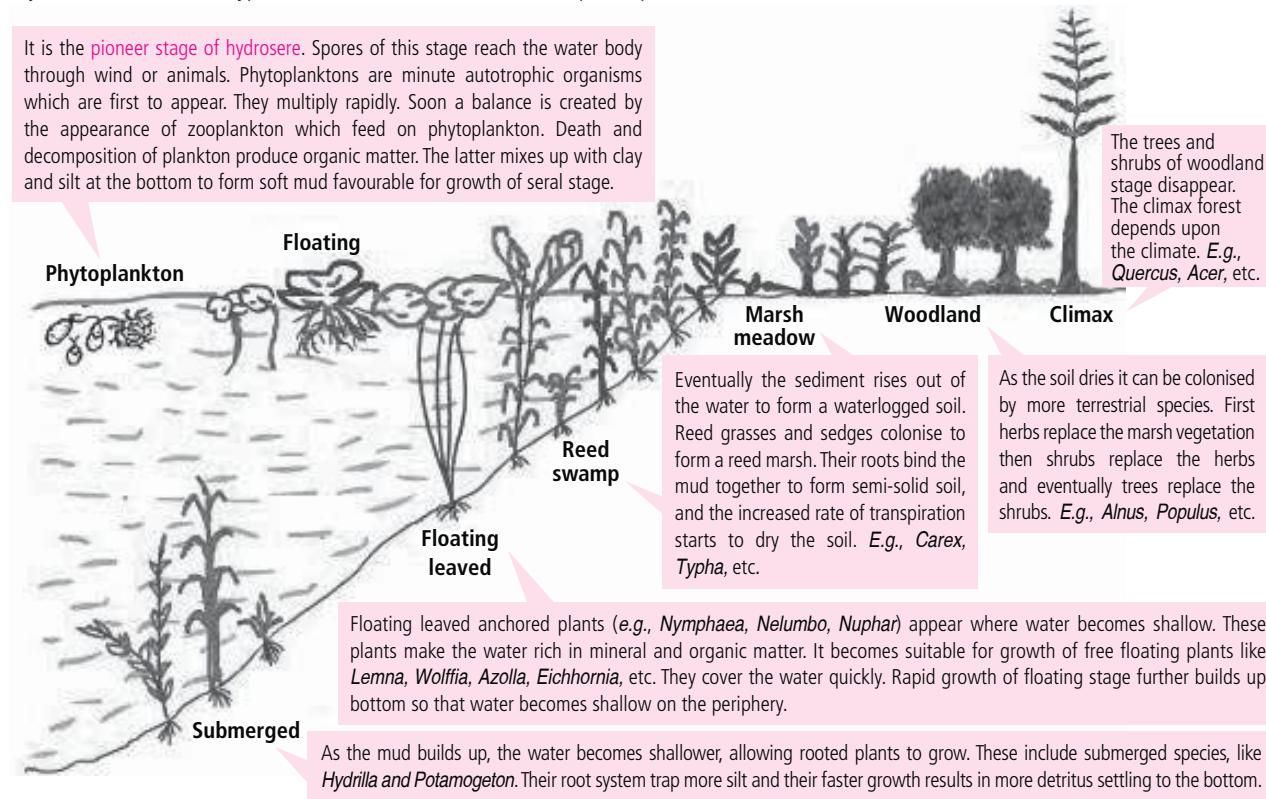
## Examples of Primary Succession

**Xerosere:** This is a type of biotic succession that occurs on bare rock which is water deficient.



**Hydrosere:** This is a type of biotic succession that develops in a pond or lake.

It is the **pioneer stage of hydrosere**. Spores of this stage reach the water body through wind or animals. Phytoplankton are minute autotrophic organisms which are first to appear. They multiply rapidly. Soon a balance is created by the appearance of zooplankton which feed on phytoplankton. Death and decomposition of plankton produce organic matter. The latter mixes up with clay and silt at the bottom to form soft mud favourable for growth of seral stage.



### **Autogenic succession**

The succession resulting from changes brought about by the organisms themselves. The principal force of change comes from within the community. E.g., an abandoned agricultural field changing into a mature forest over long span of time.

### **Allogenic succession**

The succession resulting from changes brought about by factors external to the community. External forces may include climate change, massive disturbance, or changes in temperature and other environmental factors.

### **Autotrophic succession**

It is characterised by early and continued dominance of autotrophic organisms like green plants. It begins in predominantly inorganic environment and there is gradual increase in the organic matter content supported by energy flow.

### **Heterotrophic succession**

It is characterised by early dominance of heterotrophs such as bacteria, fungi and actinomycetes. It begins in a predominantly organic environment, e.g., a stream heavily polluted with sewage. In this type of succession, energy is maximum at the beginning followed by a progressive decline in the energy content. The end point is utilisation of all the energy, and dispersion of the community.

### **Induced succession**

It occurs due to extensive external interference. Here the initial community has high productivity which gradually decreases. Agriculture can be deemed as an example of induced succession. Here, a steady stage is maintained for an ultimate good harvest.

### **Retrogressive succession**

Due to environmental thrust and biotic influences the climax vegetation may retrograde into shrub land or savannah.

### **Deflected succession**

Sometimes due to changes in local conditions such as soil characteristic or microclimate, the process of succession becomes deflected in a different direction than that presumed under climatic condition of the area. Thus, the climax communities are likely to be different from the presumed climatic climax community.

## **NUTRIENT CYCLES**

Nutrient cycles are exchanges, storage and transfers of biogenetic nutrients through various components of ecosystem so that the nutrients can be used again and again. The term **biogeochemical cycling** is used for exchanges/circulation of biogenetic nutrients between living and non-living components of biosphere.

### **Stores of nutrients**

#### **Reservoir pool**

Reservoir pool is the reservoir of biogenetic nutrients from which the latter are slowly transferred to cycling pool. The function of reservoir is to meet deficiency of nutrient which occurs due to differences in rate of influx and efflux.

#### **Cycling pool**

Cycling pool is the pool of biogenetic nutrients which is being emptied and filled repeatedly by exchange between biotic and abiotic components of biosphere.

### **Components of nutrient cycles**

#### **Input of nutrients**

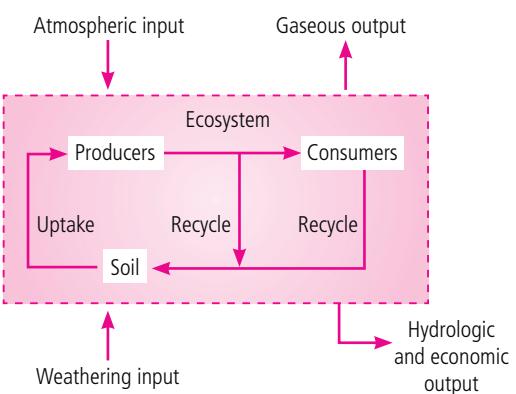
Ecosystem receives an input of nutrients from external sources and stores the same for use. The input may be of four types-wet deposition (rainfall), dry deposition (dust), biological nitrogen fixation and weathering of rocks.

#### **Output of nutrients**

It is loss of nutrients due to run off water, soil erosion, denitrification, harvesting of crops, cattle grazing, and other severe disturbances in ecosystem.

#### **Internal nutrient cycling**

Soil is depleted of its nutrients due to absorption by plants, which is then passed on to consumers through various trophic levels. Soil nutrient replenishment occurs through recycling. The bound nutrients are regularly released in the soil by decomposers in the form of detritus.



## Types of biogeochemical cycles

### Gaseous cycles

The materials involved in circulation between biotic and abiotic components of biosphere are gases or vapours and the reservoir pool is atmosphere or hydrosphere, e.g., carbon, hydrogen, oxygen, nitrogen, water, etc.

Gaseous cycles are rapid and more perfect as compared to sedimentary cycles.

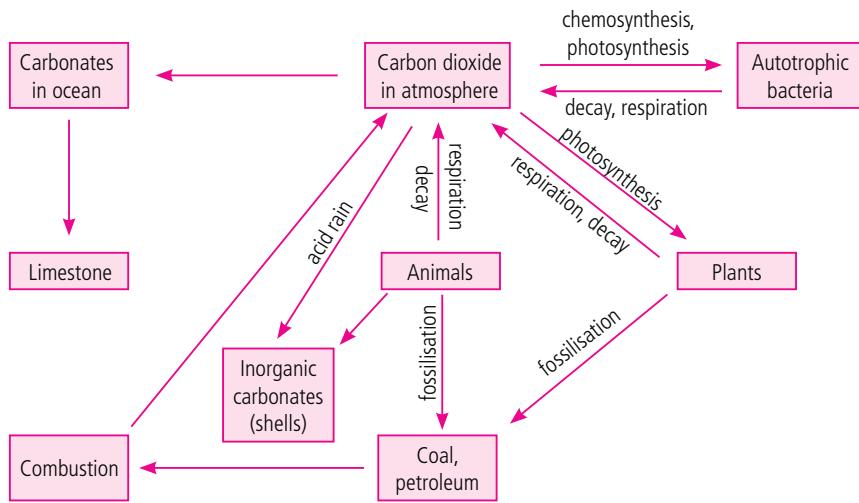
### Sedimentary cycles

Materials involved in circulation between biotic and abiotic components of biosphere are non-gaseous and the reservoir pool is lithosphere, e.g., phosphorus, calcium, magnesium, etc. Sulphur has both sedimentary and gaseous phases.

## Common Biogeochemical Cycles

### The carbon cycle

Carbon is a component of all organic compounds of protoplasm like carbohydrates, lipids, proteins, nucleic acid, enzymes, hormones, etc. It constitutes 49% of dry weight and is, therefore, next only to water in abundance.



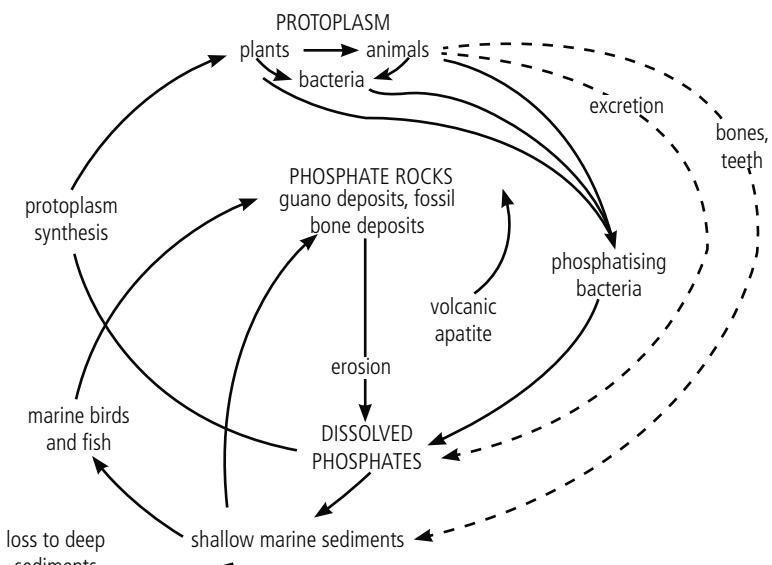
### The phosphorus cycle

Phosphorus is component of nucleic acids, biomembranes as phospholipids, cellular transfer system as ATP, body structure as shells, bone and teeth. It takes part in metabolic reactions involved in release of energy from food and utilisation of this energy in various functions of the body.

### Anthropogenic impact on phosphorus cycle

We intervene in the earth's phosphorus cycle in following three ways:

- We mine large quantities of phosphate rocks to make commercial inorganic fertilisers and detergents.
- We reduce the available phosphate in soil by cutting down forests.
- We disrupt aquatic systems with phosphate by runoff of animal wastes and fertilisers and discharge from sewage treatment systems.



## ECOSYSTEM SERVICES

Ecosystem services are the products of ecosystem processes which have environmental, aesthetic and indirect economic value. For best services the ecosystems must be healthy.

- **Carbon Fixation.** Producers of the ecosystem convert CO<sub>2</sub> from the atmosphere into organic compounds by the process of photosynthesis. This not only sustains the ecosystem but also provides food to others outside the ecosystem, e.g., tribal, migratory animals and also maintains the CO<sub>2</sub> balance of the atmosphere. Otherwise CO<sub>2</sub> concentration is going to rise very rapidly due to increase in fossil fuel combustion.
- **Oxygen Release.** Producers of the ecosystem release a lot of oxygen during photosynthesis. Release of oxygen by the producers helps in replenishing the gas being consumed in respiration and combustion.
- **Pollination.** It is an essential step in the reproduction of plants. Several plants are adapted to get pollinated by particular animals like bees, butterflies, moths, birds, etc. The animals in turn, depend upon plants for their food. Elimination of the pollinator will eliminate the plant species due to non-reproduction. A number of pollinators coming from forests are engaged in pollinating our crop plants, fruit plants and others. Absence of these plants will naturally deprive the animals of their food. They will die of hunger.
- **Soil.** Plant cover protects the soil from drastic changes in temperature. There is little wind or water erosion as soil particles are not exposed to them. The soil remains spongy and fertile. There are no landslides and no floods.
- **Perennial Water.** Plant litter and humus prevent run off of water, hold water like sponge and allow percolation of water. A lot of water is held in the soil which slowly passes towards perched water table. It comes out as springs.
- **Air.** Plant cover of natural ecosystems absorb polluting gases, cause settling of suspended particulate matter, removes CO<sub>2</sub> and releases O<sub>2</sub>. A purified air becomes available.

## SPEED PRACTICE

1. The major conduit of energy flow in an aquatic ecosystem is  
(a) grazing food chain      (b) detritus food chain  
(c) parasitic food chain      (d) both (a) and (c).
2. In an upright pyramid of energy, the base bar comprises of  
(a) top consumers      (b) secondary consumers  
(c) producers      (d) tertiary consumers.
3. Which of the following is pioneer species of xerosere?  
(a) *Graphis* and *Rhizocarpon*  
(b) *Hypnum* and *Bryum*  
(c) *Potamogeton* and *Rubus*  
(d) *Lemna* and *Azolla*
4. Which of the following pair is mismatched?  
(a) Oceans – Global sink  
(b) Producers – Transducers  
(c) Phosphorus – Gaseous cycle  
(d) Guild – Grazing animals
5. **Statement 1 :** Pioneer community is the stable and final biotic community of an ecological succession.  
**Statement 2 :** Pioneer community has maximum diversity and niche specialisation.  
(a) Both statements 1 and 2 are correct and statement 2 is the correct explanation of statement 1.
6. (b) Both statements 1 and 2 are correct but statement 2 is not the correct explanation of statement 1.  
(c) Statement 1 is correct but statement 2 is incorrect.  
(d) Both statements 1 and 2 are incorrect.
7. Percentage of incident solar radiations trapped by producers to perform photosynthesis and produce gross primary productivity is  
(a) net production efficiency  
(b) photosynthetic efficiency  
(c) assimilation efficiency  
(d) ecological efficiency.
7. Identify the incorrect statement from the following.  
(a) Atmospheric inputs of phosphorus through rainfall are much smaller than carbon inputs.  
(b) The reservoir pool for phosphorus cycle is earth's crust whereas atmosphere is the reservoir pool for carbon cycle.  
(c) Gaseous exchange of phosphorus between organism and environment are negligible.  
(d) During carbon cycle and phosphorus cycle, there is very little respiratory release of carbon and phosphorus respectively.

8. If 30J of energy is trapped at producer level, then how much energy will be available to peacock as food in the following food chain?

Plant → Mice → Snake → Peacock

- (a) 0.3J (b) 0.03J (c) 0.0003J (d) 0.003J

9. Which of the following is correct order for productivity?

- (a) Coral reefs > Estuaries > Sugarcane fields  
 (b) Estuaries > Sugarcane fields > Coral reefs  
 (c) Coral reefs > Sugarcane fields > Estuaries  
 (d) Sugarcane fields > Estuaries > Coral reefs

10. An ecosystem which can be easily damaged but can recover after some time if damaging effect stops will be having

- (a) low stability and high resilience  
 (b) high stability and low resilience  
 (c) low stability and low resilience  
 (d) high stability and high resilience.

11. Standing crops refer to

- (a) all the photosynthetic living forms in an area  
 (b) all the living forms in an area  
 (c) the amount of living matter in a component population of an ecosystem at any time  
 (d) all the crop plants in an area.

12. Some of the nutrient cycles are labelled as sulphur cycle (A), phosphorus cycle (B), carbon cycle (C) and nitrogen cycle (D). Of these, the sedimentary cycle is represented by

- (a) (D) only (b) (B) only  
 (c) (A) and (D) (d) (A) and (B).

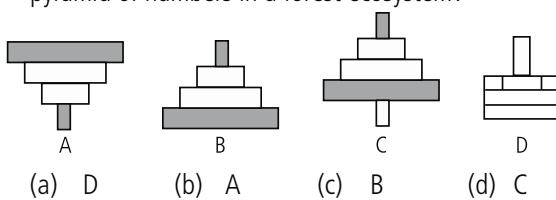
13. During the stages of succession in a given ecosystem, the following changes in characteristics may be observed.

Characteristic	Stages in ecosystem development	
	Early	Late
A. Total organic matter	Low	High
B. Species diversity	Low	High
C. Size of organism	Small	Large
D. Food chains	Short	Long

Which one of the characteristics, A, B, C or D is responsible for the apparent high degree of stability associated with a climax ecosystem?

- (a) B (b) D (c) A (d) C

14. Which of the following representations shows the pyramid of numbers in a forest ecosystem?



- (a) D (b) A (c) B (d) C

15. Select the correct statement .

- (a) The diversity of species tends to increase with succession.  
 (b) Biomass and standing crop of organic matter increase with succession.  
 (c) The succession resulting from changes brought about by factors external to community is called allogenic succession.  
 (d) All of these

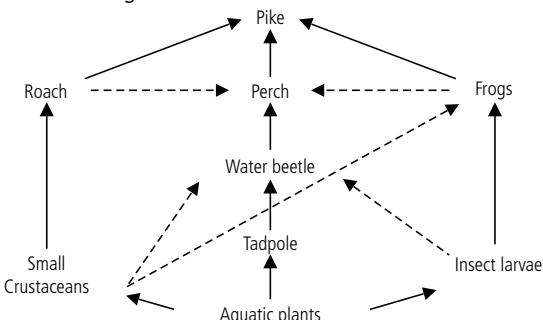
16. The reservoir and cycling pool of carbon cycle respectively are

- (a) atmosphere and fossil fuels  
 (b) atmosphere and hydrosphere  
 (c) lithosphere and hydrosphere  
 (d) industrial and soil wastes.

17. In an ecosystem, the flow of energy is always

- (a) bidirectional (b) in the reverse direction  
 (c) unidirectional (d) constant.

18. Refer to the given food web.



What will be the consequences of decrease in population of water beetle on food web?

- (a) Population of tadpole will decrease.  
 (b) Population of perch will increase.  
 (c) There will be no effect on the population of pike.  
 (d) Population of roach will decrease.

19. Which of the following factors would hasten the process of decomposition?

- (a) Soil temperature of 10-15°C  
 (b) Alkaline soil with pH of 9-12  
 (c) Detritus rich in nitrogen  
 (d) Anaerobic condition

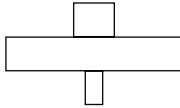
### MPP-5 CLASS XI

### ANSWER

### KEY

- |         |         |         |         |         |
|---------|---------|---------|---------|---------|
| 1. (b)  | 2. (c)  | 3. (a)  | 4. (a)  | 5. (d)  |
| 6. (c)  | 7. (d)  | 8. (a)  | 9. (b)  | 10. (a) |
| 11. (b) | 12. (b) | 13. (a) | 14. (a) | 15. (c) |
| 16. (c) | 17. (d) | 18. (d) | 19. (b) | 20. (b) |
| 21. (d) | 22. (b) | 23. (b) | 24. (c) | 25. (a) |
| 26. (b) | 27. (c) | 28. (d) | 29. (a) | 30. (a) |
| 31. (d) | 32. (a) | 33. (a) | 34. (d) | 35. (a) |
| 36. (d) | 37. (b) | 38. (a) | 39. (d) | 40. (b) |



- 20.** The correct sequence of plants in a hydrosere is  
 (a) *Volvox* → *Hydrilla* → *Pistia* → *Scirpus* → *Carex* → *Quercus*  
 (b) *Pistia* → *Volvox* → *Scirpus* → *Hydrilla* → *Quercus* → *Carex*  
 (c) *Quercus* → *Carex* → *Volvox* → *Hydrilla* → *Pistia* → *Scirpus*  
 (d) *Quercus* → *Carex* → *Scirpus* → *Pistia* → *Hydrilla* → *Volvox*.
- 21.** Early colonists in a primary succession are usually lichens, which suggests that colonisation is easier when an organism has a  
 (a) competitive edge  
 (b) parasitic association  
 (c) commensal association  
 (d) mutualistic association.
- 22.** If the decomposers from an ecosystem go on strike from functioning as decomposers, the functioning of ecosystem will be adversely affected because  
 (a) energy flow in an ecosystem will be blocked  
 (b) cycling of mineral and material will be stopped  
 (c) both (a) and (b)  
 (d) amount of biomass at each trophic level will reduce.
- 23.** The pyramid of biomass would be inverted in  
 (a) forest ecosystem (b) marine ecosystem  
 (c) grassland ecosystem (d) none of these.
- 24.** The stable community structure of an ecosystem is termed as  
 (a) dominant community (b) biocommunity  
 (c) domicile factor (d) climax community.
- 25.** What percentage of photosynthetically active radiation is captured by photosynthetic organisms?  
 (a) 1-5% (b) 2-10% (c) 50% (d) 10-12%
- 26.** Given below is one of the types of ecological pyramids. This type represents
- 
- (a) pyramid of numbers in a grassland  
 (b) pyramid of biomass in a fallow land  
 (c) pyramid of biomass in a lake  
 (d) energy pyramid in a spring.
- 27.** Which among the following would have maximum amount of energy in a terrestrial food chain?  
 (a) Rabbit (b) Wolf  
 (c) Tiger (d) Fox
- 28.** Consider the following statements (i-iv) and select the option stating which ones are true (T) and which ones are false (F).  
 (i) Detritus is the dried fallen plant matter.  
 (ii) Primary productivity is the rate of synthesis of organic matter by producers.  
 (iii) Rooted plants which occur in shallow waters are called macrophytes.  
 (iv) Submerged hydrophytes have higher photosynthetic rate than the floating hydrophytes.  
 (i) (ii) (iii) (iv)  
 (a) F T T F  
 (b) T T T F  
 (c) F F F T  
 (d) T F T F
- 29.** Primary succession takes much longer than secondary succession, because it involves  
 (a) development of the soil  
 (b) development of a seed bank  
 (c) colonisation by organisms that are farther away  
 (d) colonisation by more K-selected organisms.
- 30.** The kind of climax community in an area depends mostly on the area's  
 (a) pool of available colonists  
 (b) soil organisms  
 (c) climate (d) bedrock.

### ANSWER KEY

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



### Spellathon

1. Make as many biological terms as possible using the given letters. Each word should contain the letter given in circle.
2. Minimum 4 letter word should be made.
3. In making a word, a letter can be used as many times as it appears in the box.
4. Make at least 1 seven letter word.



Send your response at [editor@mtg.in](mailto:editor@mtg.in) or post to us with complete address by 25<sup>th</sup> of every month to win exciting prizes. Winners' name will be published in next issue.

# NCERT Xtract

New

## Questions for NEET

### Human Health and Diseases

1. Refer to the given table and select the incorrect pair of differences.

	Gonorrhoea	Syphilis
(i)	Causing agent is <i>Neisseria gonorrhoeae</i> .	Causing agent is <i>Treponema pallidum</i> .
(ii)	Appearance of chancres on genital parts.	Urethral discharge is pus.
(iii)	Dark field microscope is used to demonstrate the causative agent.	Gram stain is used to detect causative agent.
(iv)	VDRL test is done.	PCR is done.

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

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

Carcinogen		Organ affected	
I.	Soot	P.	Prostate gland
II.	Cadmium oxide	Q.	Liver
III.	Asbestos	R.	Skin and lungs
IV.	Vinyl chloride	S.	Pleural membrane

I	II	III	IV
(a) Q	S	P	R
(b) R	P	S	Q
(c) P	R	Q	S
(d) P	S	R	Q

3. Plasma cells are

- (a) the same as memory cells  
 (b) formed from blood plasma  
 (c) B-cells that actively secrete antibodies  
 (d) inactive T-cells circulating in the plasma.

4. Transfusing a person with blood plasma proteins from a person or animal that has been actively immunised against a specific antigen provides

- (a) active immunity      (b) passive immunity  
 (c) auto-immunity      (d) anti-immunity.

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

**Column I**

- (i) *P. vivax*      P. Maurer's dots  
 (ii) *P. falciparum*      Q. Jame's dots  
 (iii) *P. malariae*      R. Schuffner's dots  
 (iv) *P. ovale*      S. Ziemann's dots  
 (a) (i)-R; (ii)-P; (iii)-S; (iv)-Q  
 (b) (i)-R; (ii)-S; (iii)-Q; (iv)-P  
 (c) (i)-P; (ii)-Q; (iii)-R; (iv)-S  
 (d) (i)-P; (ii)-S; (iii)-R; (iv)-Q

**Column II**

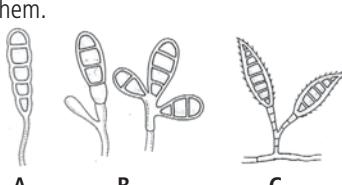
6. Read the given statements and select the option correctly stating which ones are true (T) and which ones are false (F).

- I. BCG vaccine gives protection against tuberculosis.  
 II. *Entamoeba histolytica* resides in jejunum and ileum parts of the small intestine and is more common in females than males.  
 III. Man is the primary host whereas sheep is the secondary host in life cycle of *Ascaris lumbricoides*.  
 IV. Chemical formula of caffeine is C<sub>8</sub>H<sub>10</sub>N<sub>4</sub>O<sub>2</sub>.

I	II	III	IV
(a) T	F	F	F
(b) T	F	F	T
(c) F	T	F	T
(d) F	T	T	T

7. Which of the following fixed macrophages is found in brain?

- (a) Histiocytes      (b) Mesangial cells  
 (c) Microglial cells      (d) Kupffer cells

- 8.** What will be the effect of combined intake of alcohol and antihistamines?
- Marked drowsiness
  - High risk of damage to gastric mucosa
  - Hypertension
  - Decreased insulin effect
- 9.** Read the given statements and select the correct option.
- Statement A :** Histamine is involved in allergic and inflammatory reactions.
- Statement A :** Histamine is a vasodilator.
- Both statements A and B are true and B is the correct explanation of A.
  - Both statements A and B are true but B is not the correct explanation of A.
  - Statement A is true but statement B is false.
  - Both statements A and B are false.
- 10.** Which one among the following is the causal agent of helminthic disease?
- Schistosoma haematolium*
  - Trichophyton*
  - Trichomonas vaginalis*
  - Tinea barbae*
- 11.** Select the correct statement with respect to diseases and immunisation.
- If due to some reason B and T lymphocytes are damaged, then the body will not produce antibodies against a pathogen.
  - Injection of dead or inactivated pathogens causes passive immunity.
  - Certain protozoans have been used in mass production of hepatitis B vaccine.
  - Injection of snake antivenom against snake bite is an example of active immunisation.
- 12.** Australia antigen is another name of antigen of
- hepatitis B virus
  - hepatitis D virus
  - hepatitis G virus
  - hepatitis E virus.
- 13.** Which of the following is not a type of antigen presenting cell in the body?
- Macrophage
  - T-cell
  - B-cell
  - Dendritic cell
- 14.** Refer to the given figures and select the correct option regarding them.
- 
- A infects only skin whereas B and C infect skin and hair.
  - B infects skin and nails whereas A and C infect skin and hair.
- 15.** Toxoid is a
- vaccine against MMR
  - salk polio vaccine
  - vaccine against tetanus and diphtheria
  - nucleic acid vaccine.
- 16.** Disease 'X' is an inflammation of synovial membrane in synovial joints that occurs in younger people. It is the result of an auto-immune reaction. Disease 'X' is
- Still's disease
  - Gaucher's disease
  - osteoarthritis
  - Parkinson's disease.
- 17.** X is widely used in veterinary medicine to immobilise large animals. It is available as Y and has stimulant, depressant, hallucinogenic and analgesic properties. Identify 'X' and 'Y'.
- | <b>X</b>                              | <b>Y</b>   |
|---------------------------------------|------------|
| (a) Methylenedioxy<br>Methamphetamine | Ecstasy    |
| (b) Meperidine                        | Angel dust |
| (c) PCP                               | Ecstasy    |
| (d) Phencyclidine Piperidine          | Angel dust |
- 18.** Anti-tetanus serum (ATS) is an example of
- artificial passive immunity
  - natural passive immunity
  - artificial active immunity
  - natural active immunity.
- 19.** In which one of the following options the two examples are correctly matched with their particular type of immunity?
- | <b>Examples</b>   | <b>Type of immunity</b> |
|---|-------------------------|
| (a) Polymorphonuclear<br>leucocytes and<br>monocytes  | Cellular barriers       |
| (b) Horse anti-toxin  | Active immunity         |
| (c) Saliva and tears  | Physical barriers       |
| (d) Mucus coating of<br>epithelium lining the<br>urinogenital tract and<br>the HCl in stomach | Physiological barriers  |
- 20.** Motile zygote of *Plasmodium* occurs in
- gut of female *Anopheles*
  - salivary glands of *Anopheles*
  - human RBCs
  - human liver.
- 21.** Antiserum is rich in
- steroids
  - antibodies
  - antigens
  - RBCs.

- 22.** Chemical messengers of immune cells are  
(a) interferons                            (b) histamines  
(c) lysozymes                                (d) both (a) and (b).
- 23.** Cholera patients are given saline solution as this  
(a) prevents water loss from body  
(b) inhibits repeated vomiting  
(c) provides energy  
(d) is antibacterial.
- 24.** Antibody mediated immune system protects the body against  
(a) viruses                                    (b) bacteria  
(c) toxins                                    (d) all of these.
- 25.** The basic difference between B and T-cells is  
(a) their site of origin is different  
(b) their maturation and storage site is different  
(c) they are found at different places in the lymphoid pool  
(d) none of these.
- 26.** Which of the following are viral and mosquito borne diseases respectively?  
(a) Balantidiasis and chikungunya  
(b) Kala-azar and malaria  
(c) Whooping cough and malaria  
(d) Measles and dengue
- 27.** Choose the correct statement.  
(a) Immunoglobulins are produced by descendants of B-cells.  
(b) Clumping of microorganisms due to an antigen-antibody reaction is called precipitation.  
(c) B-cells are responsible for humoral immunity and T-cells for cellular immunity.  
(d) Secondary immune response mainly consists of IgM antibodies.
- 28.** Refer to the given statements and select the option that correctly fill the blanks.  
I. In (i) and (ii), the immune system starts destroying body's own proteins.  
II. (iii) is the malignant growth of tissues derived from primitive mesoderm.  
III. (iv) was the first drug used for the treatment of AIDS.  

(i)	(ii)	(iii)	(iv)
(a) diabetes mellitus	Hashimoto's thyroiditis	Sarcoma	Zidovudine
(b) rheumatic fever	SCID	Carcinoma	Azidothymidine
(c) cancer	AIDS	Sarcoma	Didanosine
(d) Addison's disease	rheumatoid arthritis	Carcinoma	Didanosine
- 29.** Which of the following suppresses immune response during transplantation?  
(a) Humoral immunity  
(b) Cell-mediated immunity
- 30.** Immediate hypersensitivity which result in the release of histamine and other inflammatory substances is mediated by  
(a) IgA    (b) IgD  
(c) IgE    (d) IgG.
- 31.** *Phlebotomus argentipes* transmits the parasite  
(a) *Leishmania donovani*  
(b) *Taenia saginata*  
(c) *Trypanosoma gambiense*  
(d) *Giardia intestinalis*.
- 32.** Identify the type of T-cells from given characteristics.  
I. Secrete perforins  
II. Their antigen receptors cause specific binding with antigen.  
III. May kill body's own cells  
(a)  $T_H$  cells    (b)  $T_C$  cells  
(c) Memory T-cells                                        (d)  $T_R$  cells
- 33.** Choose the odd one out.  
(a) Rabies, influenza, AIDS  
(b) Amoebiasis, giardiasis, trypanosomiasis  
(c) Taeniasis, ascariasis, elephantiasis  
(d) Cancer, tuberculosis, tetanus
- 34.** Identify the incorrectly matched pair.  
(a) NK cells – Apoptosis  
(b) Sebum – Physiological barrier  
(c) First generation vaccine – Vaccine against rabies  
(d) Colostrum – Passive immunity
- 35.** The major histocompatibility complex is a/an  
(a) set of molecules responsible for lymphocyte recognition and antigen presentation  
(b) set of genes encoded by genes located on chromosome 21  
(c) group of proteins that create pores in the plasma membrane of microbes  
(d) enzyme precursor and is produced by liver.
- 36.** Which antibody is excreted through faeces?  
(a) IgG    (b) IgA  
(c) IgM    (d) IgE
- 37.** Which of the following is a matching pair of the vector and the disease?  
(a) *Culex* - Elephantiasis  
(b) Housefly-Yellow fever  
(c) Body louse-Typhoid  
(d) Sandfly-Plague
- 38.** Principle of immunisation is based on which property of immune system?  
(a) Diversity  
(b) Memory  
(c) Self and non-self recognition  
(d) Specificity

**39.** Which of these sets is correct?

- (a) *Plasmodium falciparum*, quartan malaria, relapse, mosquito
- (b) *Trypanosoma gambiense*, *Glossina*, sleeping sickness, winterbottom's sign
- (c) *Wuchereria bancrofti*, elephantiasis, rhabditiform larva, mosquito
- (d) *Entamoeba histolytica*, dysentery, binucleate cyst, colon



## HIGHER ORDER THINKING SKILLS QUESTIONS (HOTS)

**41.** At which stage of HIV infection does one usually show symptoms of AIDS?

- (a) When viral DNA is produced by reverse transcriptase.
- (b) When HIV replicates rapidly in helper T-lymphocytes and damages large number of these cells.
- (c) Within 15 days of sexual contact with an infected person.
- (d) When the infecting retrovirus enters host cells.

**42.** Refer to the given table and identify A, B, C and D.

	Disease	Pathogen	Site of infection	Mode of infection
(i)	Ancylostomiasis	<i>Ancylostoma duodenale</i>	<b>A</b>	Larvae bore through skin of feet
(ii)	Oxyuriasis	<b>B</b>	Caecum and colon appendix	Eating food infected with eggs
(iii)	Dracunculiasis	<i>Dracunculus medinensis</i>	<b>C</b>	Drinking infected water
(iv)	Filariasis	<i>Wuchereria bancrofti</i>	Lymphatic system	<b>D</b>

- | A                    | B                              | C                   | D                             |
|----------------------|--------------------------------|---------------------|-------------------------------|
| (a) Small intestine  | <i>Trichinella spiralis</i>    | Subcutaneous tissue | Bite of tse-tse fly           |
| (b) Caecum and colon | <i>Enterobius vermicularis</i> | Small intestine     | Bite of <i>Culex</i> mosquito |
| (c) Small intestine  | <i>Enterobius vermicularis</i> | Subcutaneous tissue | Bite of <i>Culex</i> mosquito |
| (d) Caecum and colon | <i>Trichinella spiralis</i>    | Small intestine     | Bite of tse-tse fly           |

**43.** Refer to the given figure and select correct statement regarding it.

- (a) A psychotropic drug having sedative and calming effect is obtained from it.
- (b) Its derivative is a mild analgesic and is used in medicines.



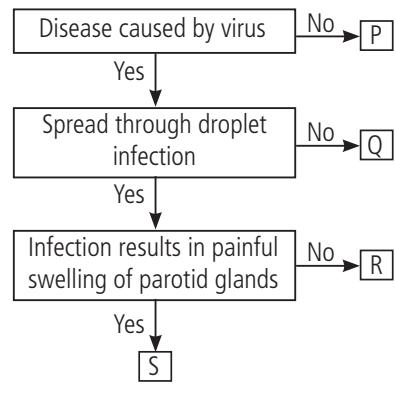
**40.** The clonal selection theory states that

- (a) an antigen selects certain B-cells and suppresses them
- (b) an antigen stimulates the multiplication of B-cells that produce antibodies against it
- (c) T-cells select those B-cells that should produce antibodies, regardless of antigens present
- (d) T-cells suppress all B-cells except the ones that should multiply and divide.

- (c) Its derivative depresses respiratory centre and contributes to fall in blood pressure.

- (d) A psychedelic drug that produces hallucinations and false imaginations by effecting cerebrum and sense organs is obtained from it.

**44.** Study the given flow chart and identify P, Q, R and S.



- | <b>P</b>         | <b>Q</b>       | <b>R</b>    | <b>S</b> |
|------------------|----------------|-------------|----------|
| (a) Dengue fever | Tetanus        | SARS        | Rubella  |
| (b) Typhoid      | Measles        | Parotitis   | SARS     |
| (c) Tetanus      | Yellow fever   | SARS        | Mumps    |
| (d) Diphtheria   | Bubonic plague | Chicken pox | SARS     |

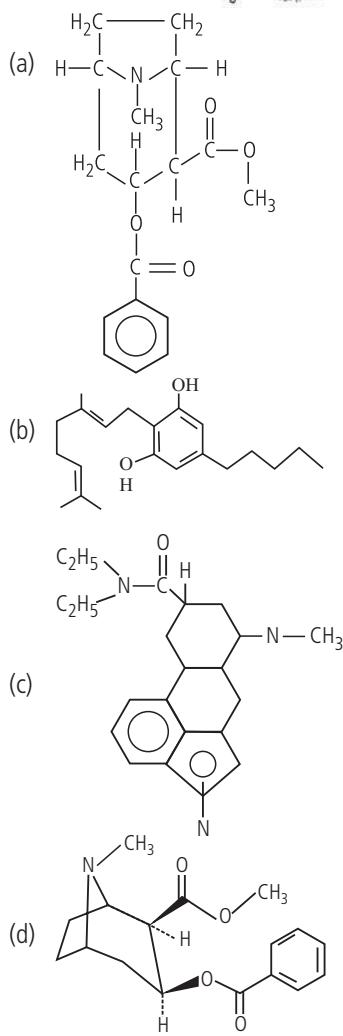
**45.** Consider the following four statements (I-IV) regarding kidney transplant and select the two correct ones out of these.

- I. Even if a kidney transplant is proper the recipient may need to take immuno-suppressants for a long time.
- II. The cell-mediated immune response is responsible for the graft rejection.
- III. The B-lymphocytes are responsible for rejection of the graft.
- IV. The acceptance or rejection of a kidney transplant depends on specific interferons.

The two correct statements are

- (a) II and III
- (b) III and IV
- (c) I and III
- (d) I and II

46. Refer to the given figure and select the correct chemical structure of derivative obtained from it.



47. Which one of the following options gives the correct matching of a disease with its causative organism and mode of infection?

Disease	Causative organism	Mode of infection
(a) Yellow fever	<i>Flavi virus</i>	Bite of <i>Culex</i> mosquito
(b) Chicken pox	<i>Varicella zoster virus</i>	Droplet infection
(c) Lock jaw	<i>Mycobacterium leprae</i>	Wound infection
(d) Taeniasis	<i>Taenia saginata</i>	Eating ill cooked pork

48. Read the given statements and select the incorrect one.
- An exaggerated immune response on exposure to pollen, dust, etc., in some individuals is due to release of histamine and serotonin from mast cells.
  - Immunodeficiency diseases are due to failure of immune system to distinguish between self and non-self cells.
  - During HIV injection, RNA genome of virus replicates to form viral DNA which gets incorporated into host cell's DNA.
  - Cancer cells resist induction of cell death and promotes tumour development.

49. Refer to the given statements regarding malarial parasite and select the incorrect ones.

- Infective stage of *Plasmodium* in man is sporozoite, which reaches the liver through blood.
  - In the liver of man parasite reproduces sexually producing a large number of metacryptomerozooids in blood.
  - When female *Anopheles* sucks blood the gametocytes are taken in and they become lodged in the salivary glands as ookinete.
  - The sexual stage, gametocytes of *Plasmodium* develops in RBCs of man.
- I and II
  - II and III
  - I and IV
  - II and IV

50. Which is the proper order of events in cell-mediated immunity?

- Antigen enters tissue, macrophages engulf antigen, antigen presented to members of a clone of lymphocytes, sensitised T-lymphocytes attack antigen-bearing agents
- Antigen enters tissues, antigen passed to members of a clone of lymphocytes, lymphocytes sensitised, macrophages engulf antigen, T-lymphocytes attack antigen-bearing agents
- Antigen enters tissues, macrophages engulf antigen, antigen passed to members of a clone of lymphocytes, lymphocytes sensitised, B-lymphocytes secrete antibodies that react with antigen-bearing agents
- Antigen enters tissues, lymphocytes sensitised, antigen passed to members of a clone of lymphocytes, macrophages engulf antigen, T-lymphocytes attack antigen-bearing agents

### ANSWER KEY

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



This specially designed column enables students to self analyse their extent of understanding of specified chapters. Give yourself four marks for correct answer and deduct one mark for wrong answer. Self check table given at the end will help you to check your readiness.

- Strategies for Enhancement in Food Production
- Microbes in Human Welfare

**Total Marks : 160**

1. Pisciculture includes production of
 

(a) prawns	(b) shellfish
(c) catla	(d) none of these.
2. Identify the organic acid obtained from yeast *Candida lipolytica*, which is used in flavouring and preservation of food and candies.
 

(a) Acetic acid	(b) Citric acid
(c) Gluconic acid	(d) Butyric acid
3. Holstein-Friesian, Brown Swiss and Jersey are all well known
 

(a) exotic breeds of cow
(b) exotic breeds of goat
(c) exotic breeds of poultry
(d) animal husbandry scientists.
4. Fungus *Aspergillus fumigatus* is associated with
 

(a) production of single cell protein
(b) production of proteases
(c) brooder pneumonia of poultry
(d) all of these.
5. Consider the following three statements and select the correct option stating which ones are true (T) and which ones are false (F).
  - (i) In allopolyploidy, there is a numerical increase of the same genome.
  - (ii) Mutation breeding involves developing desirable plant by changing base sequence of gene.
  - (iii) Somaclonal variations are produced due to crossing over and recombination during meiosis.

<b>(i)</b>	<b>(ii)</b>	<b>(iii)</b>
(a) F	T	F
(b) T	T	F
(c) F	T	T
(d) T	F	T



**Time Taken : 40 Min.**

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

<b>Column I</b>	<b>Column II</b>
A. Statins	(i) <i>Trichoderma polysporum</i>
B. SCP	(ii) <i>Monascus purpureus</i>
C. Lipase	(iii) <i>Pseudomonas</i>
D. Biogas	(iv) <i>Methylophilus methylotrophus</i>
	(v) <i>Candida lipolytica</i>

(a) A – (iii), B – (v), C – (i), D – (iv)  
 (b) A – (i), B – (ii), C – (v), D – (iv)  
 (c) A – (v), B – (i), C – (iv), D – (iii)  
 (d) A – (ii), B – (iv), C – (v), D – (iii)
7. Read the given statements and select the correct option.  
**Statement 1 :** Out-crossing refers to the mating of animals of two different species.  
**Statement 2 :** Interspecific hybridisation refers to the mating of superior males of one breed with superior females of the same breed.  
 (a) Both statements 1 and 2 are true and statement 2 is the correct explanation of statement 1.  
 (b) Both statements 1 and 2 are true but statement 2 is not the correct explanation of statement 1.  
 (c) Statement 1 is true but statement 2 is false.  
 (d) Both statements 1 and 2 are false.
8. Which of the following statements are incorrect?
  - I. VAM is commonly called ectomycorrhiza because it lives in cortex of roots and provides nitrogen to the plants.
  - II. Honeybees suck the nectar and convert its sucrose into dextrose and levulose by the action of invertase enzyme.
  - III. Anther culture cannot be used to produce homozygous plants.
  - IV. *Phytophthora palmivora* is a bioherbicide used in *Citrus* orchards.

(a) I and II	(b) II, III and IV
(c) I and III	(d) I, III and IV

9. Select the correct statement regarding antibiotics.
- Ampicillin is a semi-synthetic antibiotic.
  - Terramycin is obtained from *Streptomyces aureofaciens*.
  - Polymyxin acts as bacteriostatic by inhibiting the translation in bacteria.
  - Micromonospora purpurea* is the source of neomycin.

10. Match the following and select the correct option.

Column I	Column II
(i) Swiss cheese	(p) Inhibition of translation
(ii) Chloramphenicol	(q) Lowers blood cholesterol
(iii) Proteases	(r) <i>Propionibacterium shermanii</i>
(iv) Lovastatin	(s) <i>Bacillus</i>
(a) (i)-(s), (ii)-(p), (iii)-(r), (iv)-(q)	
(b) (i)-(r), (ii)-(q), (iii)-(s), (iv)-(p)	
(c) (i)-(r), (ii)-(p), (iii)-(s), (iv)-(q)	
(d) (i)-(q), (ii)-(s), (iii)-(r), (iv)-(p)	

11. Read the given statements and select the correct option.

**Statement 1 :** *Spirulina* is an alternate source of proteins for animals and human.

**Statement 2 :** *Spirulina* can be grown easily on waste water containing starch, straw, molasses, etc.

- Both statements 1 and 2 are true and 2 is the correct explanation of 1.
- Both statements 1 and 2 are true but 2 is not the correct explanation of 1.
- Statement 1 is true but statement 2 is false.
- Both statements 1 and 2 are false.

12. Three fishes, *Catla*, *Labeo* and *Cirrhinus*, can be grown together in the same pond more economically as they have
- positive interactions
  - commensalism
  - symbiosis
  - no competition for food.

13. Select the mismatched pair.

- Brewer's yeast — *Saccharomyces cerevisiae*
- Wine yeast — *Saccharomyces pyriformis*
- Yoghurt — *Lactobacillus bulgaricus*
- Butter milk — *Streptococcus cremoris*

14. The most common fungal partner of mycorrhiza belongs to the genus

- Azolla*
- Glomus*
- Frankia*
- Azotobacter*.

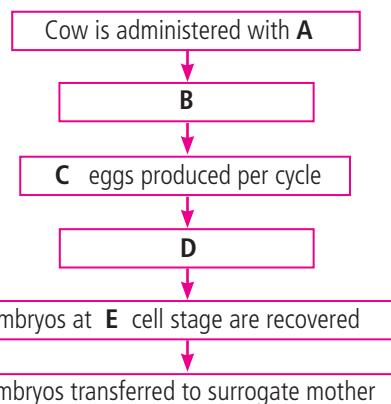
15. Hybrid vigour is mostly due to

- heterozygosity
- homozygosity of pure characters
- superiority of all the genes
- none of these.

16. A fishery by-product obtained from air bladder of fish that is used for clearing wine and beer is

- shagreen
- fish oil
- isinglass
- none of these.

17. Study the given flow chart representing events of MOET and select the option that correctly fill in the blanks.



- A-Luteinising hormone; B-Follicular maturation and super ovulation; C-2 to 8; D-Cross breeding; E-16 to 32
- A-Follicle stimulating hormone; B-Follicular maturation and super ovulation; C-6 to 8; D-Artificial insemination; E-8 to 32
- A-Interstitial cell stimulating hormone; B-Superovulation; C-5 to 10; D-Cross breeding; E-12 to 24
- A-Gonadotropin releasing hormone; B-Gamete formation; C-4 to 8; D-Artificial insemination; E-7 to 14

18. Biofortification refers to the development of crop plants having

- higher iron content
- resistance against diseases
- improved nutritional quality
- pest resistance.

19. A person suffering from myocardial infarction was admitted to hospital and injected with 'streptokinase', as

- it stimulates heart beat
- it reduces hypertension
- it acts as clot buster
- it reduces the level of blood cholesterol.

20. Select the statement which is true for both out-crossing and cross-breeding.

- They are the types of interspecific hybridisation.
- They are included under out-breeding methods.
- In these methods, superior males of one breed are mated with inferior females of another breed.
- Both breeding methods involve superior male and superior female of two different breeds.

21. In crop improvement programmes, virus-free clones can be obtained through

- embryo culture
- shoot apex culture
- grafting
- hybridisation.

22. A nitrogen fixing bacterium that forms a loose association with the roots of crop plants is

- Azotobacter*
- Bacillus polymyxa*
- Clostridium*
- Azospirillum*.

**FIND  
MORE  
FREE  
MAGAZINES**

**FREEMAGS.CC**

- 23.** Consider the following statements about secondary sewage treatment.
- In secondary treatment, useful aerobic microbes grow rapidly and form flocs. Flocs are masses of bacteria associated with fungal filaments to form mesh-like structures.
  - The growing microbes consume organic matter and reduce the biochemical oxygen demand. When BOD of sewage has reduced, the effluent is passed into settling tank.
  - In settling tank, the bacterial flocs settle and the sediment is called activated sludge.
  - A small part of the sludge is used as an inoculum in the aeration tank and the remaining part is passed into large tanks called anaerobic sludge digesters.
  - In the digesters, heterotrophic microbes anaerobically digest bacteria and fungi in sludge producing mixture of gases such as, carbon dioxide and methane which form the biogas.
- Which of the statements given above are correct?
- I, II, III and IV
  - I, III, IV and V
  - II, III, IV and V
  - I, II, III, IV and V
- 24.** Which strategy is to be adopted to evolve a pureline in an animal?
- Interspecific hybridisation
  - Out-crossing
  - Inbreeding
  - Artificial insemination
- 25.** Match column I with column II. (There can be more than one match of column I in column II).
- | <b>Column I</b>          | <b>Column II</b>                                     |
|--------------------------|--|
| A. Inbreeding            | (i) Gamma rays                                       |
| B. Goat                  | (ii) Lincoln   |
| C. Mutagens              | (iii) <i>Triticale</i>                               |
| D. Exotic breed of sheep | (iv) <i>Capra capra</i>                              |
| E. Allopolyploid         | (v) Homozygosity                                     |
|                          | (vi) Ultraviolet rays                                |
|                          | (vii) Dorset   |
|                          | (viii) Sodium azide                                  |
| (a)                      | A-(ii, iii), B-(i), C-(iv), D-(v), E-(vi, vii, viii) |
| (b)                      | A-(v), B-(iv), C-(i, vi, viii), D-(ii, vii), E-(iii) |
| (c)                      | A-(vii), B-(ii, v), C-(vi, viii), D-(iv), E-(i, iii) |
| (d)                      | A-(i, vii), B-(ii), C-(iv, vi), D-(iii, v), E-(viii) |
- 26.** Haploid production in plants is achieved by
- meristem culture
  - mutation breeding
  - sub-culture
  - anther culture.
- 27.** Which of the following is an example of mutation breeding?
- Pusa Swarnim, resistant to white rust
  - Mung bean, resistant to yellow mosaic virus
  - Pusa Sadabahar, resistant to chilli mosaic virus
  - Pusa Gaurav, resistant to aphids
- 28.** A collection of plants and seeds having diverse alleles of all the genes of a crop is called
- herbarium
  - germplasm
  - gene library
  - genome.
- 29.** What gases are produced in anaerobic sludge digesters?
- Methane and CO<sub>2</sub> only
  - Methane, Hydrogen sulphide and CO<sub>2</sub>
  - Methane, Hydrogen sulphide and O<sub>2</sub>
  - Hydrogen sulphide and CO<sub>2</sub>
- 30.** Read the given statements and select the option that shows the correct order of various steps involved in the plant breeding.
- Cross-hybridisation among selected parents for bringing their traits together in the progeny.
  - Selection and testing the hybrid plants to find superior recombinant.
  - Germplasm or all the diverse alleles for all genes are collected.
  - Testing the hybrids for their yield and agronomic traits and finally new cultivars are commercially released for the farmers.
  - Evaluation and selection of germplasm to identify plant with desired traits.

Contributed by : Ratul Pan (Durgapur), Avinash Mishra (Gurugram)

## SOLUTIONS TO JULY 2017 CROSSWORD

<sup>1</sup> F	<sup>2</sup> U	<sup>3</sup> N	<sup>4</sup> O	<sup>5</sup> R	<sup>6</sup> I	<sup>7</sup>	<sup>8</sup>	<sup>9</sup>	<sup>10</sup>	<sup>11</sup>	<sup>12</sup>	<sup>13</sup>	<sup>14</sup>	<sup>15</sup>	<sup>16</sup>	<sup>17</sup>	<sup>18</sup>	<sup>19</sup>	<sup>20</sup>	<sup>21</sup>	<sup>22</sup>	<sup>23</sup>	<sup>24</sup>	<sup>25</sup>	<sup>26</sup>	<sup>27</sup>	<sup>28</sup>	<sup>29</sup>	<sup>30</sup>			
				B		<sup>5</sup> D	O	B	S	O	N									Z	E	A	S	C	T	P						
<sup>7</sup> G	O	U		T		<sup>8</sup> S	P	A	R	G	E	R	A																			
						S	C	O	T																							
<sup>10</sup> P	<sup>11</sup> L	E	R	O	M	E														<sup>12</sup> S	P	G										
		Y		A	M	P	L	E	X	U	S	C	O	A																		
		C		T	A	C	R	I	N	E	Y	A	T																			
<sup>18</sup> S	O	<sup>19</sup> R	O	S	I	S					S	B	E	<sup>20</sup> L	I																	
		P	E	R	T					Z	E	A	T	I	N	I	V															
<sup>22</sup> H	E	L				<sup>23</sup> S	C	I	O	N	O	E	T	A	I																	
I	N	A								T	E	L	S	O	N	P																
N	E	X																		E	<sup>25</sup> E		A	A								
N		I																														
Y	N																															
		R	E	M	A	K					P	I	N	E	A	L																

- (a) III → V → I → II → IV  
 (b) I → II → III → IV → V  
 (c) II → IV → I → III → V  
 (d) V → IV → III → II → I

**31.** Father of plant tissue culture is

- (a) Haberlandt      (b) Skoog  
 (c) Bergmann      (d) Borlaug.

**32.** Read the given statements and select the correct option.

**Statement 1 :** Antibiotics are used as food supplements for animals.

**Statement 2 :** Antibiotics are harmless to host and have ability to destroy pathogens.

- (a) Both statements 1 and 2 are true and 2 is the correct explanation of 1.  
 (b) Both statements 1 and 2 are true but 2 is not the correct explanation of 1.  
 (c) Statement 1 is true but statement 2 is false.  
 (d) Both statements 1 and 2 are false.

**33.** *Triticale* has been developed through hybridisation between (i) and (ii), followed by (iii) of chromosomes.

Select the correct option for (i), (ii) and (iii).

- | (i)                          | (ii)                     | (iii)    |
|------------------------------|--------------------------|----------|
| (a) <i>Triticum turgidum</i> | <i>Secale cereale</i>    | halving  |
| (b) <i>Triticum aestivum</i> | <i>Secale cereale</i>    | halving  |
| (c) <i>Triticum turgidum</i> | <i>Secale cereale</i>    | doubling |
| (d) <i>Triticum turgidum</i> | <i>Triticum aestivum</i> | doubling |

**34.** In protoplast fusion, the enzymes required is/are

- (a) cellulase, pectinase    (b) pectinase  
 (c) ligase, hemicellulase    (d) hemicellulase.

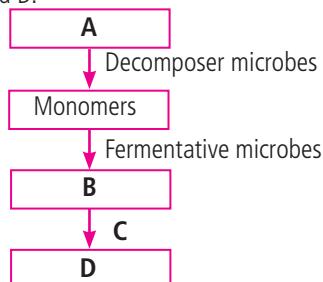
**35.** 'Roquefort cheese' is ripened by using a

- (a) bacterium      (b) type of yeast  
 (c) cyanobacteria    (d) fungus.

**36.** Probiotics are

- (a) cancer inducing microbes  
 (b) new kind of food allergens  
 (c) live microbial food supplements  
 (d) safe antibiotics.

**37.** Study the given flow chart of biogas formation and identify A, B, C and D.



- (a) A-Organic waste, B-Organic acid, C-Methanogenic bacteria, D-Biogas  
 (b) A-Organic waste, B-Organic acid, C-Anaerobic bacteria, D-CH<sub>4</sub> and H<sub>2</sub>S  
 (c) A-Inorganic fertilisers, B-Organic acid, C-Methanogenic bacteria, D-Biogas  
 (d) A-Organic waste, B-Organic acid, C-Methanogenic bacteria, D-H<sub>2</sub>S and CO<sub>2</sub>

**38.** Which of the following statements is incorrect for callus culture?

- (a) Cell division in explant forms a callus.  
 (b) It need not to be agitated.  
 (c) The culture is maintained in liquid medium.  
 (d) Growth regulators like auxin and cytokinin are added to the medium.

**39.** Which one of the following pairs is wrongly matched?

- (a) Alcohol - Nitrogenase    (b) Fruit juice - Pectinase  
 (c) Textile - Amylase        (d) Detergents - Lipase

**40.** Fill the blank spaces in the table given below by selecting the correct option.

Crop	Variety	Resistance to Diseases
Wheat	A	Leaf and stripe rust
Brassica	Pusa Swarnim	B
C	Pusa Snowball K-1	Black rot and curl blight black rot
Chilli	D	Leaf curl

- (a) A-Jaya; B-Hill bunt; C-Millets; D-Pusa Shubhra  
 (b) A-Himgiri; B-White rust; C-Cauliflower; D-Pusa Sadabahar  
 (c) A-Pusa Sadabahar; B-White rust; C-Chilli; D-Pusa Komal  
 (d) A-Himgiri; B-Hill bunt; C-Sugarcane; D-Pusa Sem 2

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## SELF CHECK

Check your score! If your score is

No. of questions attempted .....  
 No. of questions correct .....  
 Marks scored in percentage .....

- |        |                   |  |
|--------|-------------------|--|
| > 90%  | EXCELLENT WORK !  | You are well prepared to take the challenge of final exam. |
| 90-75% | GOOD WORK !       | You can score good in the final exam.                      |
| 74-60% | SATISFACTORY !    | You need to score more next time.                          |
| < 60%  | NOT SATISFACTORY! | Revise thoroughly and strengthen your concepts.            |

# **CBSE BOARD**

## **UNITWISE PRACTICE PAPER, 2018**

### **UNIT - I**

- Reproduction in Organisms
- Sexual Reproduction in Flowering plants
- Human Reproduction
- Reproductive Health

### **GENERAL INSTRUCTIONS**

- All questions are compulsory.
- This question paper consists of five Sections A, B, C, D and E. Section A contains 5 questions of one mark each. Section B contains 5 questions of two marks each, Section C contains 12 questions of three marks each. Section D contains 1 question of VBQ type with four marks and Section E contains 3 questions of five marks each.
- There is no overall choice. However, an internal choice has been provided in one question of 2 marks, one question of 3 marks and all the three questions of 5 marks weightage. A student has to attempt only one of the alternatives in such questions.
- Wherever necessary, the diagrams drawn should be neat and properly labelled.

Time Allowed : 3 hours

Maximum Marks : 70

### **SECTION - A**

- How do the pollen grains of *Vallisneria* protect themselves?
- Sperms have a tail whereas eggs do not. Why so?
- Offspring derived by asexual reproduction are called clones. Justify giving two reasons.
- Name an IUD that you would recommend to promote the cervix hostility to the sperms.
- Date palm is a dioecious plant. Comment on its sexuality.

### **SECTION - B**

- Draw and label the parts of the head region only of a human sperm.
- Banana is a parthenocarpic fruit whereas oranges show polyembryony. How are they different from each other with respect to seeds?
- The cell division involved in gamete formation is not of the same type in different organisms. Justify.
- Mention the number of cells in the following embryonic stages; zygote, morula, blastocyst.

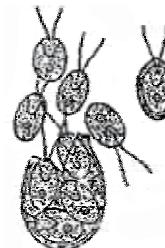
**OR**

Some angiosperm seeds are said to be 'albuminous', whereas few others are said to have a perisperm. Explain each with the help of an example.

- A couple where both husband and wife are producing functional gametes, but the wife still unable to conceive, is seeking medical aid. Describe any one method that you can suggest to this couple to become happy parents.

### **SECTION - C**

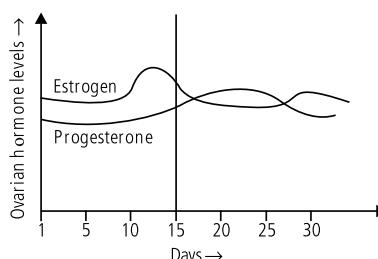
- (a) Name and explain the role of the inner and middle walls of the human uterus.  
(b) Write the location and function of Sertoli cells in humans.
- (a) Identify the given reproductive structure and name the organism, they are being released from.



- (b) Explain the function of scutellum in a monocot seed.
- Differentiate between geitonogamy and xenogamy in plants. Which one between the two will lead to inbreeding depression and why?
- A woman has certain queries as listed below, before starting with contraceptive pills. Answer them :

- (a) What do contraceptive pills contain and how do they act as contraceptives?  
 (b) What schedule should be followed for taking these pills?

15. (a)



Read the graph given above and correlate the uterine events that take place according to the hormonal levels on

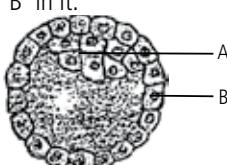
- (i) 6-15 days
  - (ii) 16-25 days
  - (iii) 26-28 days (if the ovum is not fertilised).
- (b) Specify the sources of the hormones mentioned in the graph.

16. (a) Mention the site in a flowering plant where the following developments take place.

- (i) Deposition of sporopollenin
- (ii) Megasporogenesis

(b) Draw a labelled diagram of a male gametophyte of an angiosperm.

17. (a) Name the human embryonic stage shown below. Identify 'A' and 'B' in it.



(b) Mention the part of the above embryonic stage that forms the fetus.

(c) Name the embryonic stage that gets implanted in the uterine wall of human female.

18. (a) Mention the problems that are taken care of by Reproduction and Child Health Care Programme.

(b) What is amniocentesis and why there is a statutory ban on it?

19. List the changes each part of the fertilised ovule undergoes to develop into a seed.

OR

(a) Why do algae and fungi shift to sexual mode of reproduction just before the onset of adverse conditions?

(b) Unicellular organisms are immortal, whereas multicellular organisms are not. Justify.

20. State the significance of pollination. List any four differences between wind-pollinated and animal-pollinated flowers.

21. State any four methods to overcome infertility in human couples.

22. Describe the events of oogenesis with the help of schematic representation.

### SECTION - D

23. Your school has been selected by the Department of Education to organise and host an interschool seminar on "Reproductive Health-Problems and Practices". However, many parents are reluctant to permit their wards to attend it. Their argument is that the topic is "too embarrassing". Put forth four arguments with appropriate reasons and explanation to justify the topic to be very essential and timely.

### SECTION - E

24. (a) Draw a diagram of an enlarged view of T.S. of one microsporangium of an angiosperm and label the following parts:

- (i) Tapetum
- (ii) Middle layer
- (iii) Endothecium
- (iv) Microspore mother cells

(b) Mention the characteristic features and function of tapetum.

(c) Explain the following with reasons:

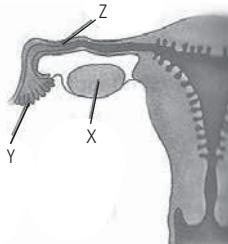
- (i) Pollen grains are well preserved as fossils.
- (ii) Pollen tablets are in use by people these days.

OR

(a) Explain any three outbreeding devices in flowering plants.

(b) Suggest the advantages to a farmer of using apomictic seeds of hybrid varieties.

25. (a)



The above given diagram shows a part of the human female reproductive system.

(i) Name the gamete cells that would be present in 'X' in a new born baby.

(ii) Name 'Y' and write its function.

(iii) Name 'Z' and write the event that takes place here.

(b) Explain the process of fertilisation of an ovum in humans.

OR

(a) How is placenta formed in the human female?

(b) How is the placenta connected to the embryo?

(c) Comment on the role of placenta as an endocrine gland.

26. (a) Explain the role of accessory glands in human male reproductive system.

- (b)** Explain the role of pituitary and sex hormones in the process of spermatogenesis.

**OR**

- (a)** Why is fertilisation in an angiosperm referred to as double fertilisation? Mention the ploidy of the cells involved.

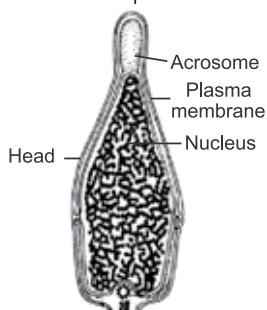
- (b)** A flower of brinjal plant following the process of sexual reproduction produces 360 viable seeds.

Answer the following questions giving reasons.

- (i)** How many megasporangium mother cells are involved?  
**(ii)** How many male gametes are involved in the above case?  
**(iii)** How many microsporangium mother cells must have undergone reduction division prior to dehiscence of anther in the above case?

### SOLUTIONS

1. *Vallisneria* is a water pollinated plant. Pollen grains of *Vallisneria* have a protective mucilaginous coat that prevents the water from damaging the pollen grains.
2. Sperms are tailed whereas eggs do not, as sperms have to move (tail helps in locomotion) through the cervix, uterus and Fallopian tube to reach to the egg already present there.
3. In asexual reproduction, offsprings are produced by a single parent with or without the involvement of gametes. The offspring produced are similar to one another and, are also exact copies of their parents. Thus, these offsprings are morphologically and genetically similar and hence called as clones.
4. Progestasert is a hormone releasing IUD (intrauterine contraceptive device) which makes the cervix hostile to the sperms.
5. Date palm is a plant producing staminate flowers and pistillate flowers on different plants. Therefore, it is a dioecious plant.
6. The head region of human sperm is as follows:



7. With respect to seeds, bananas and oranges differ as bananas are seedless whereas oranges contain many seeds. Banana shows parthenocarpy. Its fruit is formed without fertilisation and is therefore seedless. Polyembryony refers to presence of more than one embryo in a seed, e.g., orange. Some of the nucellar cells surrounding the embryo sac start dividing, protrude into the embryo sac and develop into embryos. Thus, each ovule contains many embryos.

- 8.** Gametes are haploid though the parent body from which they arise may be either haploid or diploid. A haploid parent produces gametes by mitotic division. Several organisms belonging to fungi, algae and bryophytes have haploid plant body, but in organisms belonging to pteridophytes, gymnosperms, angiosperms and most of the animals including human beings, the parental body is diploid. Meiosis, the reduction division, has to occur if a diploid body has to produce haploid gametes.

- 9.** The number of cells each in zygote - 1, morula - 16 and blastocyst - 64.

**OR**

The seeds in which endosperm persists as food storage tissue are called endospermic or albuminous seeds, e.g., castor, maize, wheat, barley, rubber, coconut.

In some seeds, remains of nucellus persist. The residual nucellus which persists in the seed is called perisperm, e.g., black pepper, coffee, castor, cardamum, *Nymphaea*.

- 10.** In the given case, both the partners are producing normal gametes but female is unable to conceive. This means there is some problem with Fallopian tube or uterus or hormonal levels of the female. Thus, one of the method that we can suggest to the couple is of surrogacy. In this method the ova from the wife and sperms from the husband are induced to form zygote in the laboratory. The zygote is then allowed to divide to form embryo. A developing embryo is then implanted in the uterus of another female (surrogate mother). The surrogate mother then gives birth to the child.

- 11. (a)** The inner glandular wall of the uterus is known as endometrium.

Role - During the menstrual cycle, the endometrium wall grows into a thick, vascular (blood vessel-rich) glandular layer. These modifications favour the implantation of the embryo. If fertilisation does not occur, the endometrium is shed during the hemorrhagic phase of the menstrual cycle. The middle wall of the uterus is known as myometrium.

Role - It consists of smooth muscles. It exhibits contraction during delivery of the baby.

- (b)** Sertoli cells are located in the germinal epithelium of the seminiferous tubules. These cells nourish the germ cells in the testes.

- 12. (a)** The given figure shows zoospores produced inside zoosporangia. Zoospores are special kind of motile and flagellated spores. Given figure represents zoospores released from *Chlamydomonas*, that reproduces asexually by zoospore formation.

- (b)** Scutellum is the tissue in a monocot seed that lies between the embryonic axis and the endosperm. It is the modified cotyledon of grasses. It is very thin with high surface area and serves to absorb nutrients from the endosperm during germination.

- 13.** Differences between xenogamy and geitonogamy are as follows:

	Xenogamy	Geitonogamy
(i)	It is pollination between two flowers of different plants.	It is pollination between two flowers of the same plant.
(ii)	The flowers are genetically different.	The flowers are genetically similar.
(iii)	It is genetically cross pollination.	It is genetically self pollination.

Geitonogamy will lead to inbreeding depression because this type of pollination occurs between the genetically similar flowers.

- 14. (a)** Contraceptive pills may contain either hormone progestogen or a combination of both progestogen and estrogen hormones.

Oral (contraceptive) pills help to prevent pregnancy by inhibiting body's natural cyclical hormones. They usually stop the body from ovulating, change cervical mucus to make it difficult for sperm to go through cervix, and prevent implantation of the fertilised egg.

**(b)** Contraceptive pills have to be taken daily for 21 days starting within the first five days of menstrual cycle and this has to be repeated after a gap of 7 days in the same pattern till the female desires to prevent conception.

- 15. (a)** (i) It is the follicular phase during which FSH stimulates the ovarian follicles to secrete estrogen which in turn stimulates the proliferation of the endometrium of the uterine wall. The endometrium becomes thicker accompanied by increase of uterine glands and blood vessels.

(ii) From 16-25 days, secretion of progesterone stimulates the uterine glands to produce increased amount of watery mucus. Progesterone is also essential for the maintenance of endometrium which is necessary for the implantation of fertilised ovum and other events of pregnancy.

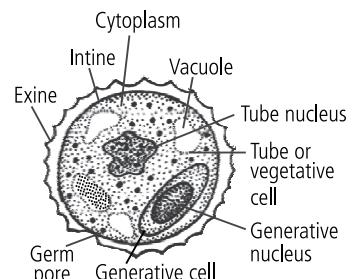
(iii) If the ovum does not get fertilised, corpus luteum degenerates which decrease the level of progesterone. This causes disintegration of the endometrium leading to menstruation.

**(b)** The hormones mentioned in the graph are ovarian hormones. Estrogen is secreted by ovarian follicles and progesterone is secreted by corpus luteum.

- 16. (a)** (i) Deposition of sporopollenin occurs in exine layer of pollen grains.

(ii) Megasporogenesis occurs inside the nucellus of developing ovule of angiosperms.

**(b)** The labelled diagram of a male gametophyte of an angiosperm is as follows:



- 17. (a)** The embryonic stage shown in the given figure is blastocyst. Here, 'A' is inner cell mass and 'B' is trophoblast.

**(b)** Inner cell mass (A) forms the fetus.

**(c)** Embryo at blastocyst stage gets implanted in the uterine wall of human female.

- 18. (a)** Reproduction and Child Health Care (RCH) programmes cover wide range of reproduction related areas. Creating awareness among people about various reproduction related aspects and providing facilities and support for building up a reproductively healthy society are the major tasks under these programmes.

**(b)** Amniocentesis is a prenatal diagnostic technique based on the chromosomal pattern in the amniotic fluid used to determine sex, genetic and metabolic disorders of an unborn child.

There is a statutory ban on amniocentesis because it is being misused to abort unborn normal female fetuses.

- 19.** The following changes take place in fertilised ovule to develop into a seed:

	Parts before fertilisation	Parts after fertilisation
(i)	Ovule	Seed
(ii)	Outer integument	Testa (tough)
(iii)	Inner integument	Tegmen (delicate)
(iv)	Nucellus	Perisperm
(v)	Primary endosperm nucleus	Endosperm
(vi)	Egg cell or zygote	Embryo
(vii)	Funiculus	Stalk
(viii)	Antipodal	Degenerate
(ix)	Synergids	Degenerate

## ANSWERS

## WHO AM I...

1. Lecithin Pg. 39
2. Carbonic anhydrase Pg. 42
3. Inverted Pg. 61

## OR

**(a)** Organisms, such as fungi and algae, switch to sexual mode of reproduction just before the onset of adverse conditions because sexual reproduction brings variation into the individuals, some of which might help the individuals to adapt to the changed environmental conditions and survive. This ensures the continuity of species.

**(b)** Most unicellular organisms specially those which undergoes binary fission are immortal because they reproduce by cell division. The parent body as a whole constitutes the reproductive unit and disappears when its division into daughter individuals is completed. There is no remains of parent body cell and thus, parent cannot be said to have died. Infact, after binary fission, the parent continues living as two daughter individuals.

In multicellular organisms reproduction occurs in specialised organs involving specialised cells. The whole body of parent dies due to ageing and senescence.

### 20. Significance of pollination:

- Pollination leads to fertilisation and production of seeds and fruits, which ensures continuity of plant life.
- The pollination, especially cross pollination results in the production of plants with a combination of characters from two plants. So it introduces genetic recombinations and hence variations in the progeny.

Differences between wind pollinated and animal pollinated flowers are as follows :

	Wind pollinated flowers	Animal pollinated flowers
(i)	The flowers are small.	The flowers are either large or if small they are grouped to form a large mass.
(ii)	The flowers are inconspicuous due to the absence of bright colours.	The flowers are usually gaudy due to the presence of bright colours in corolla, sepals, bracts, etc.
(iii)	Flowers are odourless.	Odour is commonly present in flowers.
(iv)	The flowers are devoid of nectar and edible pollen.	The flowers usually possess nectar or edible pollen.

### 21. Following are the four methods to overcome infertility in human couples:

- Test tube baby : In this method, the fusion of ovum and sperm is done outside the body of a woman (in vitro fertilisation), to

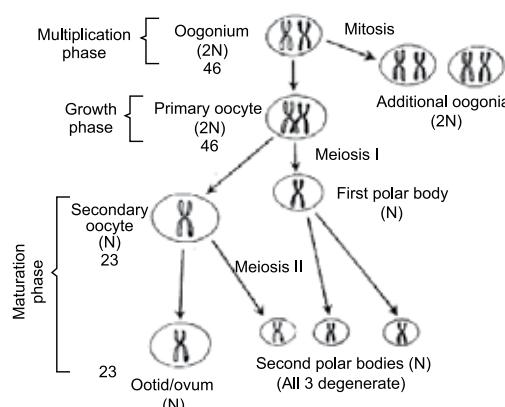
form zygote which is allowed to divide to form embryo. The embryo is then implanted in the uterus where it develops into a fetus and then into the child.

(ii) Intra Cytoplasmic Sperm Injection (ICSI) : In this technique, embryo is formed in the laboratory by directly injecting the sperm into the ovum followed by embryo transfer.

(iii) Artificial Insemination Technique (AIT) : Semen (containing sperms) from husband or donor is artificially introduced into vagina or uterus (IUI).

(iv) Gamete Intra Fallopian Transfer (GIFT) : Sperm and unfertilised ova are transferred into the Fallopian tube of the female to complete fertilisation and further development.

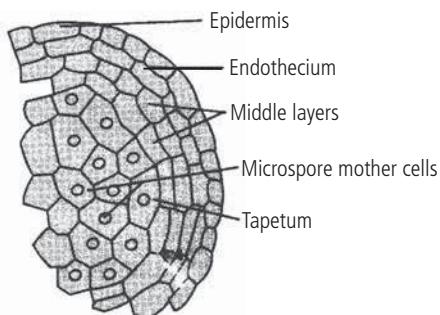
### 22. The schematic representation of events of oogenesis is as follows:



**23.** Parents should encourage their children to attend such seminar as they will get right information regarding myths and misconceptions about sex-related aspects. Following are the four points to justify this topic to be essential:

- Awareness of problems due to uncontrolled population growth, social evils like sex abuse and sex-related crimes, etc. need to be created so that children should think and take up necessary steps to prevent them and thereby build up a reproductively healthy society.
- Large group of school students comprises of adolescents who have attained puberty, therefore, these seminars are necessary to provide medical help and care for reproduction related problems like menstrual problems, infertility, pregnancy, delivery, contraception, abortions, etc.
- Knowledge about sexually-transmitted diseases (STDs) is essential as children should be aware that unprotected sex with multiple partners results in the transmission of sex-related problems.
- Increasing population is a major problem of India which is directly related with reproductive health. Children should be aware of family planning programmes such as reproductive and child health care (RCH) programmes.

**24. (a)** Sectional view of microsporangium of an angiosperm is as follows:



**(b)** The characteristics of tapetum are as follows:

- (i) Tapetal cells are filled with protoplasmic contents as well as nutrients.
- (ii) They are either multinucleate or their nucleus becomes polyploid due to endopolyploidy.
- (iii) Tapetum is of two types – amoeboid and secretory.
- (iv) In amoeboid type, the tapetal cells fuse to form a plasmodium or periplasmodium because it passes in between the sporogenous cells to nourish them.
- (v) The cells of secretory tapetum pass out substances over the sporogenous cells for their growth and differentiation.

Tapetum has a number of functions:

- (i) Nourishment of the developing microspore mother cells and pollen grains.
- (ii) It produces lipid rich ubisch granules containing sporopollenin for exine formation, pollenkitt, special proteins for the pollen grains which recognise compatibility and hormone IAA.
- (iii) It secretes enzyme callase responsible for the degradation of callose wall around pollen tetrad.

**(c)** (i) Sporopollenin is present in exine layer of pollen grains. Sporopollenin is highly resistant fatty substance not degraded by any enzyme and not affected by high temperature, strong acid or strong alkali therefore, pollen grains can be well preserved as microfossils.

(ii) Pollen tablets are used as food supplement by people to improve health.

OR

**(a)** The three outbreeding devices that flowering plants have developed are as follows:

- (i) Dicliny (Unisexuality) : 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).
- (ii) Dichogamy : Anthers and stigmas mature at different times in a bisexual flower so as to prevent self pollination.
- (a) Protandry : Anthers mature earlier than stigma of the same flower. Their pollen grains become available to stigmas of the older flowers, e.g., sunflower, *Salvia*. (b) Protogyny

: Stigmas mature earlier so that they get pollinated before the anthers of the same flower develop pollen grains, e.g., *Mirabilis jalapa*, *Gloriosa*, *Plantago*.

(iii) Heterostyly : There are 2 or 3 types of flowers with different heights of styles (and stamens), e.g., In diheterostyly (dimorphic heterostyly), there are two types of flowers, pin eyed (long style and short stamens) and thrum eyed (short style and long stamens), e.g., *Primula* (primrose), jasmine. Pollination occurs between anthers and stigmas of the same height present in different flowers.

**(b)** Advantages of using apomictic seeds of hybrid varieties are as follows:

- (i) Apomixis can be used to preserve desired characters.
- (ii) It will reduce the cost of purchasing hybrid seeds every year.
- (iii) Embryos formed through apomixis are generally free from infections.

**25. (a)** (i) Primary oocytes will be present in ovary (X) of a new born baby.

- (ii) Y is fimbriae. They help in collection of the ovum after ovulation.
- (iii) Z is the ampullary-isthmic junction. It is the site of fertilisation in humans.

**(b)** The events of fertilisation in human female are:

(i) Acrosomal reaction : After ovulation, the secondary oocyte reaches the Fallopian tube. The capacitated sperm releases hydrolytic enzymes (sperm lysins) present in the acrosome, when it comes in contact with surface of egg covering. Important sperm lysins are (i) hyaluronidase that acts on the ground substances of follicle cells, (ii) corona penetrating enzyme that dissolves corona radiata and (iii) zona lysine or acrosin that helps to digest the zona pellucida. Due to acrosomal reaction, plasma membrane of sperm fuses with that of secondary oocyte and depolarisation of oocyte membrane occurs.

(ii) Cortical reaction : Immediately after the fusion of sperm and egg plasma membranes, the egg shows a cortical reaction to further check the entry of more sperms. In this reaction, the cortical granules present beneath the ovum's plasma membrane fuse with the same and release their contents (enzymes) between it and zona pellucida. These enzymes harden the zona pellucida, which now functions as the sure block to polyspermy.

(iii) Sperm entry : The egg extends around the entering sperm, finger-like processes, called microvilli, which constitute a fertilisation cone. The latter take the entire sperm into the egg. The distal centriole of the sperm divides and forms two centrioles to generate the mitotic spindle for cell division.

(iv) Karyogamy : The sperm entry stimulates the egg (secondary oocyte) to resume and complete the suspended meiosis - II. This produces a haploid mature ovum and a second polar body. The head of sperm separates from the middle piece and tail to become male pronucleus and nucleus of ovum is called female pronucleus. The second polar body and sperm tail degenerate. Mixing up of the chromosomes of a spermatozoon and an ovum is called karyogamy or amphimixis. This completes the act of fertilisation. The fertilised ovum is now a diploid cell having 23 pairs of chromosomes, and is termed zygote.

OR

- (a)** After implantation, finger-like projections appear on the trophoblast called chorionic villi which are surrounded by the uterine tissue and maternal blood. The chorionic villi and uterine tissue become interdigitated with each other and jointly form a structural and functional unit between developing embryo (fetus) and maternal body called placenta, which facilitates the supply of oxygen and nutrients to the embryo and also removal of carbon dioxide and excretory waste materials produced by the embryo.
- (b)** The placenta is connected to embryo through an umbilical cord which helps in the transport of substances to and from the embryo.
- (c)** Placenta also acts as an endocrine tissue and produces several hormones essential for supporting the fetal growth, metabolic changes in the mother and maintenance of pregnancy. It secretes the following hormones:

- (i) Human chorionic gonadotropin (hCG)
- (ii) Human chorionic somatomammotropin (hCS)
- (iii) Progesterone (iv) Estrogen (v) Relaxin
- (vi) Chorionic thyrotropin and (vii) Chorionic corticotropin

The hCG stimulates and maintains the corpus luteum to secrete progesterone until the end of pregnancy. The hCS stimulates the growth of the mammary glands during pregnancy. Relaxin facilitates parturition (act of birth) by softening the connective tissues of the pubic symphysis. The level of hormones like estrogen, progesterone, etc. are increased in maternal blood during pregnancy. Increased production of these hormones is necessary for supporting the fetal growth, metabolic changes in mother and maintenance of pregnancy.

- 26.** (a) There are three accessory glands present in male reproductive system: seminal vesicles, prostate gland and bulbourethral glands.

Seminal vesicles produce an alkaline secretion which forms 60% of the volume of semen. Alkaline nature of this fluid helps to neutralise the acidic environment of the male urethra

as well as that of female reproductive tract which otherwise would inactivate and kill sperms. The secretion of prostate gland nourish and activates the spermatozoa to swim.

**(b)** During spermatogenesis, gonadotropin releasing hormone (GnRH) is secreted by the hypothalamus, which stimulates the anterior pituitary gland to secrete luteinising hormone (LH) and follicle stimulating hormone (FSH). LH acts on the Leydig's cells of the testes to secrete testosterone while FSH acts on Sertoli cells of the seminiferous tubules of the testes to secrete androgen binding protein (ABP) and inhibin. ABP concentrates testosterone and inhibin suppresses FSH synthesis. FSH also acts on spermatogonia to stimulate sperm production.

OR

**(a)** In angiosperms, one of the male gametes fuses with the egg cell to form the zygote (syngamy). The other male gamete fuses with the two polar nuclei to produce a triploid primary endosperm nucleus (triple fusion). Since two types of fusions, syngamy and triple fusion take place in the same embryo sac, the phenomenon is termed as double fertilisation. Both the male gametes and egg cell show (n) ploidy i.e., haploid while the secondary cell is (2n) i.e., diploid.

**(b)** If a flower of brinjal plant contains 360 viable seeds.

(i) Megaspore mother cell undergoes reduction division to form four haploid megasporangia. Only one megasporangium remains functional and other three degenerate. Only the functional megaspore develops into female gametophyte. Hence, the number of megaspore mother cells involved = 360.

(ii) Each pollen grain releases two male gametes in an embryo sac. One male gamete fuses with the egg to form zygote and second male gamete fuses with polar nuclei to form endosperm nucleus. Hence, number of male gametes involved is =  $360 \times 2 = 720$ .

(iii) Each microspore mother cell undergoes meiosis and gives rise to tetrad of four haploid microspores or pollen grains.

Number of microspore mother cells that have undergone reduction division prior to dehiscence of anther =  $\frac{360}{4} = 90$ .



### MPP-5 CLASS XII      ANSWER      KEY

1. (c)	2. (b)	3. (a)	4. (d)	5. (a)
6. (d)	7. (d)	8. (c)	9. (a)	10. (c)
11. (b)	12. (d)	13. (b)	14. (b)	15. (a)
16. (c)	17. (b)	18. (c)	19. (c)	20. (b)
21. (b)	22. (d)	23. (d)	24. (c)	25. (b)
26. (d)	27. (b)	28. (b)	29. (b)	30. (a)
31. (a)	32. (b)	33. (c)	34. (a)	35. (d)
36. (c)	37. (a)	38. (c)	39. (a)	40. (b)

- **MTG : Why did you choose medical entrance?**  
**Mrinal Dewangan :** I chose medical entrance because it is a noble profession and you get opportunities to learn new things everyday and also I wanted to do something different from engineering.
- **MTG : What exams you have appeared for and what is your rank in these exams?**  
**Mrinal :** I appeared in AIIMS 2017 - AIR 26, NEET 2017 - AIR 142, JIPMER 2017 - AIR 295.
- **MTG : Any other achievements? (Please mention the name of exams and rank)**  
**Mrinal :** I also qualified KVPY with AIR-591 and INBO in both classes 11<sup>th</sup> and 12<sup>th</sup>.
- **MTG : How did you prepare for AIIMS and other medical exams?**  
**Mrinal :** I mainly focussed on NCERT books. I used to solve a lot of MCQs. I got through various coaching test papers and other sources for AIIMS. I also focussed on Assertion Reason questions.
- **MTG : What basic difference you found in various papers you cleared?**  
**Mrinal :** AIIMS exam is bit difficult than NEET and JIPMER because it checks both, concepts via AR questions and memory via MCQs and also includes GK portion. Other exams I found, were more based on memory.
- **MTG : How many hours in a day did you study to prepare for the examination?**  
**Mrinal :** Apart from school and coaching, I used to devote around 3-4 hours for self study every day.
- **MTG : On which topic and chapters you laid more stress in each subject?**  
**Mrinal :** I laid more stress on topics in which I was weak (Inorganic Chemistry) and those topics which were important from exam point of view.
- **MTG : How much time does one require for serious preparation for this exam?**  
**Mrinal :** If one starts preparing seriously from class 11<sup>th</sup>, I think two years are enough for this exam.
- **MTG : Any extra coaching?**  
**Mrinal :** I joined APEX CLASSES for Biology. VIDYA ACADEMY for Physics and IIT ZONE for Chemistry.
- **MTG : Which Subjects/Topics you were strong/weak at?**  
**Mrinal :** Inorganic chemistry (mainly s, p, d, f blocks) was my weakest portion. I was a bit strong at Physics and moderate at Biology.
- **MTG : Which Books/Magazines/Tutorial/Coaching classes you followed?**  
**Mrinal :** I followed study material provided in my coaching and MTG magazines, books (NCERT at Fingertips) and explorers.
- **MTG : In your words what are the components of an ideal preparation plan?**

“I followed study material provided in my coaching and MTG magazines, books (NCERT at Fingertips) and explorers. MTG magazines provided practice paper and “you ask we answer” section, NCERT at Fingertips is a great book and Explorers provided very accurate question papers similar to those asked in exams, which helped me a lot during preparation.”

**Mrinal :** Hard work, focus on goal, strong concepts, stress free environment, right guidance from teachers are important during preparation.

- **MTG : What role did the following play in your success:**
  - (a) parents      (b) teachers      (c) school?**Mrinal :** (a) Parents always supported throughout this journey. They kept me motivated, even if I scored less in some tests, to try again and keep dreaming big.  
 (b) Teachers provided right guidance and solved my doubts regularly and kept me updated necessary to crack such exams.  
 (c) School provided me a circle of good friends with whom I discussed topics and my friends also helped me to remain stress free.
- **MTG : Your family background?**  
**Mrinal :** My father is a Senior Technician in Bhilai Steel Plant and my mother is housewife.
- **MTG : What mistake you think you shouldn't have made?**

**Mrinal :** I failed to figure out that a calculator was provided during AIIMS exam, which could have saved some of my time during exam. I also ignored Inorganic Chemistry initially.

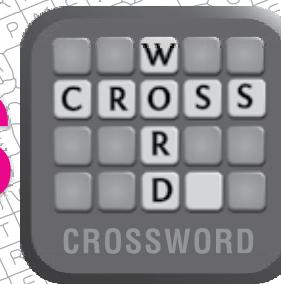
• **MTG : How did you de-stress yourself during the preparation? Share your hobbies and how often could you pursue them?**

**Mrinal :** I used to play cricket with my brother and friends regularly to keep myself, stress free. I also love playing mobile games but had to avoid smartphone during preparation.

- **MTG : How have various MTG products like Explorer, Books and Magazines helped you in your preparation?**  
**Mrinal :** MTG magazines provided practice paper and “you ask we answer” section, NCERT at Fingertips is a great book and Explorers provided very accurate question papers similar to those asked in exams, which helped me a lot during preparation.
- **MTG : Was this your first attempt?**  
**Mrinal :** Yes, this was my first attempt.
- **MTG : Had you not been selected then what would have been your future plan?**  
**Mrinal :** I was sure that I would be selected in NEET if not AIIMS. But if I had failed to clear all these exams, I would have taken admission through KVPY to pursue a research career.
- **MTG : What do you think is the secret of your success?**  
**Mrinal :** Remaining calm during exams, self belief, support and blessings of my parents and the almighty and a bit of luck is secret of my success.
- **MTG : What advice would you like to give our readers who are PMT aspirants?**  
**Mrinal :** I advise all PMT aspirants to remain focussed on their goals, dream big, remain stress free and work hard and last but not the least, take care of your health during preparation.

All the Best!

# CROSS WORD



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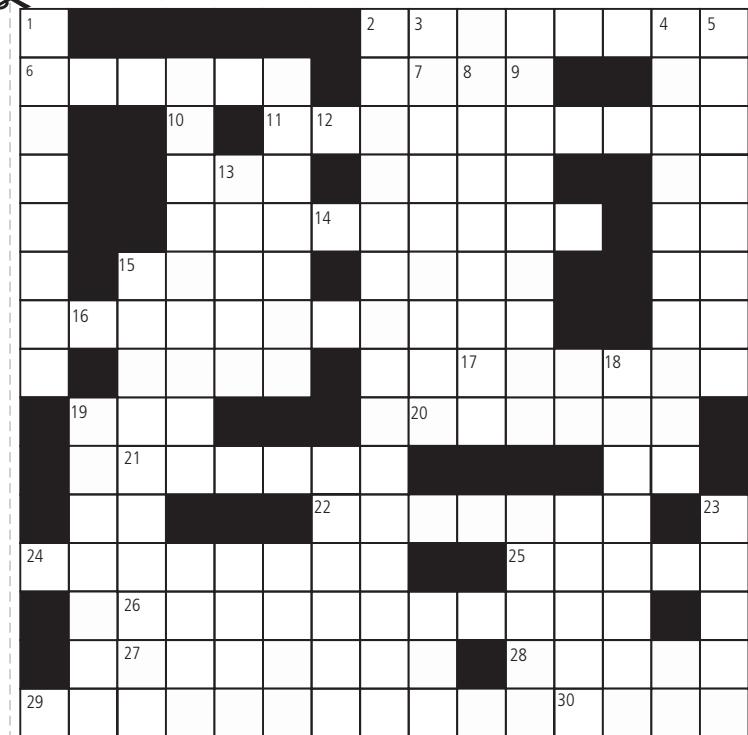
## ACROSS

3. A kind of chest pain caused due to inadequate oxygen in the heart muscles. (6)
6. A species that has the tendency to combine population into single group. (6)
12. A colony of *Volvox*. (9)
14. A structure formed during diplotene stage of prophase I when chromosomes separate and chromatids have distinct appearance. (6)
16. A term used to describe a plant cell that has become less rigid than normal because cytoplasm has shrunk through plasmolysis. (7)
17. The region of biosphere reserve where all human activities are prohibited. (4)
20. A complete succession of biotic communities from initial to climax stages. (4)
21. The early stage of embryonic development where a solid mass of cells is formed. (6)
22. Reduction in the size of individual muscle cells. (7)
24. The transfer of pollen grains from anther to the stigma of genetically distinct flower. (8)
25. The underground stem modification found in *Allium cepa*. (4)
26. Study of migratory history of human species. (10)
27. A commercial bioherbicide having fungal spores. (7)
28. The anterior folding of corpus callosum. (4)
29. The excretory cells found in flatworm. (11)
30. A group of populations having a common gene pool. (4)

## DOWN

1. The outer functional wood of an old tree stem. (8)
2. A protein found in blood plasma that destroys microbes and toxic substances. (9)
4. Specialised channels found in cell membrane for water transportation. (10)
5. A type of indehiscent fruit which is constricted in between the seeds. (8)

*Cut Here*



7. The process of separation of jute fibres by bacterial fermentation. (7)
8. Acute renal failure with daily urine output of less than 50 mL. (6)
9. The non-protein part in a conjugate enzyme. (8)
10. Individual placed at the top of a pedigree. (7)
11. Environmental friendly treatment of e-wastes. (6)
13. An extremely addictive drug obtained from coca plant that causes heart and mental problems. (5)
15. The scientist who coined the term mitosis. (8)
18. The plant hormone used artificially for ripening of some fleshy fruits. (8)
19. A sporozoan disease of honeybee that reduces life span of adult honeybees. (6)
23. Irregular foldings of mucous membrane lining the stomach. (5)



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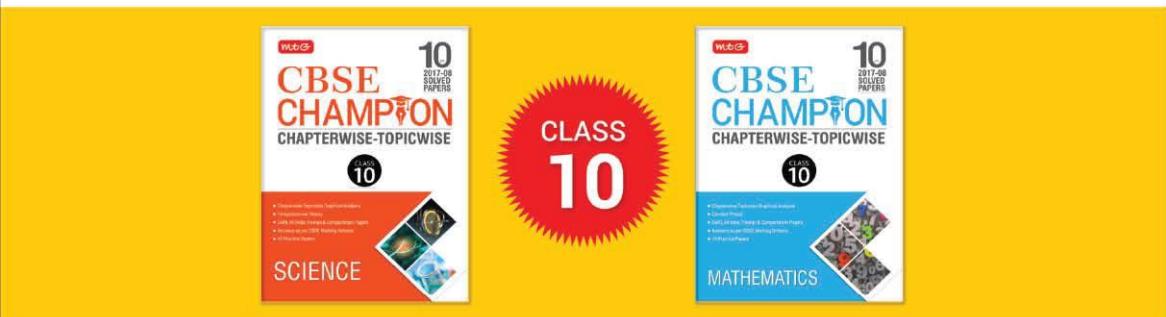
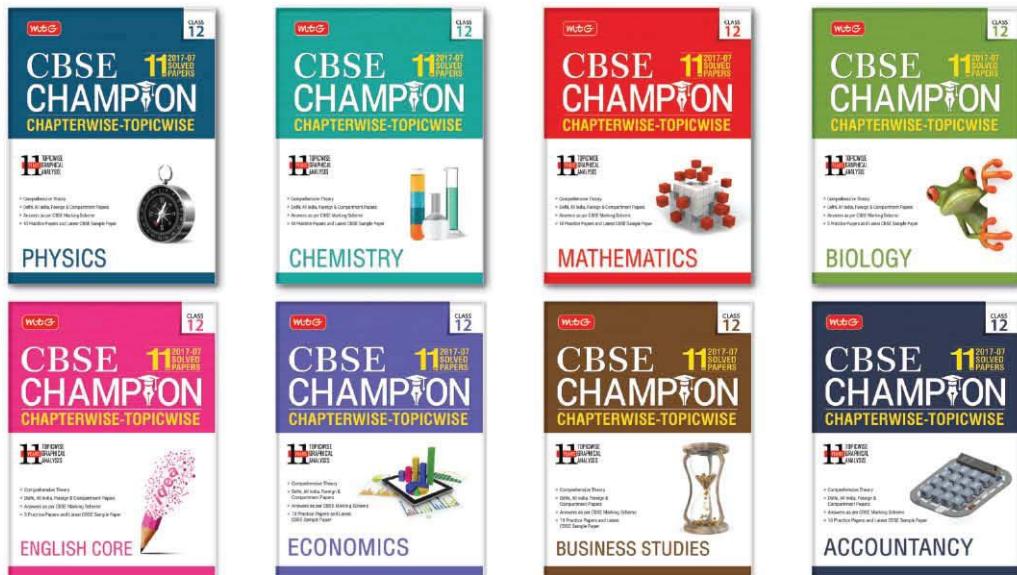
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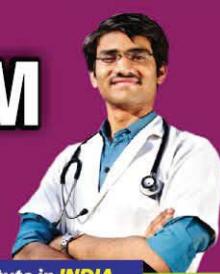
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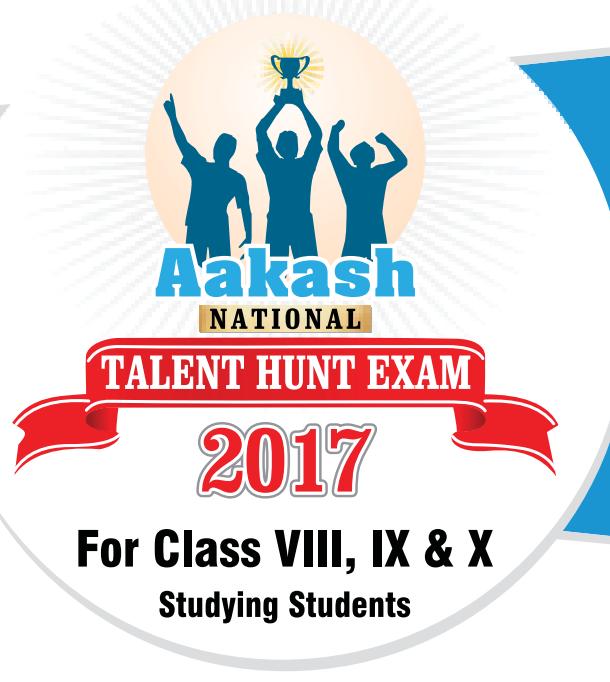
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